AgriTech Today

AGRICULTURE AND ALLIED SCIENCES E-MAGAZINE

VOLUME 1
SPECIAL ISSUE (NOVEMBER, 2023)

SPECIAL ISSUE ON
FOOD SCIENCE AND NUTRITION

DR. VINUTHA MUKTAMATH
GUEST EDITOR

https://agritechmagazine.com

AgriTech Today

Volume 1
Special Issue (November, 2023)

Publisher
Valmiki Sahitya Sampada
Harthikote Post
Hiriyur, Chitradurga Dist.,
Karnataka - 577545

From the Editor-in-Chief's Desk

I am happy and proud to announce the release of the Special issue on Food Science and Nutrition for the month of November, 2023.

Food science and nutrition are intertwined disciplines that explore the composition, properties, and effects of food on human health. Food science delves into the physical, chemical, and biological aspects of food production, preservation, and enhancement. Nutrition focuses on the relationship between food and the human body, studying the nutrients, their functions, and their impact on overall health. These fields collaborate to assess food quality, safety, and the nutritional value of various food items. Understanding food science and nutrition aids in creating healthier diets, preventing diseases, and addressing global health challenges related to malnutrition and food insecurity. Research in these areas continually evolves, influencing dietary recommendations and shaping food policies to promote better health outcomes worldwide.

It gives me great pleasure to inform you that we have curated and finalized 44 articles for publication in this issue.

I extend my heartfelt gratitude to the Guest Editor Dr. Vinutha Mukhtamath for her contribution as Guest Editor in this Issue and also for the dedicated editorial team and the talented authors for their invaluable contributions in bringing this issue. Your efforts have played a pivotal role in making AgriTech Today Magazine a source of enlightenment and knowledge in the agricultural domain.

Editor-in-chief

EDITOR'S MESSAGE

Dear Readers,

It is an honor to serve as your guest editor for this edition of our esteemed AgriTech Today magazine. In a world inundated with information and choices, our approach to food as a science and nutrition has never been more crucial. The decisions we make about what we eat have profound implications for our health, well-being, and the planet we call home.

As we embark on this journey together, let us first acknowledge the dynamic nature of nutritional science. The field is ever-evolving, with new discoveries challenging old paradigms and urging us to reevaluate our dietary habits. In this issue, we aim to unravel some of the complexities surrounding nutrition, empowering our readers, to make informed and conscious choices.

One of the prevailing themes we explore is the delicate balance required in our diets. The push and pull between macronutrients and micronutrients, the interplay of vitamins and minerals, and the importance of maintaining equilibrium tailored to individual needs. Our contributors delve into the intricacies of creating a well-rounded diet that not only fuels the body but also promotes longevity and vitality. Also the issue explores intersection of nutrition and sustainability, investigating dietary choices to a healthier planet and food enterprises. From the benefits of a plant-based indigenous diet to understanding the new age of our food like 3D food print, we aim to inspire mindful eating for the benefit of both personal and planetary health.

As we navigate the nutritional landscape together, let us remain curious, open-minded, and discerning in our choices. May this edition serve as a guide, empowering you to make choices that resonate with your values and contribute to a healthier, happier future.

Here's to your health and the exciting journey ahead!

Warm regards,

V.u. Mukhtamath

(VINUTHA MUKHTAMATH)
GUEST EDITOR

MESSAGE

Dear Readers,

It is my pleasure to extend heartfelt congratulations to Dr. Vinutha Muktamath on assuming the role of guest editor for this special edition of AgriTech Today Magazine. As the Director of Research of University of Agricultural Sciences, Dharwad, I am delighted to witness our esteemed scholar lend their expertise to a publication dedicated to unraveling the science of food and nutrition.

Dr. Vinutha Muktamath has contributed significantly to the advancement of knowledge in the field of nutrition for children, women and elderly. This guest editorship is a testament to her commitment to excellence and dedication to sharing valuable insights with a broader audience.

The articles published under her editorial guidance promise to be a source of inspiration and knowledge, reflecting the depth and breadth of their understanding of the dynamic world of nutrition. May this special issue be a source of inspiration, fostering a deeper understanding of nutrition and its implications for a healthier and vibrant life.

Best regards,

Dr. B.D. Biradar
Director of Research
Directorate of Research
University of Agricultural Sciences
Dharwad, Karnataka

TABLE OF CONTENTS

Postharvest Management of Lemon

Ravi Y., Vinutha U. Muktamath and Sannapamma K. J.
AICRP-Women in Agriculture, MARS, University of Agricultural Sciences, Dharwad
*Corresponding Author: raviy@uasd.in

Citrus fruits being non-climacteric have a relatively short post-harvest life in stark contrast to the climacteric fruits like mango, banana and sapota. In a developing country like India, post-harvest losses of citrus fruits are in the range of 25-30%. This is mainly due to the unscientific practices of picking, handling, packaging, transport and storage. However, with the thrust given to agriculture modernization from 11th five-year plan, several post-harvest technologies have been developed to minimize the post-harvest losses. Post-harvest treatments such as curing, washing, wax coating with fungicide have contributed to minimize post-harvest losses in the last decade.

Maturity Indices

Minimum juice content by volume of 28 or 30% depending on grade; color lemons picked at the dark-green stage have the longest postharvest life while those picked fully-yellow must be marketed more rapidly.

Quality Indices

- Yellow color intensity and uniformity
- Size
- Shape
- Smoothness
- Firmness
- Freedom from decay
- Freedom from defects including freezing damage, drying, mechanical damage, rind stains, red blotch, shriveling, and discoloration.

Optimum Temperature

12-14°C (54-57°F) depending on cultivar, maturity-ripeness stage at harvest, production area, and duration of storage and transport (can be up to 6months).

Optimum relative humidity - 90-95%

Rates of respiration

Temperature	10°C (50°F)	15°C (59°F)	20°C (68°F)
ml CO_2/kg hr	5-6	7-12	10-14

To calculate heat production multiply ml CO_2 /kg hr by 440 to get BTU/ton/day or by 122 to get kcal/metric ton/day.

Rates Of Ethylene Production

<0.1 µl/kg hr at 20°C (68°F)

Responses To Ethylene

If degreening is desired, lemons can be treated with 1-10 ppm ethylene for 1-3 days at 20 to 25°C (68-77°F), but this exposure may accelerate deterioration rate and decay incidence.

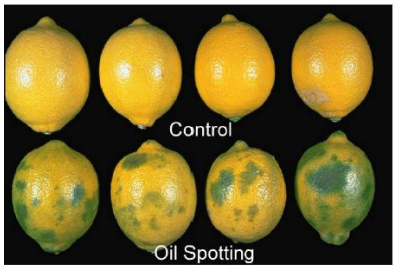
Responses To Controlled Atmospheres (Ca)

CA of 5-10% O_2 and 0-10% CO_2 can delay senescence including loss of green color of lemons. Fungistatic CO_2 levels (10-15%) are not used because they may induce off-flavors due to accumulation of fermentative volatiles, especially if O_2 levels are below 5%. Removal of ethylene from lemon storage facilities can reduce rate of senescence and decay incidence.

Physical Disorders

Oil spotting (Oleocellosis)

Breaking of oil cells due to physical stress on turgid fruits causes release of the oil that damages surrounding tissues. Avoiding harvesting lemons when they are very turgid and careful handling reduces severity of this disorder.



OIL SPOTTING

Physiological Disorders

Chilling injury


Symptoms include pitting, membranous staining, and red blotch. Severity depends upon cultivar, production area, harvest time, maturity-

ripeness stage at harvest, and time-temperature of postharvest handling operations. Moderate to severe chilling injury is usually followed by decay.

Pathological Disorders

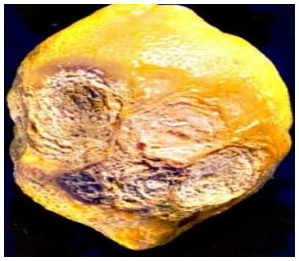
- **Green mold:** Caused by *Penicillium digitatum* which penetrates the fruit rind through wounds. Symptoms begin as water-soaked area at the fruit surface followed by growth of colorless mycelium, then sporulation (green color).


Green mold

- **Blue Mold:** Caused by *Penicillium italicum* which can penetrate the uninjured peel and can spread from one lemon to adjacent lemons. Symptoms are similar to green mold except that the spores are blue.


Blue mold

- **Altenaria rot:** Caused by *Alternaria citri* which enters the lemons through their buttons. Preharvest treatment with gibberellic acid or postharvest treatment with 2, 4-D delay senescence of the buttons and subsequent decay by Alternaria.



Fruit Handling to Avoid Postharvest Losses

Green and blue molds and sour rot usually develop on fruit where the rind has been physically damaged. Without this injury site the fungal spores do not grow and cannot penetrate the fruit surface.

By following these few tips, you will reduce postharvest losses:

- Do not leave harvested fruit out in the hot sun;
- Do not pick cold, wet fruit. When wet turgid fruit is handled the oil glands can be ruptured. The released oil burns the fruit surface (oleocellosis) and also stimulates fungal spores to germinate. The burn marks can take 2-3 days to develop.
- Wear cotton gloves when harvesting. This reduces puncture marks from fingernails and jewelry
- Use picking bags. This reduces damage as a result of abrasion on wooden or metal picking bins and allows fruit to be gently lowered into bulk harvesting bins.
- Do not leave stems on fruit or damage buttons by "plugging".
- Use clean, smooth harvesting bins.
- Make sure packing line equipment is cleaned regularly. This reduces dirt and wax buildup which can cause fruit abrasion.
- Reduce packing line abrasion by using foam, rubber and smooth belts to cushion fruit.
- Remove all old fruit regularly from the packing shed and surrounds.
- Treat harvested fruit with a registered fungicide within 24hrs of harvest.
- Don't leave rejected/rotten fruit in or around the packing shed or orchard.

Storing Lemons

Lemons are non-climacteric fruit and have low respiration rates. They are therefore able to be stored for long periods of time. In contrast to other citrus varieties there are significant changes in the internal quality of lemon fruit during storage. During storage the percentage of juice increases (by up to16%) primarily due to the water stored in the peel. The acid content of fruit also increases (by up to 24%) during storage and the peel color changes from green to yellow.

Lemons are sensitive to cold temperatures and should not be stored at temperatures below 10oC as they develop chilling injury. The length of time lemons can be stored depends on the stage that they are picked. Fruit harvested with a yellow tinge can be stored for a few weeks, silver-green fruit 6 weeks, light green fruit 2 months and dark green fruit 5-6 months.

Advantages

- Possibility of achieving higher market prices when local fruit is in short supply.
- Better quality main crop lemons. The main winter crop if stored is usually smaller with thinner skins

- Stored fruit have been shown to have higher juice content

Disadvantages

- Moisture loss from stored fruit. Unwaxed fruit can lose about 5% of their weight/month. Applying wax should reduce this by 30-40%.
- Additional costs of running the cool room.
- Overstored fruit can develop a deep yellow colour that makes them appear old.
- High capital costs if a storage facility has to be specially built.
- Competition on the market from other stored fruit and from imported fruit.

* * * * * * * *

Impact of Processed Foods on Health

Neetu Yadav[1]* and Bishnupriya Rout[2]
[1]Department of Foods and Nutrition, CCSHAU, Hisar (125004)
[2]Department of Nutrition and Dietetics, GD Goenka University, Sohna (122103)
*Corresponding Author: neetuhr75@gmail.com

In our fast-paced, modern world, processed foods have become a ubiquitous part of our daily diet. Processed foods are those that have been altered from their natural state through methods like cooking, canning, freezing or adding preservatives and artificial ingredients. These foods are often convenient and have a longer shelf life but lack the nutritional value of fresh, unprocessed foods. They are widely available and commonly found in grocery stores. Processed foods are a common choice, from canned goods and frozen meals to snacks and sugary beverages. These foods are often high in added sugars, unhealthy fats and sodium, leading to obesity, diabetes and hypertension. Processed foods are also linked to nutritional deficiencies due to the loss of essential nutrients during processing. Moreover, it contains artificial preservatives and additives, which may trigger allergies and sensitivities in some individuals. Regular intake of processed foods has been correlated with an increased risk of heart diseases, certain cancers and mental health disorders like depression and anxiety.

Nutritional Depletion and Imbalance

The loss of essential nutrients during food processing is a significant concern in modern diets. Processing methods such as cooking, canning and refining at high temperatures often lead to the degradation or removal of vital vitamins, minerals and fiber in raw, unprocessed foods. For instance, vegetables and fruits lose nutrients like vitamin C and certain B vitamins when exposed to heat during cooking. Additionally, processing often strips away natural fiber present in whole grains and fresh produce to make products *i.e.*, refined flour, lose valuable fiber and essential nutrients present in the outer layers of the grain are lost. Moreover, processed foods are often loaded with refined sugars, unhealthy fats and high sodium levels, which can have detrimental effects on health. High sugar content contributes to obesity, diabetes and dental issues. Excessive salt intake raises blood pressure, increasing the risk of heart disease and stroke. Unhealthy fats, especially trans fats, elevate bad cholesterol levels, leading to cardiovascular problems.

Impact on Weight and Obesity

Processed foods often have a high calorie content due to added sugars, fats and refined carbohydrates. Despite their calorie density, they lack the necessary fiber and nutrients that promote feeling of fullness and satisfaction. This low satiety factor can lead to overeating and excessive calorie consumption, contributing to weight gain and related health issues. The widespread availability and consumption of processed foods play a significant role in the global obesity epidemic. These foods are convenient, affordable and often marketed extensively, making them a staple in many diets. Their high calorie content, coupled with the low satiety factor, encourages overconsumption, leading to an increase in obesity rates worldwide. These foods are rich in sugars, unhealthy fats and salt, disrupt the body's natural mechanisms of appetite regulation. Consuming these foods regularly can lead to insulin resistance, metabolic imbalances and fat accumulation. The excess consumption of processed foods, coupled with a sedentary lifestyle, promotes unhealthy weight gain. Additionally, processed foods often lack essential nutrients, encouraging further overeating as the body attempts to meet its nutritional needs, exacerbating the problem of obesity and related health complications.

Artificial Additives and Health Risks

Preservatives

Sodium Benzoate

This common preservative, when combined with certain food additives like artificial colors, may form benzene, a known carcinogen, under certain conditions.

Sulfites

These are used to preserve the color of some foods and inhibit the growth of microorganisms. However, sulfites can cause allergic reactions

particularly in individuals with asthma are sensitive to sulfites, experiencing symptoms such as wheezing, difficulty in breathing or anaphylaxis.

Flavor Enhancers

Monosodium Glutamate (MSG)

While MSG is generally recognized as safe, some people report symptoms like headaches, sweating and nausea after consuming foods containing it. This phenomenon is known as the "Chinese restaurant syndrome" or "MSG symptom complex." However, scientific evidence supporting these claims is limited.

Colorings

Artificial Food Dyes

Artificial colorings have been linked to hyperactivity in children and there have been concerns about their potential long-term effects. Some studies have shown a possible association between artificial food dyes and behavioral issues. Some people are allergic or sensitive to certain artificial colors, experiencing symptoms like hives, itching or swelling.

Impact on Mental Health

The impact of processed foods on mental health is an area of growing research and interest. There are several ways in which the consumption of processed foods may influence mental well-being.

1. **Nutrient Deficiency:** Processed foods often lack essential nutrients such as vitamins, minerals and antioxidants. A diet deficient in these nutrients can negatively impact brain function and contribute to mental health issues.
2. **Inflammatory Response:** Many processed foods, especially those high in refined sugars and unhealthy fats, can contribute to chronic inflammation in the body. Chronic inflammation has been linked to various mental health conditions, including depression and anxiety.
3. **Blood Sugar Fluctuations:** Processed foods with a high glycemic index can lead to rapid spikes and crashes in blood sugar levels. These fluctuations can affect mood, energy levels and cognitive function.
4. **Impact on Gut Health:** Highly processed foods may negatively affect the gut microbiota, disrupting the gut-brain axis. The gut microbiota plays a crucial role in producing neurotransmitters that influence mood and behavior.
5. **Dietary Patterns and Mental Health:** Long-term consumption of a diet high in processed foods has been associated with an increased risk of developing mental health disorders, including depression and anxiety. Conversely, diets rich in whole, unprocessed foods, such as fruits, vegetables and lean proteins, are often associated with better mental health outcomes.
6. **Cognitive Decline:** Diets high in processed foods, especially those high in trans fats and lacking in nutrient-dense foods, may contribute to cognitive decline over time. Cognitive decline can impact memory, concentration and overall mental function.
7. **Behavioral and Psychological Impact:** Some individuals may experience changes in behavior and mood in response to the consumption of highly processed foods, potentially leading to an increased risk of mental health issues.

The Importance of Reading Food Labels

Reading food labels is crucial for making informed and healthy food choices. Food labels provide valuable information about the nutritional content of a product, its ingredients and other relevant details. Here are several reasons highlighting the importance of reading food labels:

Nutritional Information

- Calories and Serving Size
- Macronutrients (Protein, Carbohydrates, Fats)
- Micronutrients (Vitamins and Minerals)

Ingredients List

- Identify Additives and Preservatives
- Allergen Information

Sugar Content

- Distinguish Between Natural and Added Sugars

Fiber Content

- Supports Digestive Health

Sodium Content

- Monitor Sodium Intake

Transparency about Nutrient Claims

- Validate Health Claims

Caloric Density

- Weight Management

Comparing Products

- Make Informed Choices

Understanding Serving Sizes

- Avoid Overeating

Dietary preferences and restrictions

- Vegetarian, vegan and gluten-free

Strategies for Reducing Processed Food Intake

To address the challenge of excessive processed food intake, a multifaceted approach involving the promotion of whole, unprocessed foods, meal planning, home cooking and community-wide nutrition education is essential. Initially, placing a strong emphasis on integrating whole foods into daily dietary choices forms the foundation of a healthier lifestyle. This involves prioritizing fresh fruits, vegetables, whole grains, lean proteins and natural sweeteners over processed alternatives. Encouraging individuals to choose nutrient-dense options, paves the way for improved overall health and well-being. Weekly meal planning allows individuals to proactively structure their diets, reducing reliance on processed convenience foods. Batch cooking during designated times, exploring quick and easy recipes and involving family members in the cooking process contribute to a sustainable and enjoyable approach to home-cooked meals. This not only ensures better control over ingredient quality but also fosters a sense of empowerment and connection within households.

Conclusion

While the allure of processed foods is hard to resist, it is imperative to recognize the severe consequences they pose to our health. High in added sugars, unhealthy fats and sodium, processed foods contribute to an increased risk of chronic conditions. The lack of essential nutrients in these foods may lead to nutritional deficiencies, impacting overall well-being. Additionally, the presence of artificial additives, preservatives and flavor enhancers in processed foods has been linked to adverse reactions in sensitive individuals. Regular consumption of these highly palatable but nutritionally poor options is associated with inflammation, which is implicated in various health issues, including mental health disorders. Therefore, minimizing the intake of processed foods is crucial for maintaining optimal health and preventing a range of chronic diseases. We must embrace a collective call to action by making informed dietary choices and advocating for healthier food options. By prioritizing whole, unprocessed foods and raising awareness about the detrimental effects of excessive processed food consumption, we can significantly enhance public health and overall well-being. Moreover, as informed consumers, we possess the power to influence the food industry towards providing more nutritious options. This shift towards reducing processed food intake has the potential to mitigate the rising prevalence of chronic diseases, improve mental health and ultimately create a society that thrives on the principles of balanced and nourishing nutrition.

Table 1: Increased Risk of Chronic Diseases

Diabetes Mellitus	Diets high in processed foods, especially those with added sugars and unhealthy fats, can lead to insulin resistance, a condition where the body's cells do not respond properly to insulin.
Obesity	Processed foods are often calorie-dense and nutrient-poor, leading to overconsumption of calories without meeting the body's nutritional needs. This imbalance can result in weight gain and obesity.
Cardiovascular Disease	Processed foods that are high in sodium, unhealthy fats and added sugars can contribute to high blood pressure, elevated cholesterol levels and atherosclerosis. These factors increase the risk of heart attacks, strokes and other cardiovascular problems.
Cancer	Diets rich in processed foods have been associated with an increased risk of certain cancers. Factors such as additives, high sugar content and the formation of carcinogens during food processing can contribute to the development of cancer cells.
Gastrointestinal disorders	Processed foods often lack dietary fiber, which is essential for a healthy digestive system. Insufficient fiber intake can lead to constipation, diverticulosis and other digestive issues.
Liver Disease	Excessive consumption of processed foods, especially those high in added sugars and unhealthy fats, can lead to non-alcoholic fatty liver disease (NAFLD), a condition where fat accumulates in the liver, potentially leading to liver inflammation and damage.
Renal disorders	Diets high in processed foods may contribute to the development and progression of chronic kidney disease, particularly in individuals with hypertension and diabetes, both of which can be exacerbated by poor dietary choices.

* * * * * * * *

Biofortification: Enhancing Crop Nutritional Value through Soil Amendments

Varsha Pandey[1*], Deepak Kumar[2], Nitesh Samadhiya[1] and Arpita Sharma[1]
[1]School of Agricultural Sciences, GD Goenka University, Gurugram, Haryana, India
[2]School of Agriculture, Galgotias University, Greater Noida, Uttar Pradesh, India
*Corresponding Author: varshapandey.p93@gmail.com

Agriculture plays a critical role in ensuring food security and providing the necessary nutrients for human health. However, malnutrition remains a global challenge, affecting millions of people worldwide, especially in developing countries. One promising approach to address this issue is biofortification, a process that enhances the nutritional value of crops by improving the nutrient content in the plants themselves. One of the key strategies within biofortification is the use of soil amendments, which involves enriching the soil with essential nutrients to improve crop nutrition. This article delves into the concept of biofortification, its significance, and the role of soil amendments in enhancing crop nutritional value.

What is Biofortification?

Biofortification is a sustainable and cost-effective approach to improve the nutritional quality of staple crops. It involves the breeding and selection of crop varieties that are naturally higher in essential nutrients such as vitamins, minerals, and amino acids. These nutrient-enriched varieties are designed to be grown in regions where malnutrition is prevalent. Biofortified crops are particularly important in areas where people rely heavily on a few staple foods for their daily nutrition. The primary goal of biofortification is to increase the nutrient content of crops, making them more nutritious without the need for dietary or lifestyle changes. This can significantly impact public health by addressing widespread nutrient deficiencies. Key nutrients targeted for biofortification include vitamin A, iron, zinc, and essential amino acids, among others.

Biofortification Methods

There are several approaches to biofortification, including:

- **Conventional Breeding**: Traditional breeding techniques involve selecting and cross breeding crop varieties with naturally higher nutrient content. This method relies on identifying natural genetic variations to develop improved crop varieties. For example, scientists have successfully developed maize varieties with enhanced levels of vitamin A (beta-carotene) through conventional breeding.
- **Genetic Modification (GM):** Genetic modification is a more advanced approach to biofortification, where specific genes responsible for nutrient production are introduced into the crop's genome. For instance, Golden Rice is a genetically modified variety that contains higher levels of vitamin A.
- **Agronomic Practices:** Biofortification can also be achieved through soil management and agronomic practices. This includes the use of soil amendments to enhance nutrient uptake by crops, which is the focus of this article.

Enhancing Crop Nutritional Value through Soil Amendments

Soil amendments are a crucial component of biofortification, as they can improve the nutrient content of crops by enhancing nutrient availability in the soil. These amendments provide the essential elements necessary for plants to grow and accumulate higher levels of key nutrients. Some common soil amendments used in biofortification include:

- **Micronutrient Fertilizers:** These fertilizers contain essential micronutrients like iron, zinc, and selenium. Adding them to the soil helps increase the availability of these nutrients for plant uptake. For example, zinc fertilizers can be applied to enhance the zinc content in crops like wheat and rice.
- **Lime and Calcium**: Soil pH plays a vital role in nutrient availability. By adjusting soil pH with the application of lime or calcium, nutrients like iron and manganese can become more accessible to crops.
- **Organic Matter:** Incorporating organic matter into the soil, such as compost or well-rotted manure, improves soil structure and nutrient-holding capacity. This enhances the availability of

nutrients like phosphorus, which is essential for plant growth and nutrition.

- **Sulphur:** Sulphur is an essential nutrient for plants and affects the uptake of other nutrients. Sulfur amendments can help improve the nutritional quality of crops by ensuring that other key nutrients are efficiently absorbed.
- **Beneficial Microorganisms:** Some microorganisms in the soil can enhance nutrient availability through processes like nitrogen fixation. Inoculating soils with specific beneficial microorganisms can help boost crop nutrient content.

Impact of Soil Amendments on Crop Nutritional Value

Soil amendments play a crucial role in biofortification by ensuring that crops receive the necessary nutrients to produce nutrient-enriched grains. The impact of these amendments on crop nutritional value is significant. Here are some of the benefits:

- **Improved Nutrient Content:** Soil amendments directly influence the nutrient content of crops. By supplying essential nutrients to the soil, they help crops accumulate higher levels of these nutrients in their edible parts.
- **Enhanced Nutrient Bioavailability:** Soil amendments can modify the soil's physical and chemical properties to improve nutrient bioavailability. This means that the nutrients become easier for crops to absorb, leading to better nutritional quality.
- **Sustainable and Cost-Effective**: Biofortification through soil amendments is a sustainable and cost-effective strategy. It doesn't require changes in agricultural practices or diets, making it an accessible and viable solution for addressing malnutrition.
- **Targeted Approach**: Soil amendments can be tailored to the specific nutrient deficiencies in a given region. This allows for a targeted approach to address the most prevalent nutritional deficiencies.

Challenges and Considerations

While biofortification through soil amendments is a promising strategy, it comes with its own set of challenges and considerations:

- **Soil Variability**: Soil conditions can vary greatly from one region to another. Thus, the choice of soil amendments must consider the specific nutrient deficiencies and soil properties in each area.
- **Environmental Impact:** The use of soil amendments, especially chemical fertilizers, can have environmental consequences, such as nutrient runoff into water bodies. Sustainable and eco-friendly practices must be implemented to mitigate these issues.
- **Crop Varietal Suitability:** The choice of crop varieties that respond effectively to biofortification through soil amendments is critical. Not all crops are equally amenable to this approach, and careful selection is necessary.
- **Farmer Adoption**: Encouraging farmers to adopt biofortification practices and invest in the necessary amendments can be a challenge. Education and awareness programs are crucial for the success of this strategy.

Conclusion

Biofortification through soil amendments represents an innovative and effective approach to addressing malnutrition and improving public health. By enriching the soil with essential nutrients, we can significantly enhance the nutritional value of staple crops. This approach is sustainable, cost-effective, and can be tailored to specific regions and nutritional deficiencies. While there are challenges to overcome, the potential benefits are enormous, and biofortification is a promising solution to tackle the global issue of malnutrition. As research and technology continue to advance, biofortification through soil amendments will likely play an increasingly critical role in improving human nutrition worldwide.

* * * * * * * *

Soybean: A Wonder Crop for Human Being

Jyoti Saket[1], Yogendra Singh[2*] and M. K. Shrivastava[3]
[1]P.G Research Scholar (Biotechnology), J.N.K.V.V, Jabalpur (M.P)
[2] Assistant Professor (Biotechnology), J.N.K.V.V, Jabalpur (M.P)
[3]Principal Scientist (Genetics & Plant Breeding), J.N.K.V.V, Jabalpur (M.P)
*Corresponding Author: yogendrasinghbt@gmail.com

Soybean is one of the major legume crops in the world, providing an abundant source of oil, protein, macronutrients and minerals. Soybean is a high value and profitable crops. The economic viability of soy production is determined by the commercial utilization of its sub product, meal and oil which respectively, account for about two thirds and one third of crops economic value. An important characteristic of the soybean plant is its nitrogen fixation capability through symbiosis with nodule forming-bacteria in the soil. It has been estimated that up to 50% of the total nitrogen of the plant may be supplied by the nitrogen fixing mechanism. Soybean oil is a good source of polyunsaturated fatty acids, such as linoleic acid and alpha linolenic acid which are good for human health. It is one of the best vegetarian sources of total protein containing all essential amino acids required in the human diet. Soybean based protein food are an important strategy to relieve to malnutrition and hunger problem. It contains 36.6 g of protein, 19.9 g of total fat, 30.2 g of carbohydrate, 9.3 g of dietary fibre and 15.7 mg of iron per 100 g of seed.

Botany

Soybean scientific name *Glycine max* and chromosome no. 2n=40. Soybean basically pulse crop but in India mostly grown as oil seed crop. This crop originated in China. Soybean all known as wonder crop or yellow jewel. Soybean is world first rank crop as source of vegetable oil. Soybean belongs to family Leguminosae and it is C3 short day plant. This plant highly self-pollinated. Soybean has perfect flower consisting of calyx, corolla, pistil and stamens.

Area, production, productivity

Soybean occupies 5.52 million hectares in MP producing 5.23 m illion tonnes and yielding 939 kg\ha (Director's report, IISR) Soybean production in Madhya

Pradesh, the leading soybean producing state in the country. The maximum production of soybean in Madhya Pradesh is in Malwa. The Malwa plateau region of western MP covers the districts of Dewas, Indore, Dhar, Ujjain, Jhabua, Ratlam, Mandsaur and Rajgarh. Soybeans are of crucial importance in India. They are a source of protein, minerals, and vitamins. Soybeans are also important for meeting the vegetable oil requirement of India's population and for contributing to the national economy through soy meal export.In general, soybean seeds contain 35%–40% protein, 30% carbohydrates, 20% lipids,9% dietary fiber, and 9% moisture based on its dry weight and these values would slightly vary depending on variety, the location, and its climate .

Soybean is an important source of food, protein, and oil, and hence more research is essential to increase its yield under different conditions, including stress. The most important countries of the world with the highest rate of soybean production include the USA, Brazil, Argentina, China, and India.

Uses of Soybean

Soy flour- soybean flour has a nutty aroma and is similar to chickpea flour. It is usually mixed with wheat flour to make rotis, parathas or pancakes.

Soy sauce- Soy sauce is a condiment commonly used as an ingredient in Chinese fast food and other Asian cuisines. It is widely available in the market and is present in the ingredient racks of every fast-food centre. It gives food an intense, savoury and salty flavour. Soy sauce is a dark brown liquid that can enhance the aroma and taste of stir-fries, soups, fried rice and noodles.

Soy paneer (Tofu)-It is a great meat alternative for vegans and vegetarians. It can be used in dishes like: Tofu Rolls, Tofu Noddle's, Tofu Sand witch, Tofu Crispy bites & Tofu Salad.

Soy milk-Soy milk is a plant-based drink made from soybeans. Some uses of soy milk are;

- It can be used as an alternative to cow's milk, especially for lactose intolerant people.
- It can be flavoured with vanilla, chocolate, or other ingredients.
- It can lower the risk of some cancers, such as breast and prostate cancer.
- It can control cholesterol and blood pressure levels.
- It can help in arthritis, anaemia and weight loss.

Soy protein powder- It is a plant-based protein that comes from the soybean, which is a legume**.** This makes a great source of protein for both vegetarians and vegans alike, as well as those avoiding dairy, with no cholesterol and very little saturated fat.

Soybean oil -Soybean oil is the most widely consumed vegetable oil world- wide. Although it is used as cooking oil.

Soybean Meal -Livestock feed, aqua culture feed, poultry feed. Poultry and livestock feed make up 97 percent of soybean meal used in the U.S.

Industrial Uses - Paint, cleaner, cosmetics, soaps.

Biodiesel- Using biodiesel reduces life cycle emissions because carbon dioxide released from biodiesel combustion is offset by the carbon dioxide absorbed from growing soybeans or other feedstocks used to produce the fuel.

Mineral -The mineral content of soybeans, determined as ash, is about five percent. When soybeans are processed, most of the mineral constituents go with the meal and few with the oil. The major mineral constituents are potassium, calcium and magnesium. The minor constituents comprise trace elements of nutritional importance, such as iron, zinc, copper etc.

The biological availability of minerals may be impaired somewhat as a result of the presence of phytates in soybeans and soybean products. The mineral composition of soybeans is affected by the composition of the soil. Thus, the contamination of soils with undesirable elements such as heavy metals, as a result of irrigation with poorly treated waste water, may be reflected in the composition of the soybeans.

Isolated soybean proteins, or soy protein as they are also called, are the most concentrated form of commercially available soybean protein products. They contain over 90% protein, on a moisture free basis.

Carbohydrate- Soybeans contain about 30% carbohydrates. These can be divided into two groups: soluble sugar (sucrose 5%, stachyose 4%, raffinose 1%) and insoluble "fibre" (20%). Raffinose is a trisaccharide composed of galactose, glucose and fructose linked in that order. Stachyose is a tetra saccharide with the following structure: galactose-galactose-glucose-fructose. Raffinose and stachyose are not broken down by the enzymes of the digestive track but are fermented by the microorganisms present in the intestine, with the formation of intestinal gas. Flatulence, an inconvenience associated with the ingestion of pulses in general, is a factor which must be considered, sometimes, in the use of soybean products in human nutrition.

The insoluble fraction is a complex mixture of polysaccharides and their derivatives. The major part of this fraction consists of cell wall carbohydrates: cellulose, hemicelluloses and pectic substances. The insoluble carbohydrates are not digested by the enzymes of the gastro-intestinal track and can be characterized as "dietary fibre". They absorb water and swell considerably. Unlike other legumes, soybeans contain very little starch (less than 1%).

Antinutritional factors- The main anti-nutritional factors in soybean that inhibit growth in animals are trypsin inhibitor and lectin. Many anti-nutrients like phytates, lectins, and glycosylates can be removed or deactivated by soaking, sprouting or boiling the food before eating.

* * * * * * * *

Emerging Food Processing Technologies to Improve the Quality of Plant-Based Milk During Processing

Ramya C. S.[1]*, Parvathy Nayana N[1] and Juhi Ranjan[1]
[1] Ph.D. Scholar, Division of Agricultural Engineering, ICAR-IARI, New Delhi
*Corresponding Author: ramyacs8369@gmail.com

Nowadays, the demand for an alternative to animal-sourced milk is high due to medical reason such as lactose intolerance, dairy milk protein allergy, and cholesterol problem and lifestyle choices includes a vegan diet and ready-made healthy beverages. Since then, consumers have tended towards plant-based beverages that have been extracted from oilseeds, nuts, cereals, etc. Plant-based milk substitutes are one of the food groups that are irreplaceable in the vegan food industry because plant-based milk substitutes are used as an essential ingredient in many vegan food products such as plant-based yogurt, cheese, kefir, butter, ice cream, etc. People also choose plant-based milk substitutes because of their rich antioxidant activity and fatty acids which reduce the risk of cardiovascular diseases, cancer, atherosclerosis, and diabetes. However, these substitutes also have various negative effects which include less availability of micronutrients because of the presence of anti-nutritional factors like phenols, which can be overcome by various processing methods such as fermentation.

The production of plant-based milk typically involves several steps: wet grinding, filtration, pasteurization/sterilization, homogenization, aseptic packaging, and cold storage. However, a challenge arises with product stability, as heat treatment can adversely affect sensory and nutritional qualities. Hence, there is a need for novel technologies like ultrasound, pulsed electric fields, ohmic heating, high and ultra-high-pressure homogenization, and cold plasma treatment to enhance stability without the need for additives and to enhance nutritional properties.

High-pressure processing

High-pressure processing is a method of food processing technology, in which the food material is subjected to high pressure ranging from 100 MPa to 600 MPa to eliminate microorganisms and alter the attribute of food materials to achieve the desired quality of food products with minimum loss of nutrients (Gupta & Balasubramaniam, 2011). This technology is also called High Hydrostatic Pressure Processing and Ultra Pressure Processing. The HPP technology works on two principles; Le Chatelier's principle which states that any process accompanied by a decrease in volume is enhanced by pressure and the Isostatic principle which states that the pressure acts equally and homogeneously in all directions irrespective of size and geometry of the particle (Sehrawat et al., 2021).

High-pressure processing has gained significant attention as a technique to achieve considerable microbial inactivation comparable to that of pasteurization. The application of 600 MPa pressure for a duration of 180 seconds significantly reduces the aerobic plate count, coliforms, and yeast count in plant-based milk. Simultaneously, it led to a noteworthy decrease in immunoreactivity within milk. This reduction in immunoreactivity could be attributed to a reduced solubility of milk proteins due to high-pressure processing. Furthermore, it is important to note that high-pressure treatment also demonstrated a lesser impact on the colour change of the milk when compared to pasteurized milk samples. Regarding the dispersive and aggregative characteristics of almond milk, pressure treatment induces relatively more and larger aggregates in comparison to samples treated with heat. This phenomenon can be attributed to the aggregation of macromolecules under high-pressure conditions. The variation in dispersive and aggregative properties observed in high-pressure and heat-treated almond milk was due to differences in protein denaturation, particle coagulation, and aggregate morphological characteristics (Dhakal et al., 2016). Moreover, HPP also increases the emulsion stability and viscosity of the milk samples. Knowledge gained from the studies will help food processors formulate novel plant-based beverages treated with high pressure.

Ultrasound

Ultrasonic devices are utilized as ultrasonic homogenizers to enhance the homogeneity of the emulsion in plant-based milk samples, consequently improving their stability. Moreover, these ultrasonic devices are employed to inactivate microorganisms and thus increase microbial safety. The main mechanism of action of the ultrasound approach resulted from acoustic cavitation, including the formation and collapse of air bubbles in treated systems. In treatment with ultrasound waves, waves with a frequency of over 20 kHz to 100MHz are generated, which in turn affect the cells through cavitation. Bubbles generated by ultrasonic waves attack the cell walls by bursting near them a short time after formation, creating a pressure difference. This can facilitate both extraction and inactivation of microorganisms. Consequently, ultrasound treatment increases the viscosity, particle size, and stability of the emulsion.

Iorio et al. (2018) suggest that the ultrasound treatment could exert a sub-lethal injury on the pathogens, as evidenced by the lag phase in L. monocytogenes or the reduction of the growth rate for E. coli O157:H7, which, combined with the storage under refrigeration, could contribute to increasing the shelf life. High-intensity ultrasounds effectively disrupt peanut cells, increase hydrolysed protein content in milk, improve sedimentation index, prevent phase separation, and improve microstructure with smaller particle and fat globule size. Additionally, ultra-sonication significantly reduces the trypsin inhibitor activity by up to 52% and improves the digestibility of protein in soymilk. This treatment increases the absolute value of ζ-potential and modifies colour parameters (increased a*, but decreased L* and b*). It also mitigates the presence of beany-flavor compounds in soybean milk. Ultrasound can amplify the effect of pH-shift on increasing the thermal stability of coconut milk by modifying the functional properties and structures of coconut milk protein, especially under alkaline pH-shift treatment

Pulsed Electric Field (PEF)

Nowadays, PEF is used for processing different types of beverages. In general, the pulsed electric field is a technique for fluid stabilization through the reduction of fat particle size. This treatment is suggested as an alternative nonthermal technique to increase the shelf life without compromising the quality, nutritional, and sensory attributes of the plant-based milk. In this technique, the food product is usually placed between two electrodes and subjected to pulses that are short at a very high voltage and minimal processing time. The electric fields generate an induction of the membrane potential, which, exceeding a certain value, can cause damage to the cells and even cell death which in turn leads to the destruction of unwanted micro-organisms in plant-based milk.

Pulsed electric field (PEF) treatment profoundly influences the physicochemical, physical, and structural properties of plant-based milk. It greatly reduces the particle size, leading to emulsion with enhanced stability, and reduced phase separation, while also increasing apparent viscosity and changing the consistency index of milk samples. Additionally, PFE treatment improves the physical stability, whiteness index, clarity, and overall appearance of plant-based beverages with a noticeable colour change (Manzoor et al., 2019). However, the important factor to be considered is the PEF treatment time, as an increase in processing time the relative activities of soybean lipoxygenase (SLOX) and peroxidase decreased and the inactivation of *Escherichia coli* and *Staphylococus aureus* increased significantly.

Cold plasma treatment

Cold plasma one of the non-thermal processing technologies, is a well-known technology for reducing the microbial load in foods. Cold plasma has also been reported to maintain quality, reducing both anti-nutritional and allergens. Most allergens and antinutritional factors are proteins, they can be modified, or their structures can be altered by the reactive species. The reactive species produced during plasma generation reacts and bombards with the antinutritional factors and reduces them; or it activates the enzymes that can reduce the antinutritional factor (Lokeswari et al., 2021).

The application of cold plasma treatment in sesame milk resulted in a reduction of anti-nutritional factors such as phytates, oxalates, and lipoxygenase activity. However, it also led to undesired alterations in the physicochemical properties of the plant-based milk. Notably, the application of plasma bubbles effectively decreased the microbial load in plant-based milk (Dharini et al., 2023)

Conclusion

The increasing demand for plant-based milk alternatives, driven by health concerns and lifestyle choices, has given rise to the need for innovative processing methods. High-pressure processing (HPP), ultrasound, pulsed electric fields (PEF), and cold plasma treatment have all shown promise in improving the quality, safety, and nutritional properties of plant-based milk. HPP effectively reduces microbial counts and immunoreactivity while enhancing emulsion stability. Ultrasound treatment improves emulsion homogeneity and microbial safety while reducing allergenicity. PEF treatment modifies physicochemical properties, enhancing stability and appearance. Cold plasma treatment reduces anti-nutritional factors and microbial load. These techniques provide avenues for addressing the challenges in plant-based milk production and expanding the choices available to consumers seeking dairy alternatives.

References

Dhakal, S., Giusti, M. M., & Balasubramaniam, V. M. (2016). Effect of high-pressure processing on dispersive and aggregative properties of almond milk. *Journal of the Science of Food and Agriculture*, *96*(11), 3821–3830.

Dharini, M., Jaspin, S., & Mahendran, R. (2023). Cold plasma bubbling: Impact on safety, physicochemical properties, and nutritional quality of sesame milk. *Food and Bioproducts Processing*, *139*, 109-120.

Gupta, R., & Balasubramaniam, V. M. (2011). High-Pressure Processing of Fluid Foods. In *Novel Thermal and Non-Thermal Technologies for Fluid Foods*. Elsevier Inc. https://doi.org/10.1016/B978-0-12-381470-8.00005-0

Iorio, M. C., Bevilacqua, A., Corbo, M. R., Campaniello, D., Sinigaglia, M., & Altieri, C. (2019). A case study on the use of ultrasound for the inhibition of Escherichia coli O157: H7 and Listeria monocytogenes in almond milk. *Ultrasonics Sonochemistry*, *52*, 477-483.

Lokeswari, R., Sharanyakanth, P., & Mahendran, R. (2021). Combination of air plasma bubbling and soaking in the reduction of phytic acid and improving free iron availability in pearl millet. *Int. J. Chem. Stud.*, *9*(1), 1041-1045.

Manzoor, M. F., Ahmad, N., Aadil, R. M., Rahaman, A., Ahmed, Z., Rehman, A., ... & Manzoor, A. (2019). Impact of pulsed electric field on rheological, structural, and physicochemical properties of almond milk. *Journal of Food Process Engineering*, *42*(8), e13299.

Mehany, T., Siddiqui, S. A., Olawoye, B., Olabisi Popoola, O., Hassoun, A., Manzoor, M. F., & Punia Bangar, S. (2023). Recent innovations and emerging technological advances used to improve the quality and process of plant-based milk analogs. *Critical Reviews in Food Science and Nutrition*, 1-31.

Munekata, P. E., Domínguez, R., Budaraju, S., Roselló-Soto, E., Barba, F. J., Mallikarjunan, K., & Lorenzo, J. M. (2020). Effect of innovative food processing technologies on the physicochemical and nutritional properties and quality of non-dairy plant-based beverages. *Foods*, *9*(3), 288.

Sehrawat, R., Kaur, B. P., Nema, P. K., Tewari, S., & Kumar, L. (2021). Microbial inactivation by high-pressure processing: principle, mechanism, and factors responsible. *Food Science and Biotechnology*, *30*(1), 19–35.

* * * * * * * *

Black Rice: A Nutrient-Packed Superfood

Angam Raleng
College of Food Technology, Lamphelpat, Central Agricultural University, Imphal, Manipur - 795004
*Corresponding Author: angamraleng@gmail.com

In Manipur, black rice (*Oriza Sativa* L. Indica), also known as chak-hao, is highly valued for its eye-catching colour and mouthwatering aroma. Of all the nutritional grain products, it is thought to provide the highest concentrations of vitamins, minerals, fibre, proteins, and many other nutrients. It is also one of the richest sources of anthocyanin. The delightful aroma and stickiness of Manipur's black aromatic rice set it apart from other varieties farmed across the world. It is not entirely clear how chak-hao can be used in processed food items. Its distinctiveness, abundance, and health benefits make Chak-hao a promising ingredient for a wide range of processed food products. Since it contains more vitamins and minerals than both brown and white rice, purple or black rice is regarded as the healthiest type of rice. Anthocyanins are potent naturally occurring black colouring pigments that give black rice its colour and contribute to its health benefits. Black rice has been demonstrated to lower inflammatory levels in the body in addition to being a powerful source of protein, fibre, and vitamin E (Nitin and Roshini 2020). The results of the study suggest that eating black rice may aid in the treatment and prevention of major illnesses such allergies, high blood pressure, cancer, atherosclerosis, and arthritis. Black rice is the greatest type of rice since it contains more amylopectin and less amylase than brown or regular white rice. Two substances make up starch: amylopectin and amylose. Therefore, stickier black rice is sticky; in spite of its name, it is gluten-free. Second, rice's high anthocyanin content imparts a black pigment that gives it a dark colour when it's fresh. As a matter of fact, black rice tastes slightly nutty. It pairs nicely with sticky textures, so it's a great choice for desserts like rice pudding, Kheer, rice bread, noodles, and other pasta dishes. Black rice is generally thought to be healthier than brown rice, and frequent consumption is thought to improve general health.

nutritional profile of black rice

It's claimed that black rice has the highest nutritional content of any variety. Additionally, the nutritional content of brown rice is comparable to that of black rice. Most people like and eat white rice because it tastes nice, is easily accessible, and is reasonably priced. Due to black rice's increased nutritional content and health advantages over white rice, more people are incorporating it into their diets (Priya et al., 2019). Lipids, protein, iron, tocopherols, zinc, and vitamin B (riboflavin and thiamin) are found in the highest concentrations in black rice (Table 1). Therefore, in a number of foods processing companies, adding black rice to typical food items can improve their overall nutritional profiles.

Purpose of including Black rice in our daily menu

Any method of incorporating black rice into our regular diets can enhance our bodies' health and medical conditions. It is thought to be among the meals with the greatest nutrients. A few of the health and medicinal benefits of black rice are discussed here.

Low Glycaemic Index

A food's Glycaemic Index (GI), a numerical measurement, indicates how much it can raise blood sugar levels in the body. Meals are scored on a range of 1 to 100 and classified as low, medium, or high glycaemic meals. Blood sugar levels are affected as GI increases. When sticking to a low-glycaemic diet, high-GI foods should be replaced by low-GI ones. According to Christine et al. (2017), a low-glycaemic diet can help control blood sugar, lower cholesterol, and facilitate short-term weight loss. Therefore, black rice, which is popular in northeast India, might be used in place of a number of cereals, including those made from brown and white rice, due to its low glycaemic index of 42.

Powerhouse of antioxidant

Black rice's intense colour is a sign that it contains potent antioxidants known as anthocyanins. The rich purple and black colour of black rice is attributed to anthocyanins, which are also responsible for the colour of blueberries and blackberries. Dark-coloured fruits, including blueberries and blackberries, are well known for having great antioxidant qualities. Black rice works in a similar way. Antioxidants prevent diabetes, heart disease,

cancer risks, and illnesses that may lead to cancer by reducing the harm that free radicals cause to cells. (Roshini and Nitin, 2020)

Aids in diabetes prevention or management

Research shows that whole grains are far more advantageous and preventive than processed carbohydrates when it comes to the risk of acquiring diabetes and even obesity. Black rice is a lot better option than processed carbohydrates when it comes to slowing down the absorption of sugar in the circulation because it contains fibre, antioxidants, and other minerals (Nitin and Roshini, 2020). The body can benefit from the complete bran (where the fibre is stored) of black rice, which can help with the grain's longer-term absorption of glucose (sugar). Black rice also helps reduce blood sugar levels and diabetes due of its low glycaemic index.

Free of gluten

People with wheat allergies, gluten intolerance, or celiac disease can safely eat black rice because it doesn't contain gluten. All of the gluten-free grains—brown rice, black or purple rice, buckwheat, quinoa, amaranth, and white rice—are gentle on the small intestine and promote healthy digestion. When everything is considered, black rice is by far the healthiest type. It slows down aging, enhances cardiovascular health, and helps avoid various diseases like diabetes and Alzheimer's. Nitin and Roshini (2020) claim that ingestion appears to lower inflammation and maintain blood cholesterol levels. Black rice is a very beneficial food choice because it is high in fibre, low in sugar, and contains a moderate quantity of vitamin E.

Minimizes allergies and avoids constipation

Black rice has twice as much fibre than brown rice, which helps to ease constipation and promote smoother bowel movements. Thanuja B and Parimalavalli (2018) claim that after binding with harmful substances, the fibres likewise quickly wash out of the colon with the stool. The release of histamine, an amino acid that aggravates allergy symptoms, is inhibited by black rice. When black rice is eaten, the skin gets less inflamed and red (Nitin and Roshini, 2020).

Regulates Obesity

Black rice bran's high fibre content helps with weight loss and weight management. Eating black rice not only prevents hunger and increases feelings of fullness, but it also reduces the synthesis of fatty acids, which leads to an accumulation of intercellular lipids between tissues (Nitin and Roshini, 2020). Black rice also has detoxifying properties.

Keeps heart conditions at bay

Black rice is a fantastic diet since it contains the black pigment known as "anthocyanin" and has many other health advantages. According to Nitin and Roshini (2020), utilizing black rice in food processing can enhance the nutritional value of the goods made with it. It can also be used to create functional foods for certain groups of people, like those who have diabetes, obesity, high blood pressure, or heart problems. Making food out of black rice, which is not a food that is often consumed, will be a novel and beneficial approach to produce food for the coming generation of customers.

Use of black rice in processing and value addition

Because it includes the black pigment known as "anthocyanin" and has numerous other health benefits, black rice is an incredible diet. Nitin and Roshini (2020) assert that using black rice in food processing can improve the nutritional content of the products that are prepared with it. Additionally, it can be applied to the development of functional foods for certain populations, such as individuals with diabetes, obesity, high blood pressure, or cardiac issues. Since black rice is not a food that is commonly consumed, converting it into food will be a unique and healthful way to create food for the next generation of consumers.

Utilizing black rice in the contemporary food processing sector

People rarely have time to cook meals in today's fast-paced world, thus ready-to-eat (RTE) foods are growing more and more popular. It offers a useful way to eat whenever and wherever you like. It simultaneously fills the stomach and is easily eatable, lightweight, and portable. Ready to eat Cereals are produced using a variety of technological processes,

including heating, shaping, drying, sweetening, flavouring, and incorporating vitamins and minerals (Caldwell et al., 2016). Black rice pudding, Gulab jamun, noodles, and pastas; black rice mix cereals; black rice beer; black rice Nutri-bars; black rice cakes, muffins, and cookies; and black rice baby meals are just a few of the goods that are now made using black rice-fortified food processing technology.

Conclusion

Because black rice possesses latent potential that other varieties of rice do not, it is also referred to as the "magic cereal." The nutritional and therapeutic benefits that this specific rice can offer are really substantial. Black rice's strong antioxidant concentration places it in the superfood category, which is a nutritional bombshell. Due to black rice's high nutritional content, using it as a component would not only aid in creating a wide range of excellent food products but will also help to enhance nutrition, which is currently customers' top concern. The significant antioxidant activity, health benefits, and natural colouring properties of anthocyanin—particularly cyanidin-3-glucoside, the main pigment of black rice—are drawing increased attention from researchers. Because it contains a lot of tocopherols (vitamin E), iron, and antioxidants, black rice is a practical and inventive component in food processing. Its all-around nutritious makeup has also made it a viable addition and processing ingredient for meals. Due to its low glycaemic index, black rice has been shown to be beneficial for people who have allergic reactions to other cereal grains. It also reduces the risk of developing diabetes, obesity, and cardiovascular diseases. Black rice has to be utilized as a special ingredient in food formulation, development, and value addition in order to fully realize its potential and validate its latent strength as a nutritional and therapeutic powerhouse. Furthermore, including black rice as an ingredient will increase the number of applications for it in the food processing industry and help increase knowledge, understanding, and technical expertise regarding the benefits of black rice's potential.

References

Caldwell EF, McKeehen JD, Kadan RS. Cereals: Breakfast Cereals. In: Encyclopaedia of Food Grains. Second Edition, 2016, 262-267.

Christine C, Lena AK, Emma L, Sarah AMK, Louise H, Nadine F, Roberta G, Gary F, and Karen R. Low glycaemic index diets for the prevention of cardiovascular disease. Cochrane Database Syst Rev. 2017; 2017(7): CD004467. doi: 10.1002/14651858.CD004467.pub3

Nitin K and Roshini DM. Black rice: A Novel ingredient in food processing. J Nutr Food Sci.2020. 10:771. doi: 10.35248/2155-9600.20.10.771

Priya TS, Nelson AR, Ravichandran K, Antony U. Nutritional and Functional properties of Coloured rice Varieties of South India: a review. J Ethn Foods. 2019;6(1).

Thanuja B, Parimalavalli R. Role of Black Rice in Health and Diseases. Int J Health Sci Res. 2018;8(2).

Table 1: This table shows the nutritional profile of several rice cultivars per 100 g serving

(Priya *et.al.*, 2019)

Rice Cultivar	Carbohydrates (g)	Protein (g)	Fat (g)	Fiber (g)	Iron (mg)	Tocopherol (mg)	Thiamin (mg)	Riboflavin (mg)	Zinc (mg)
Black rice	34 ± 0.05	8.5± 0.5	2± 0.06	4.9± 0.3	3.5± 0.15	12.54±0.34	0.46± 0.032	0.403± 0.04	3.16± 0.05
Red rice	23 ± 0.04	7± 0.05	0.8± 0.01	2± 0.6	5.5± 0.14	10.77±0.24	0.33± 0.15	0.105± 0.03	1.91± 0.036
Brown rice	24 ± 0.07	7.9± 0.07	0.8± 0.02	1.8± 0.5	2.2± 0.07	2.2 ± 0.76	0.54± 0.07	0.1 ± 0.2	1.8± 0.05
White rice	28 ± 0.03	2.7± 0.04	0.3± 0.01	0.6± 0.1	1.2± 0.19	0.1 ± 0.14	0.7± 0.06	0.03± 0.33	1.4± 0.039

* * * * * * * *

Functional Foods: Benefits, Uses, Types of Functional Foods

Anam Aijaz
Ph.D scholar, SKUAST – K, Shalimar Srinagar
*Corresponding Author: adaaaijaz@gmail.com

Functional foods are the food industry's response to the consumer's demand for foods that are both attractive and healthy. Healthy diets offer a number of proven benefits: epidemiological and clinical studies show that a diet rich in fruits, vegetables, unrefined grains, fish, and low-fat dairy products, and low in saturated fats and sodium can reduce the risk of coronary heart disease and hypertension and perhaps even of some types of cancer. Some people have changed their diet accordingly, and have benefited from it with a much lower risk of heart disease. However, for most consumers it is a struggle to meet dietary guidelines. This is where industry steps in with special foods that promise to improve health and well-being with less effort and sacrifice.

What are functional foods?

Functional foods are ingredients that offer health benefits that extend beyond their nutritional value. Some types contain supplements designed to improve health. The concept originated in Japan in the 1980s when government agencies started approving foods with proven benefits in an effort to better the health of the general population. Some examples include foods fortified with vitamins, minerals, probiotics, or fibre. Nutrient-rich ingredients like fruits, vegetables, nuts, seeds, and grains are often considered functional foods as well. Oats, for instance, contain a type of fibre called beta glucan, which has been shown to reduce inflammation, enhance immune function, and improve heart health.

Examples of functional foods

Functional foods are generally separated into two categories: conventional and modified. Conventional foods are natural, whole-food ingredients that are rich in important nutrients like vitamins, minerals, antioxidants, and heart-healthy fats. Meanwhile, modified foods have been fortified with additional ingredients, such as vitamins, minerals, probiotics, or fibre, to increase a food's health benefits. Here are some examples of conventional functional foods:

- Fruits: berries, kiwi, pears, peaches, apples, oranges, bananas
- Vegetables: broccoli, cauliflower, kale, spinach, zucchini
- Nuts: almonds, cashews, pistachios, macadamia nuts, Brazil nuts
- Seeds: chia seeds, flax seeds, hemp seeds, pumpkin seeds
- Legumes: black beans, chickpeas, navy beans, lentils
- Whole grains: oats, barley, buckwheat, brown rice, couscous
- Seafood: salmon, sardines, anchovies, mackerel, cod
- Fermented foods: tempeh, kombucha, kimchi, kefir, sauerkraut
- Herbs and spices: turmeric, cinnamon, ginger, cayenne pepper
- Beverages: coffee, green tea, black tea. Here are some examples of modified functional foods:
- fortified juices
- fortified dairy products, such as milk and yogurt
- fortified milk alternatives, such as almond, rice, coconut, and cashew milk
- fortified grains, such as bread and pasta
- fortified cereal and granola

Benefits of Functional Foods

Functional foods offer various potential health benefits that can help prevent nutrient deficiencies and promote overall well-being. These foods are typically rich in essential nutrients such as vitamins, minerals, healthy fats, and dietary fiber. Incorporating a diverse range of functional foods into your diet, both conventional and fortified options, can ensure you receive the necessary nutrients, safeguarding against deficiencies. Fortified foods, have played a significant role in reducing nutrient deficiencies on a global scale. For instance, the

introduction of iron-fortified wheat flour in Jordan drastically lowered the rates of iron deficiency anaemia among children. Fortification has been instrumental in preventing other conditions resulting from nutrient deficiencies, including rickets, goiter, and birth defects. Many functional foods are abundant in antioxidants, which help combat harmful free radicals, shielding cells from damage and reducing the risk of chronic conditions like heart disease, cancer, and diabetes. Some are excellent sources of omega-3 fatty acids, a type of healthy fat known to reduce inflammation, enhance cognitive function, and support heart health. Others are high in dietary fibre, which can improve blood sugar control and protect against various conditions, including diabetes, obesity, heart disease, and stroke. Fiber may also reduce the risk of digestive disorders like diverticulitis, stomach ulcers, and acid reflux. For infants and children, proper growth and development require specific essential nutrients. A diet rich in nutrient-dense functional foods ensures these nutritional needs are met. Additionally, fortified foods with specific nutrients like B vitamins, such as folic acid, are crucial for growth and development. Folic acid is essential for fatal health and can significantly reduce the risk of neural tube defects. Other vital nutrients found in functional foods, including omega-3 fatty acids, iron, zinc, calcium, and vitamin B12, play pivotal roles in supporting proper growth and development in children.

Uses

A well-rounded, healthy diet should be rich in a variety of functional foods. These foods not only supply your body with the vitamins and minerals it needs but also support overall health. Fortified functional foods can also fit into a balanced diet. In fact, they can help fill any gaps in your diet to prevent nutrient deficiencies, as well as enhance health by boosting your intake of important nutrients like vitamins, minerals, fibre, heart-healthy fats, or probiotics. The bottom-line Functional foods are a category of food associated with several powerful health benefits. They can not only prevent nutrient deficiencies but also protect against disease and promote proper growth and development.

Types of functional foods

1. **Fortified product:** A diet that's fortified with extra nutrients. Example's; Fruit juices fortified with vitamin C.
2. **Enhanced product:** A food that has new nutrients incorporated that are not usually present in a specific food. Example's; Margarine with plant sterol ester, probiotics, prebiotics.
3. **Modified product:** A food that has extracted, reduced or replaced a deleterious component with another substance with beneficial effects. Example's; Fibre's as fat releasers in meat and ice-cream products.
4. **Unaltered product:** Foods that naturally contain an increased nutrient or component content. Example's; Natural foods.
5. **Upgraded product:** A food that has been naturally improved by one of the components by unique growing conditions, new feed composition, genetic handling or in other ways. Example's; Eggs with increased Omega-3 content achieved by altered chicken feed.

Can functional foods promote health?

Functional foods, while often more expensive than regular options, can be justified if they promote health. They hold the potential to fund nutrition research, similar to how pharmaceutical profits support drug development. The food industry possesses the expertise to create healthy foods that cater to consumer preferences, making them more likely to sell.

A successful model of industry-sponsored research is the development of foods enriched with plant stanols or sterols, which can lower LDL cholesterol levels. Functional foods can also assist consumers in meeting recommended dietary intakes, addressing nutrient deficiencies, and promoting public health. For example, iodized salt has been a successful public health initiative in India, eradicating goitre and other iodine deficiency disorders. However, the list of functional foods with proven health benefits remains relatively short, and many foods with health claims lack scientific validation. Safety concerns are growing, particularly with the

indiscriminate addition of botanicals to foods. Some herbs, such as Hypericum perforatum, can interact with drugs, raising safety issues.The FDA and other regulatory bodies have issued advisories and recommendations regarding the safety of functional foods, urging the development of clear regulations and safety information requirements for food labels. The border between foods and dietary supplements can be blurry, and some structure/function claims for dietary supplements remain unregulated. These claims can be misleading and may not require as much scientific evidence as explicit health claims.

Regulations need to be clearer and more stringent, ensuring that claims on functional foods are accurate and safe. Although the food industry can benefit from the sales of these products, the priority should be the health and safety of consumers. Proper legislation and oversight are essential to establish trust and protect public health in the functional food industry.

Regulation of functional foods

Many countries have established regulations to protect consumers from misleading health claims on food products. The United States and the European Union, for example, prohibit claims that foods can cure diseases, although the U.S. allows claims that foods can reduce the risk of disease. In Europe, stating that nutrients reduce disease risk is presently illegal, but this is under reconsideration.The distinction between foods and dietary supplements is sometimes blurry. In the U.S., dietary supplements can carry unregulated structure/function claims, which are largely the responsibility of manufacturers for accuracy. This has raised concerns about the limited evidence required for supplement claims.Both the U.S. and European Union are moving towards allowing claims for foods to reduce disease risk factors, subject to evaluation by appropriate authorities. The EU's system for nutrition and health claims is complex, with varying rules among member states.In all these regions, "nutrient content" and "structure-function" claims are allowed, requiring less evidence than explicit health claims. These claims can be misleading to consumers. Manufacturers may use these claims to reposition unhealthy foods as healthy, which can lead to misunderstandings. The existing regulations leave room for misleading health claims, and some companies may exploit this ambiguity. While some responsibility falls on the industry, regulatory systems need to be clearer and more stringent. In contrast, mandatory food fortification measures are based on solid research, are well-regulated, effective, and safe, and reach the entire population, unlike functional foods, which may be accessible primarily to specific demographics.

What evidence should we demand for functional foods?

Well-established systems for evaluating health claims in food exist in various countries, such as the "Significant Scientific Agreement" criteria in the United States, the Dutch Code of Practice, and the UK Joint Health Claims Initiative. These evaluations should be mandatory for any claims, explicit or implied, that a food promotes health.

The criteria for assessing the safety and effectiveness of functional foods don't need to be as strict as those for drugs, given the fundamental difference between food ingredients and pharmaceuticals. Food components have been part of the human diet for centuries. Research often involves studying associations between diet and health in populations, generating leads for health-promoting foods. However, controlled experiments are also necessary to demonstrate a functional food ingredient's effectiveness and safety, particularly for less common components or higher dosages.

Clinical trials showing disease reduction in humans (phase III trials) are sometimes deemed expensive, but the food industry could afford them, provided the results benefit sales or profit margins. Governments can play a role in incentivizing research by offering the prospect of health claims if trials are successful, not exclusively to the funding company. This encourages competition and research collaboration.

Proper legislation is crucial to ensure the success of evidence-based functional foods. If a claim is scientifically validated, manufacturers should be

allowed to advertise it. Conversely, false claims should be subject to legal action. This framework promotes the development and promotion of genuinely beneficial functional foods while protecting consumers from misleading claims.

Do functional foods have a future?

On a short-term basis, functional foods do have a future. There is plenty of demand. In 1999, United States consumers spent about $15 billion for dietary supplements and $16 billion for functional foods. However, the system for ensuring the validity of health claims in the United States is eroding, and regulations in most of the rest of the world are even weaker. As a result, consumers are exposed to unfounded claims and allusions to health benefits of foods and supplements. But, that is not a solid basis for long-term commercial success. Sooner or later, consumers will realize that they have been misled. This may explain why the sales of dietary supplements in the United States have seen some decline since their peak years of the mid late 1990s. If governments do not set clear and strict standards for efficacy and safety of functional foods, then the field has no real future.

* * * * * * * *

Food and Nutritional Security through Sustainable Organic Farming

Niyati Thakur[1], Anshuman Klate[1], Shilpa[1], Pawan Kumar Sharma[2*] and Ajit Sharma[1]
[1]Dr. Yashwant Singh Parmar University of Horticulture & Forestry, Nauni, Solan (HP) – 173230
[2]Sher-e-Kashmir University of Agricultural Sciences and Technology (SKUAST) Jammu- 180009
*Corresponding Author: pawanvatsya@gmail.com

Since establishment, the FAO has been dedicated to the crucial goal of ensuring sustainable food security for everyone. This mission was underscored by the World Food Summit (1996) and subsequent meetings and initiatives, including the Right to Adequate Food. Despite significant strides over the past 60 years, the 32nd Session of the Committee on World Food Security in September 2006 acknowledged a sobering reality: the World Food Summit's target of halving the number of hungry people by 2015 would not be met. The number of undernourished individuals has, regrettably, shown little change since 1990-92, even though there has been a decrease in the percentage of undernourished (FAO, 2016).

Food Security in Developing Countries

A substantial majority, specifically 75 per cent, of the 1.2 billion individuals living in poverty globally are concentrated in the rural areas of developing countries. These communities grapple with a myriad of challenges that are intricately tied to subsistence production in geographically isolated and marginalized settings, characterized by a scarcity of advanced technology. The livelihood systems of subsistence farmers and smallholders in these regions are notably susceptible to various risks. Factors such as droughts and floods pose significant threats to agricultural productivity, impacting the ability of these communities to produce enough food for sustenance. Additionally, the prevalence of crop and animal diseases introduces further complications, jeopardizing the health and well-being of both the people and their livestock. Furthermore, the vulnerability of these rural communities extends to market dynamics. Fluctuations in market conditions, including price shocks and unpredictable demand, create additional challenges for those reliant on subsistence and small-scale agriculture. These communities often lack the resilience and resources to navigate such market uncertainties, perpetuating the cycle of poverty. In essence, the complex interplay of geographical isolation, technological limitations, and environmental and market-related risks underscores the formidable obstacles faced by the rural poor in developing countries striving for sustainable livelihoods. Addressing these multifaceted challenges is essential for fostering resilience and promoting lasting improvements in the quality of life for this vulnerable populations.

Organic Agriculture

Organic agriculture has transcended its origins in developed nations and is now a global phenomenon. Commercially practiced in 120 countries, it encompasses 31 million hectares of certified croplands and pastures, constituting approximately 0.7 per cent of the world's agricultural lands (with an average of 4% in the European Union). Additionally, 62 million hectares of certified wild lands are dedicated to organic collection, including bamboo shoots, wild berries, mushrooms, and nuts. While challenging to quantify, it's noteworthy that non-certified organic systems, exemplified by indigenous models adhering to organic principles either intentionally or by default, are prevalent among several million small farmers. These systems likely contribute significantly to subsistence agriculture in developing countries, potentially representing an equivalent share to their certified counterparts.

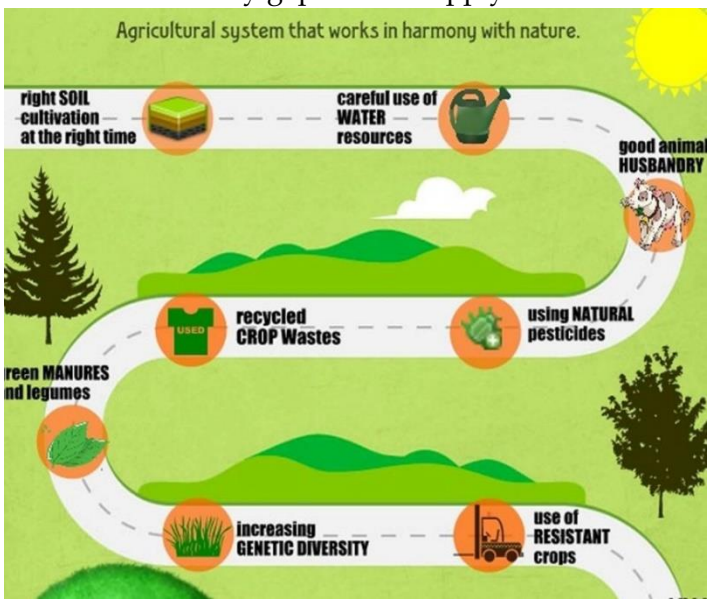
Organic Farming and Benefits

Food Security Dimensions and Organic Agriculture

The multifaceted aspect of food security encompasses dimensions such as food availability, access, stability, and utilization. Organic agriculture presents both advantages and limitations in addressing each of these dimensions, as outlined below. It's crucial to note that the benefits and challenges discussed may vary across different organic farming systems, spanning from non-certified local production to certified systems oriented toward the market, aiming for price premiums.

a) **Food Availability**: Availability in the context of food security involves ensuring an abundant

supply of food with the requisite quality. This encompasses sourcing from domestic production, input channels, and both food aid and net imports. The goal is to maintain a robust and reliable food supply chain that meets the population's needs. It includes a focus on the quality and quantity of domestically produced food, as well as strategic considerations related to external sources, such as food aid and imports, to address any gaps in the supply chain.



Source: https://www.linkedin.com/pulse/8-benefits-organic-farming-s-k-ali/

b) **Food Access**: The dimension of food access in the context of food security pertains to individuals' ability to acquire sufficient resources and entitlements necessary for obtaining appropriate foods to maintain a nutritious diet. It involves ensuring that people have the means and entitlements to access the food they need for a healthy and well-balanced diet. This dimension recognizes the importance of not just food availability but also the economic and social factors that enable individuals to secure the necessary food resources for their well-being.

c) **Food Stability**: Achieving food security requires ensuring that individuals, households, or populations consistently have access to sufficient food without the risk of losing this access due to sudden shocks such as economic or climatic crises, or cyclical events like seasonal food insecurity. In essence, food security means maintaining uninterrupted access to an ample and reliable food supply, even in the face of unexpected challenges or recurring events

d) **Food Utilization**: In context to food security, the utilization dimension pertains to how food contributes to ensuring an adequate diet, clean water, sanitation, and healthcare, ultimately leading to a state of nutritional well-being where all physiological needs are fulfilled.

Contribution of Organic Agriculture to Food and Nutritional Security

A nation achieves food security when it possesses a dependable, stable, and safe food supply capable of meeting basic needs and market demands. It's important to note that achieving food security at the national level does not necessarily eliminate hunger in marginalized regions or prevent negative trade balances due to reliance on food imports. Similarly, at the household level, food security is attained when a household can either produce or acquire sufficient food to fulfill the nutritional requirements of all its members.

a) Contribution to Household Nutrient Intake: Organic farming, through diversification and enhanced productivity on farms, plays a crucial role in alleviating hunger and poverty. By reducing reliance on purchased inputs and fostering a market-oriented approach at the household level, organic systems contribute to income generation. The profitability derived from marketing organic products enables households to shift from traditional staples to high-value alternatives like vegetables. This transition, contingent on factors such as capital investment and agro-ecosystem flexibility, offers substantial returns on both land and labor investments.

b) Contribution to Healthy Diets: While modern food patterns have effectively addressed under nutrition, the specialization of agricultural systems in a few staple foods has intensified

micronutrient deficiencies. Over half of children in developing countries suffer from low dietary diversity and related micronutrient deficiencies, posing a significant public health concern. Traditional approaches, such as supplementation and food fortification, have shown limited efficiency, particularly in reaching vulnerable populations. The promotion of a diverse local food supply accessible to impoverished households has proven a straightforward and successful strategy for tackling malnutrition. Organic farming practices align with this approach, as the viability of an organic field correlates with a diverse agro-ecosystem both spatially and temporally. The cropping diversity in organic fields, featuring rotation crops with high micronutrient and protein content, enriches household diets and health making substantial contribution to addressing "hidden hunger" or dietary micronutrient deficiencies.

c) **Contribution to Food Emergency Situation:** Impoverished households face challenges in managing production risks, prioritizing food security over maximizing yields. Organic fields exhibit reduced yield fluctuations, offering a more secure option in the face of single crop failures, environmental challenges, or socio-economic shocks. Given the escalating impacts of weather extremes, enhancing resilience in agro-ecosystems to weather has become a critical necessity, particularly in economies reliant on agriculture.

d) **Contribution to National Employment:** Agriculture engages 60 per cent of the population in developing countries, a notable contrast to the 1-2 per cent in developed nations. Despite the lower percentage, global social and ecological well-being hinges significantly on agricultural employment. Concerns arise as the adoption of chemicals and machinery in lieu of agricultural labor poses threats to societal stability, including community breakdown, mass migration, and large-scale urbanization. Additionally, this shift has a profound impact on the natural environment. Transposing the industrial food production system from developed to developing countries, where agriculture supports the livelihoods of 2.5 billion people, may escalate displacement, dispossession, and hunger unless viable alternatives are implemented.

e) **Contribution as provider of Global Environment services:** The environmental benefits of organic agriculture primarily result from avoiding the use of polluting substances like nitrogen fertilizers and synthetic pesticides. It also contributes to reduced anthropogenic impacts on desertification, biodiversity erosion, and climate change. There is an increasing urgency to foster skilled agricultural labor through organic practices to transition away from current fossil fuel-dependent agricultural systems while maintaining food production. Organic agriculture holds substantial potential for local sourcing of diverse foods through low-carbon systems and shorter supply chains. Certain food items can be produced more energy-efficiently in specific settings, emphasizing the need for comprehensive energy use indicators to inform consumer choices.

Conclusion

Organic farming significantly contributes to food and nutritional security through its environmentally sustainable practices. By avoiding harmful substances like synthetic pesticides and nitrogen fertilizers, organic farming minimizes environmental damage and addresses issues such as land degradation, water pollution, and biodiversity loss associated with conventional agriculture. Its lower environmental costs and potential to reverse natural degradation underscore its crucial role in building a resilient and sustainable global food system. Organic farming also promotes food security by advocating for diversified local sourcing, emphasizing low-carbon systems and shorter supply chains. This approach not only addresses climate

change concerns but also strengthens local communities and economies. The capacity of organic agriculture to enhance food availability and access, particularly in regions facing severe poverty and hunger, highlights its pivotal role in global food security.

Despite its limitations, organic agriculture's positive impact on nutrition, reduced environmental footprint, and support for local economies positions it as an essential component of a comprehensive strategy for achieving sustainable food and nutritional security. In the face of challenges like population growth, climate variability, and globalization, embracing organic farming practices becomes increasingly vital for the well-being of both current and future generations.

References

Badgley C, Moghtader J, Quintero E, Zakem E, Chappell J, Samulon A, Perfecto I. 20019. Organic Agriculture and the Global Food Supply. Renewable Agriculture and Food Systems.

Byerlee, D. & Alex, G. 2005. Organic Farming: a Contribution to Sustainable Poverty Alleviation in Developing Countries? In German NGO Forum on Environment and Development, Bonn. Misereor, Naturland, EED, NABU and WWF.

FAO, 2001. Organically Produced Foods. Joint FAO/WHO Food Standards Programme, Codex Alimentarius Commission, GL 32: 1999, Rev. 1: 2001.

FAO. 2016. World Agriculture: Towards 2030/2050 Interim Report. Global Perspective Studies Unit. Rome.

FAO. 2020. Assessment of the World Food Security Situation, Rome.

Halberg N, Alroe HF, Knudsen MT, Kristensen ES. 2007. Global Development of Organic Agriculture: Challenges and Prospects. CABI Publishing.

Richard S. 2016. A Market Road to Sustainable Agriculture? Ecological Agriculture, Green Food and Organic Agriculture in China. In: Development and Change 37(1): 201-226. Institute of Social Studies 2006. Blackwell Publishing, USA.

Scialabba N, Williamson, D. 2014. The Scope of Organic Agriculture, Sustainable Forest management and Ecoforestry in Protected Area Management. Environment and Natural Resources Series, Working Paper no. 18, FAO.

Soil Association. 2022. Organic works. Providing More Jobs through Organic Farming and Local Food Supply. Edinburgh, Scotland.

Thomas H. 2016. Trade Reforms and Food Security: Country Case Studies and Synthesis. FAO.

Willer H, Youssefi M. 2007. The World of Organic Agriculture Statistics and Emerging Trends 2007.International Federation of Organic Agriculture Movements IFOAM, Bonn, Germany and Research Institute of Organic Agriculture FiBL, Ackerstrasse, Switzerland.

World Food Summit. 1996. Rome Declaration on World Food Security and World Food Summit Plan of Action. FAO, Rome.

* * * * * * * *

Superfoods: Separating Fact from Fiction - A Critical Analysis of Nutritional Hype

Kirtigha R
M. Tech Scholar, Department of Food Technology, Faculty of Engineering and Technology,
JAIN (Deemed- to-be University), Bengaluru, Karnataka, India
*Corresponding Author: rkirtigha@gmail.com

In a world where fad diets and health trends come and go with the seasons, the term "superfood" has gained considerable traction. We are bombarded with messages touting the miraculous health benefits of exotic fruits, ancient grains, and rare herbs. But is there any substance behind the superfood hype, or is it just another marketing ploy to sell expensive products? This article takes a critical look at the concept of superfoods, aiming to separate fact from fiction.

Understanding Superfoods

The term "superfood" is often used to describe foods that are exceptionally rich in nutrients, particularly those with purported health benefits. Superfoods are typically marketed as dietary powerhouses that can help with weight loss, disease prevention, and overall well-being. They are foods that are particularly rich in vitamins, minerals, antioxidants, and other beneficial compounds. However, it's essential to understand that there is no universally agreed-upon definition of superfoods. This lack of standardization creates an environment where marketing and consumer perceptions often outpace scientific evidence.

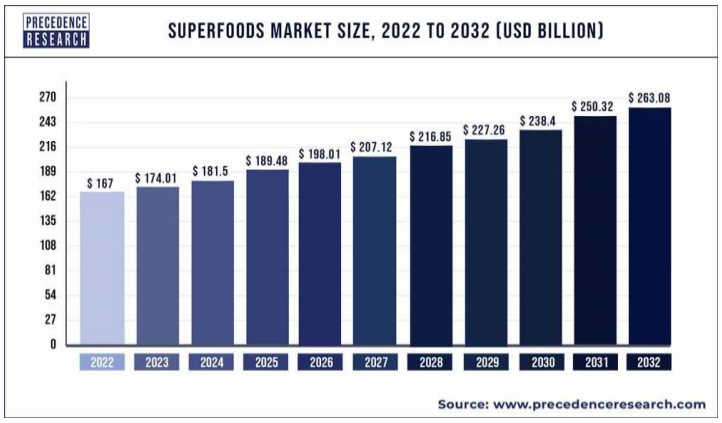
The Problem with Superfood Marketing

One of the main issues with superfoods is the marketing hype surrounding them. Often, products labelled as superfoods are sold at premium prices, leading consumers to believe they are making a substantial investment in their health. But this marketing strategy can be misleading and costly. Many common foods, which do not carry the superfood label, are equally nutritious and can be a more cost-effective way to improve one's diet.

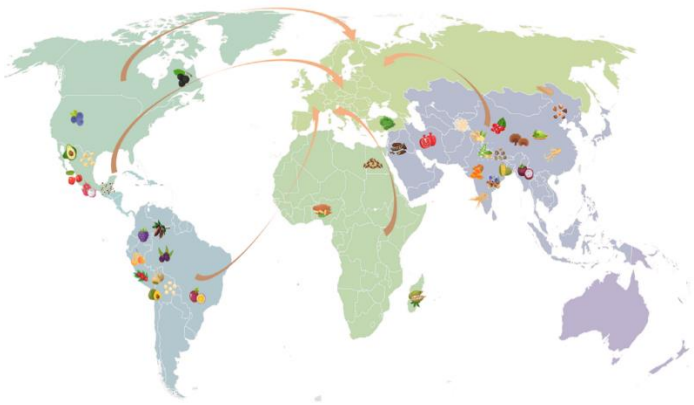
The Role of Balanced Nutrition

While superfoods offer distinct nutritional advantages, it is vital to emphasize that they are most effective when integrated into a balanced and diversified diet. No single superfood can provide the full spectrum of nutrients required for optimal health. A well-rounded dietary pattern that encompasses a variety of whole foods from different food groups is indispensable for fulfilling nutritional needs.

Marketing Consideration



The total revenue of the world market for superfoods was estimated at US$ 167 billion in 2022 and is projected to reach approximately US$ 263.08 billion by 2032, with a CAGR (compound annual growth rate) of 4.7% from 2023 to 2032. Superfoods are not exempt from marketing strategies that sometimes inflate their significance. Superfoods are often celebrated for their exceptional nutrient density, rich in vitamins, minerals, antioxidants, and other beneficial compounds. This nutritional richness makes them a natural focal point for marketing campaigns aimed at health-conscious consumers. Moreover, superfoods are associated with specific health claims, such as improved cognitive function, heart health, and disease prevention, which serve as persuasive selling points. In the context of prevailing wellness trends, where consumers are increasingly seeking natural, whole-food-based solutions for their health concerns, superfoods perfectly align with the current zeitgeist. The term "superfood" itself carries an intrinsic positive connotation, immediately fostering the perception of enhanced nutritional value. Consequently, superfood marketing can create a strong appeal that resonates with consumers, encouraging them to explore and incorporate these foods into their diets worldwide.



Scientific Basis vs. Anecdotal Evidence

Superfood claims often rely on anecdotal evidence and testimonials from individuals who have experienced health improvements after incorporating these foods into their diets. While these personal stories can be compelling, they are not a substitute for rigorous scientific research. Many superfoods are indeed packed with beneficial nutrients, such as antioxidants, vitamins, and minerals. However, the mere presence of these nutrients does not automatically translate into the promised health benefits. Scientific studies are essential to validate any health claims associated with superfoods.

A Few Superfood Stars

Despite the skepticism surrounding the term "superfood," some foods do stand out as nutrition powerhouses. These include:

1. **Berries:** Blueberries, strawberries, and blackberries are rich in antioxidants and have been linked to various health benefits, including improved cognitive function and heart health.
2. **Leafy Greens:** Spinach, kale, and Swiss chard are excellent sources of vitamins, minerals, and fibre, which support overall health and reduce the risk of chronic diseases.
3. **Nuts and Seeds:** Almonds, walnuts, flaxseeds, and chia seeds are nutrient-dense and provide essential fats, protein, and fibre.
4. **Fatty Fish:** Salmon, mackerel, and sardines are packed with omega-3 fatty acids, which are crucial for heart and brain health.
5. **Moringa:** Moringa oleifera, often referred to as the "drumstick tree" or "miracle tree," has gained popularity for its exceptional nutrient profile. It's rich in vitamins, minerals, antioxidants, and plant compounds. Moringa is known for its potential anti-inflammatory and antioxidant properties.
6. **Matcha:** Matcha is a type of green tea that is ground into a fine powder. It's packed with antioxidants, notably catechins, and provides a concentrated source of L-theanine, which may have calming and cognitive-enhancing effects. Matcha has been associated with increased metabolism and potential benefits for weight management.
7. **Turmeric's Continued Rise:** Turmeric and its active compound, curcumin, remain in the spotlight due to their powerful anti-inflammatory and antioxidant properties. Research on curcumin's potential benefits for various health conditions continues to emerge.

These foods have a solid foundation of scientific evidence supporting their nutritional benefits, but it's essential to remember that they're just a part of a balanced diet. There is no single food that can provide all the nutrients your body needs.

Balanced Diet vs. Superfood Obsession

The key to a healthy diet is balance and variety. Relying solely on a handful of superfoods will not provide all the nutrients your body requires. A well-rounded diet that includes a wide range of fruits, vegetables, whole grains, lean proteins, and healthy fats is the best way to ensure you're getting all the essential nutrients.

Rather than obsessing over individual superfoods, it's more meaningful to focus on dietary patterns. The Mediterranean diet, for example, emphasizes whole foods like vegetables, fruits, whole grains, and healthy fats. This approach has been linked to numerous health benefits, including a reduced risk of heart disease.

Incorporating Superfoods into a Nutrient-Rich Diet

To optimize the potential benefits of superfoods, it's crucial to integrate them into a dietary

approach that prioritizes three key principles. First, diversity is paramount, emphasizing the consumption of a wide range of nutrient-dense foods spanning various food groups to ensure a comprehensive intake of essential nutrients. Second, maintaining balance is essential, with a focus on distributing macronutrients (carbohydrates, proteins, fats) and micronutrients (vitamins and minerals) harmoniously within your diet. Lastly, moderation plays a pivotal role; superfoods should be enjoyed as part of a well-balanced dietary plan, avoiding excess consumption that might disrupt the delicate balance of nutrients in your overall diet. This holistic approach ensures that the remarkable potential of superfoods is fully realized within the broader context of a nutritionally sound lifestyle.

Conclusion

While some foods are undoubtedly more nutrient-dense than others, the concept of superfoods is often more about marketing than science. Rather than getting caught up in the hype surrounding specific foods, it's wise to adopt a more balanced and evidence-based approach to nutrition. Incorporate a wide variety of whole, minimally processed foods into your diet to ensure that you're receiving a broad spectrum of essential nutrients. By focusing on dietary patterns rather than individual superfoods, you'll be on a more sustainable and scientifically supported path to good health. Remember, there's no magic food that can replace the benefits of a well-rounded and balanced diet.

References

Wolfe, D. (2009). Superfoods: the food and medicine of the future. North Atlantic Books.

Fernández-Ríos, A., Laso, J., Hoehn, D., Amo-Setién, F. J., Abajas-Bustillo, R., Ortego, C., ... & Margallo, M. (2022). A critical review of superfoods from a holistic nutritional and environmental approach. Journal of Cleaner Production, 134491.

Llorent-Martínez, E. J., Fernández-de Córdova, M. L., Ortega-Barrales, P., & Ruiz-Medina, A. (2013). Characterization and comparison of the chemical composition of exotic superfoods. Microchemical Journal, 110, 444-451.

Franco Lucas, B., Costa, J. A. V., & Brunner, T. A. (2021). Superfoods: drivers for consumption. Journal of Food Products Marketing, 27(1), 1-9.

* * * * * * * *

Food Additives

Bishnupriya Rout[1] and Neetu Yadav[2]
[1]Department of Nutrition & Dietetics, GD Goenka University, Sohna,
[2]Department of Food & Nutrition, CCHSAU, Hisar, (125005)
*Corresponding Author: bishnupriya2809@gmail.com, neetuhr75@gmail.com

Food additives are chemicals substances used in the foods to keep them fresh or to enhance their color, flavor, appearance or texture. They may include food colorings (similar as tartrazine), flavor enhancers (similar as MSG) or a range of preservatives. Additives like salt, spices, and sulfites have been used since ancient times to maintain foods and make them more palatable. Numerous modern products, similar as low- calorie snack, and ready- to- eat convenience foods, would not be possible without food additives.

There are four general orders of food additives that is

1. Processing agents
2. Nutritive additives
3. Sensitive agents and
4. Preservatives.

Food additives are always included in the component lists of foods in which they're used. Product tags must identify both the function of the additive in the finished food (e.g., color, preservative) and the specific substance used either by applying to the proper E number or its name (e.g., E 415 or Xanthan goo).

The FDA maintains a database of nearly 4,000 constituents, entitled" Substances Added to Food." Here's a glance at a many groups and constituents generally used in the food supply and what they do:

Emulsifiers

Emulsifiers are added to oil and water- based fusions to help keep them blended together. Exemplifications of mixes in everyday foods include vinaigrette dressings, milk and mayonnaise. These frequently are used in marketable bread doughs, artificial whipped creams and dried, liquid or frozen egg whites.

Stabilizers, Thickeners and Gelling Agents

These are extensively used across numerous food product orders to enhance stability and produce a invariant texture by averting emulsions from separating, ice crystals from forming and constituents from settling. Example arrowroot, corn, guar, collagen, gelatin, agar- agar, pectin etc.

Anti-caking Agents

Anti-caking agents are added to ground or granulated constituents similar as powdered milks, egg mixes, sugar products, flours and baking mixes to avert lumping, crusting or sticking. Exemplar calcium phosphates, silicon dioxide, silicates, stearic acidic.

Leavening Agents

Leavening agents are incorporated into doughs and batters to increase the volume, shape and texture. Common leavening agents include baking powder, beer, buttermilk, yeast, whey protein concentrate and yogurt. Used in a wide variety of sweet and savory products, these leavening agents can be set up in croquettes, cookies, breads, biscuits, scones, muffins and soda pop chuck.

Artificial Food Coloring

AFC is used to buck up and enhance the appearance of everything from delicacies to seasonings. Specific food colorings like Blue 1, Red 40, Yellow 5 and Yellow 6 have been associated with allergic responses in some people. Anyhow, food colorings are set up primarily in processed foods, which should be limited in a healthy diet. Always choose for whole foods, which are advanced in important nutrients and naturally free of artificial food coloring.

Sodium Nitrite

Constantly found in processed flesh, sodium nitrite acts as a preservative to avert the growth of bacteria while also adding a salty flavor and reddish-pink color. When exposed to high heat and in the presence of amino acids, nitrites can turn into nitrosamine, an emulsion that can have numerous negative effects on health.

Still, it's must to keep your input of sodium nitrite and processed flesh to a minimum. Try switching out processed flesh like bacon, sausage, hot

dogs and ham for natural meat and healthy sources of protein.

Chicken, beef, fish, pork, legumes, nuts, eggs and tempeh are just a many delish high- protein foods that you can add to your diet in place of processed flesh.

Artificial Sweeteners

Artificial sweeteners are used in numerous diet foods and drinkables to enhance sweetness while reducing calorie content. Common types of artificial sweeteners include aspartame, sucralose, saccharin and acesulfame potassium.

Note that certain types of artificial sweeteners like aspartame may affect headaches in some people, and studies show that certain individualities may be more sensitive to its effects. Still, artificial sweeteners are generally considered safe for utmost people when consumed in temperance.

Trans Fat

Trans fats are a type of unsaturated fat that have undergone hydrogenation, which increases shelf life and improves the density of products. It can be set up in numerous types of processed foods like baked goods, margarine, microwave oven popcorn and biscuits.

A number of possible health threats have been associated with trans- fat input, in particular, multiple studies have linked an advanced input of trans fats to a advanced threat of heart complaint.

Numerous studies set up that eating foods high in trans fats increased several labels of inflammation, which is one of the major threat factors for heart complaint. Many research shows that there can be a connection between diabetes & trans fats. Cutting reused foods out of your diet is the easiest and most effective way to drop your trans- fat input.

Function of Food additives

Food additives serve 5 main functions. They are

Give the food a smooth and compatible texture

- Emulsifiers help liquid products from separating.
- Stabilizers and thickeners give an even texture.
- Anticaking agents plays a huge role as it allow substances to flow freely.

Enhance or conserve the nutrient value

- Numerous foods and drinks are fortified and improved to give vitamins, minerals, and other nutrients. exemplifications of usually fortified foods are flour, cereal, margarine, and milk. This can compensate those micronutrient losses that may be low or lacking in a person's diet.
- All products that contain added nutrients must be labeled.

Wholeness of foods should be maintained

- Bacteria and other origins can bring on foodborne illnesses. Preservatives reduce the decomposition that these germs can bring on.
- Certain preservatives help save the flavor in baked goods by preventing the fats and oils from going bad.
- Preservatives also keep fresh fruits from turning brown when they're exposed to the air.
- Control the acid- base balance of foods and give leavening
- Certain additives help change the acid- base balance of foods to get a certain flavor or color.
- Leavening agents that release acids when they're heated respond with baking soda to help biscuits, croquettes, and other baked goods rise.

Give color and enhance flavors

- Few coloring agents enhance the appearance of foods.
- numerous spices, as well as natural and man-made flavors, bring out the taste of food.

Side Effects

Maximum concerns about food additives have to do with man- made constituents that are added to foods. Some of these are

- Antibiotics given to food- producing creatures, similar as chickens and cows
- Antioxidants in oily or fatty foods
- Artificial sweeteners, similar as aspartame, saccharin, sodium cyclamate, and sucralose
- Benzoic acid in fruit juices

- Some components of food stabilizers and emulsifiers are Lecithin, gelatins, cornstarch, waxes, gums, and propylene glycol
- Numerous different colorings and coloring substances
- Monosodium glutamate (MSG)
- Nitrates and nitrites in processed meat & poultry products
- Sulfites in beer, wine, and packaged vegetables

Conclusion

While certain food additives have been linked to some huge side effects, there are lots of others that can be safely consumed as part of a healthy diet. It is important to start reading the component markers when grocery shopping to take control of diet and determine what's really being added in foods also, try cutting back on processed and packaged foods and incorporating further fresh constituents into the diet to minimize the input of food additives.

If there is any food additive sensitivity it is strictly prescribed to seek medical support as it may cause serious problems if not treated properly. It is also helpful if one maintains good dairy to note all symptoms caused by additives. It is important to collect information of food additives for their proper usage.

* * * * * * * *

Development of Brown Rice Burfi Enriched with Groundnut and Pistachios

Shanthala P[1], Vidyashree M[2], Chandana[2], LCV Lan Ramsan[2] and Gruhika Lotlikar
[1]Assistant professor, Department of food processing and nutraceuticals, Padmashree Institute of Management and sciences, (Affiliated to Bangalore University), Bengaluru, Karnataka, India
[2]Department of food and Nutrition, Padmashree Institute of management and Sciences, Bengaluru, India
*Corresponding Author: shanthalamudholkar@gmail.com

Abstract

Burfi is made from milk, jaggery, dry fruits and some unique ingredients like brown rice and peanuts. Brown rice is made from entire grains that have had their outer, inedible hulls removed. This variety of rice loses its outer husk or hull, but the bran and germ layer stay on the grain, giving it its brown colour or tan. Brown rice generally needs longer cooking times than white rice, unless it is broken. Brown rice contains bran layers that are usually removed from white rice. This indicates that brown rice has beneficial phytochemicals such as fibre, minerals, flavonoids, and vital amino acids. Burfi comes in a variety of forms, depending on the ingredients that are added to it. For example, besan burfi, made from gram flour, kaaju burfi, made from cashews, and pista burfi, made from pistachios. Incorporating nutritious ingredients like brown rice and peanuts into burfi can provide some physiological benefits as it helps in weight loss, Controls blood sugar, and cholesterol, supports digestion and prevents anaemia. Groundnuts and brown rice both offer nutritional qualities that are abundant in proteins and carbohydrates, which enhance health benefits.

Keywords Brown Rice, Groundnut, flavonoids

Introduction

The most popular milk sweet in India is burfi, which is made from khoa and has an odour of white to light cream. It has a firm body and smooth to granular texture and is made with khoa [1]. It has a colour range of white to light cream, a firm structure, and a smooth texture, with very fine grains. The addition of sugar or jaggery in different proportions and other ingredients is determined by the consumer's demand. Market samples of burfi exhibit a wide range of chemical composition, sensory, and rheological characteristics. The absence of legal standards is a cause of large variations in market samples. The chemical composition of burfi depends on the quality and composition of the milk, the amount of sugar, jaggery and other ingredients, and the degree of dehydration [2]. Depending on the additives present, different types of burfi are sold in the market, such as plain mawa, pista, nutty, chocolate, coconut, rawa burfi, etc., depending on the raw materials used to manufacture the product. (Figure 1)

Fig. 1: Varieties of burfi are sold in the market

The basis of all these types of burfi is khoa and sugarcane, blended in different proportions. It also contains other ingredients to give it a special taste. In some parts of the country, chhana is also used as a material to replace part of the khoa. Burfi has special significance in social celebrations and expressions of joy and happiness on various occasions. Traditional milk products are made from 50 to 55 percent of the milk produced in India. [3] High in fibre and rich in nutrients is brown rice. Brown rice still has the bran layers that are usually removed from white rice. This indicates that brown rice has beneficial phytochemicals such as fibre, minerals, flavonoids, and vital amino acids [4]. Burfi comes in a variety of forms, depending on the ingredients that are added to it. For example, besan burfi, made from gram flour, kaaju burfi, made from cashews, and pista burfi, made from pistachios. Other variations include mango burfi, coconut burfi, and cardamom burfi [5].

New product development is essential to the growth of the dairy and food industries. Many options are available to supplement milk with other nutrients and health-promoting factors, including fruits, vegetables, and grains such as brown rice, millet grains, and legumes. Milk is primarily fortified with non-dairy ingredients to enhance its sensory properties and enhance its health benefits [6]. Incorporating nutritious ingredients like brown rice and peanuts into burfi can provide some physiological benefits as it helps in weight loss., Controls blood sugar, cholesterol, supports digestion, prevents anaemia thanks to increased protein content, jaggery purifies the body.

Materials and methods

Materials

The present product development was carried out at MSc Food and Nutrition laboratory, Padmashree Institute of management and sciences, Banglore. Raw ingredients like Brown rice, Coconut grate, Water, Ghee, Cardamom powder, Salt, Jaggery Powder, Ground nut and Pistachios.

Methodology

Step 1 Soaking

Soak 1 cup brown rice for 2 hours in a clean stainless-steel vessel, after 2 h drains off the water (fig 2).

Fig 2: Soaking of brown rice

Step 2 Grinding

Then grind rice with I cup grated coconut, 1/4 teaspoon salt to a very fine paste by adding little water (fig 3).

Fig. 3: Grinding of rice with coconut

Step 3 Heating

In a large kadai take I cup sugar and 2 cup water, heat the content in an induction stir well until the jaggery dissolves completely (fig 4).

- Now add rice coconut paste, I cup water (l: 3 proportion) and ¼ teaspoon of cardamom powder and 20 g of ground nut powder, mix well.

Fig 4: Heating of brown rice along with jaggery

- Keep on low-medium flame and add 2 teaspoon ghee and stir the mixture continuously ensuring that no lumps are formed. After 15-20 min it starts leaving the sides of kadai.

Step 4 Spreading

Grease a plate with ghee and transfer this mixture to the plate spreading uniformly and decorate with pista (fig 5), leave it for 30 minutes.

Fig 5: Spreading the mixture on a plate

Step 5 Freezing

Transfer it into refrigerator under freezing condition.

Step 6 Cutting

Cut into desired shape and decorate with cashew and serve (fig 6).

Fig 6: Cutting with desired shapes

Step 7 Packaging

Burfi packed in tins and stored at 30°C ±10°C was good for 150 days, packaging in polyethylene pouches enhanced the shelf life of burfi up to 90 days.

Nutritional benefits

- Brown rice is a good source of magnesium. It aids bone development, muscle contractions, nerve functioning, wound healing, and even blood sugar regulation. Furthermore, brown rice is a good source of riboflavin, iron, potassium, and folate.[7] Brown rice may also help improve blood sugar control by aiding weight loss. [8].
- Bioactive components like phenolic compounds, stilbenes, lignin's, and isoflavonoids in the composition of peanuts reduce oxidative stress and inflammation caused by free radicals in the body. Thus, peanut consumption effectively prevents chronic diseases like cardiovascular diseases, diabetes, and cancer. The dry roasting and oil-roasting methods affect the peanuts' phytosterol content similar extent. A study showed that the total phytosterol content of oil roasted and dry roasted peanuts are 137 mg/100g and 135 mg/100g, respectively [9].
- Jaggery is rich in minerals [10] [11] and contains high amount of phenol [12] It improves digestion, relieves constipation, relives tension [13] boosts energy, purifies the blood [14] anti-toxic and anti-carcinogenic properties [15] treatment of bronchial or lung infections and pre-menstrual syndrome (PMS) [16] anti-oxidant activity [17]. Pistachios are one of the most vitamin B6-rich foods available. Vitamin B6 is important for several bodily functions, including blood sugar regulation and the formation of haemoglobin, a molecule that carries oxygen in red blood cells [18].
- The Cashew part contains fibre, carrying more fibre into the diet brings down the level of cholesterol and the danger of heart disease prominently, which is known as heart nibble. The fibre in the digestive tract lessens the assimilation of cholesterol from food consumption. Ordinary use of these nuts, as a feature of a low-soaked fat eating routine, can bring down the danger of coronary disease overall by advantageously influencing the cholesterol levels in blood and can reduce the risk of having a subsequent respiratory & cardiovascular failure [19]
- Dried coconut or coconut water used to make burfi is a rich source of water-soluble vitamins, including ascorbic acid (vitamin C), thiamine, riboflavin, niacin, pantothenic acid, pyridoxine and folic acid.[20]

Conclusions

Burfi is one of the indigenous dairy products and is a very nutritious product as it contains most of the milk solids in concentrated form, easily digestible carbohydrates and a variety of ingredients. It basically has a light caramel flavour. Its colour can vary from light creamy white to light brown. Burfi is characterized by a moderately sweet taste, a soft and slightly oily body, and a smooth texture with very fine particles. Burfi's nutritional value can be increased by adding ingredients such brown rice, milk, groundnuts, coconut, and pistachios, all of which have positive health effects. Analyses how the Indian sweet

product business is evolving in light of the country's expanding variety of burfi products supply, globalisation, private sector's entry into the market, and increased consumer demand for value-oriented goods.

Acknowledgements

I sincerely express my heartfelt thanks to Padmashree Institute of Management and Sciences for providing the facilities required for publication. I also extend my gratitude to Dr. Anuradha M, Principal, Padmashree Institute of Management and Sciences, Banglore, Karnataka.

References

1. Banerjee, A.K. (1997) Processes for commercial production, Dairy India 5th edn. Published by PR Gupta, New Delhi, India, pp. 387
2. Sachdeva, S. and Rajorhia G.S. (1982). Studies on the technology and shelf life of Burfi. India J. Dairy Sci., 35(6):513-517
3. Aneja, R.P. 1992. Traditional milk specialties. A survey, Dairy India. 4 th annual edn. P.259
4. Ravichanthiran, K., Ma, Z. F., Zhang, H., Cao, Y., Wang, C. W., Muhammad, S., ... & Pan, B. (2018). Phytochemical profile of brown rice and its nutrigenomic implications. Antioxidants, 7(6), 71
5. Navale, A. S., Deshmukh, B. R., Korake, R. L., Narwade, S. G. and P.R. Mule (2014). Production profile, proximate composition, sensory evaluation and cost configuration of wood apple burfi. Animal Science Reporter 8 (3): 114-120
6. (Vyawahare, A. N., Meshram, B. D., Gawande, H. M., & Kanoje, R. R. (2022):1-5). The development of burfi with date paste
7. Gröber, U., Schmidt, J., & Kisters, K. (2015). Magnesium in prevention and therapy. Nutrients, 7(9), 8199-8226
8. Kozuka, C., Yabiku, K., Takayama, C., Matsushita, M., Shimabukuro, M., & Masuzaki, H. (2013). Natural food science based novel approach toward prevention and treatment of obesity and type 2 diabetes: recent studies on brown rice and γ-oryzanol. Obesity Research & Clinical Practice, 7(3), e165-e172.
9. Phillips, K. M., Ruggio, D. M., & Ashraf-Khorassani, M. (2005). Phytosterol composition of nuts and seeds commonly consumed in the United States. Journal of agricultural and food chemistry, 53(24), 9436-9445
10. Gautam C, Saha L, Sekhri K, Saha P. "Iron deficiency in pregnancy and the rationality of iron supplements prescribed during pregnancy", Medscape Journal of Medicine, 2008;10(12):283.
11. Laires MJ, Monteiro CP, Bicho M. "Role of cellular magnesium in health and human disease", Frontiers in Bioscience, 2004;9:262-276
12. Nayaka HM, Sathisha UV, Manohar MP, Chandrashekar KB, Shylaja DM. "Cytoprotectivity and antioxidant activity studies]
13. Singh J. Nutritive and Eco-friendly jiggery. In: J. Singh, and R.D. Singh (ed), "Processing, handling and storage of sugarcane jiggery", IISR, Lucknow, India, 2008,3-10
14. Veldhyyzen-van Z. "New uses for panela", Food Chain, 1999;25:11-13
15. Rao J, Das M, Das S. "Jaggery- A traditional Indian sweetener", Indian Journal of Traditional Knowledge, 2007;6(1):95-102,
16. Jadhav N, Bhutani K. "Ayurveda and gynecological disorders", Journal of Ethnopharmacology, 2005;97:151- 159
17. Shah SV, Baliga R, Rajapurkar M, Fonseca VA. "Oxidants in chronic kidney disease", Journal of American Society for Nephrology, 2007;18:16-28
18. Vitamin, D. (2017). Fact sheet for health professionals. Natl. Institutes Heal. Off. Diet. Suppl. Available online https//ods. od. nih. gov/factsheets/VitaminC-HealthProfessional
19. Allen, K. G., L. M. Klevay, et al. (1977). "The zinc and copper content of seeds and nuts.
20. Parmar, P. T., Singh, A. K., & Borad, S. G. (2021). Coconut (Cocos nucifera). Oilseeds: Health Attributes and Food Applications, 163-189.

* * * * * * * *

Onions: More Than Just a Flavourful Ingredient

Riya Pandey[1], Swagat Ranjan Behera[1] and Gayatri Chatterjee[2]
[1]Ph. D. Scholar, Department of Vegetable Science, College of Agriculture, G. B. Pant University of Agriculture and Technology, Pantnagar, Uttarakhand
[2]Ph. D. Scholar, Department of Vegetable Science, College of Agriculture, Bihar Agricultural University, Sabour, Bihar
*Corresponding Author: pandeyriya510@gmail.com

Onions, often referred to as the "backbone of flavour" in many culinary traditions, are a versatile and essential ingredient in kitchens around the world. Beyond their role in adding taste and aroma to dishes, onions have long been appreciated for their numerous health benefits. These flavourful bulbs are rich in vitamins, minerals, antioxidants and other bioactive compounds that make them a valuable addition to a balanced diet. This article explores the nutritional profile of onions, their health-promoting properties and how they can be a valuable addition to a balanced diet.

The nutritional profile of onions

Onions come in various colours and types, including yellow, red and white, each with slightly different nutrient compositions. However, all onions share a common nutritional profile characterized by low calories, minimal fat and a wealth of essential nutrients.

Low in calories and fat: One cup (approximately 160 grams) of chopped (red) onions contains only about 64 calories and less than 1 gram of fat, making them a low-calorie and low-fat addition to meals.

Carbohydrates and fibre: Onions are a good source of carbohydrates, primarily in the form of natural sugars, including fructose and glucose. However, what makes onions stand out nutritionally is their fibre content. One cup of chopped onions provides approximately 3 grams of dietary fibre, which is essential for digestive health, regulating blood sugar levels and supporting weight management.

Vitamins: Onions are a notable source of several essential vitamins, including:

i. **Vitamin C:** A potent antioxidant, vitamin C plays a crucial role in immune support, collagen synthesis, and overall skin health. One cup of chopped onions can provide about 12 per cent of the recommended daily intake of vitamin C.

ii. **Vitamin B_6:** This vitamin is involved in various metabolic processes, including the production of neurotransmitters and red blood cells. Onions offer a moderate amount of vitamin B6, contributing to overall health.

Minerals: Onions contain a variety of minerals, with potassium, folate, and manganese being the most prominent:

i. **Potassium:** This mineral is essential for maintaining healthy blood pressure and regulating fluid balance in the body.

ii. **Folate (Vitamin B_9):** Onions are a good source of folate, an important nutrient for DNA synthesis and cell growth. Adequate folate intake is especially crucial for pregnant women to prevent neural tube defects in their infants.

iii. **Manganese:** Manganese is involved in various enzymatic reactions in the body and plays a role in bone formation and antioxidant defence.

Antioxidants: Onions are rich in antioxidants, particularly quercetin, which is a flavonoid with numerous health benefits. Quercetin helps protect cells from oxidative damage, reduces inflammation and supports cardiovascular health. The outer layers of onions, especially in red and purple varieties, tend to have higher quercetin concentrations.

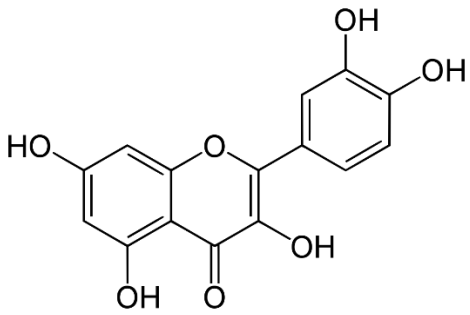


Fig. 1: Chemical structure of quercetin

Health benefits of onions

The consumption of onions has been associated with a range of health benefits, supported by scientific research:

a) **Heart health:** Onions have demonstrated heart-protective properties due to their rich quercetin content and ability to improve various cardiovascular risk factors. Studies have shown that regular onion consumption in moderate (<200 g per week) or large amounts (>600 g per week) may help lower blood pressure, reduce LDL cholesterol levels and tendency to form blood clots, and improve overall heart health. It is known to benefit in the prevention and treatment of atherosclerosis and coronary heart disease. Numerous tests of onion extract *in vitro* have shown that they can inhibit the aggregation of human blood platelets responsible for arterial blocking.

b) **Antioxidant and anti-inflammatory effects:** Quercetin, along with other antioxidants in onions, can fight oxidative stress and inflammation in the body. These properties have been linked to a reduced risk of chronic diseases, including certain types of cancer and neurodegenerative conditions.

c) **Immune support:** The vitamin C in onions is essential for a healthy immune system. It helps the body produce and maintain white blood cells, which are critical in the defence against various infections.

d) **Digestive health:** The dietary fibre in onions supports digestive health by promoting regular bowel movements and preventing constipation. It also acts as a prebiotic, nourishing the beneficial bacteria in the gut.

e) **Blood sugar regulation:** Onions may have a positive impact on blood sugar control, making them a suitable dietary choice for individuals with diabetes or those at risk of developing the condition. Studies have shown that certain compounds in onions can help lower blood glucose levels.

Incorporating onions into your diet

Including onions in your diet is easy and can enhance the flavour and nutritional value of your meals. Here are some practical ways to incorporate onions into your daily eating habits:

Fig. 2: Raw onion salad

Fig. 3: Caramelised onions

Fig. 4: Roasted onions

Fig. 5: Onion pickle

Fig. 6: Onion soup

Fig. 7: Grilled onions

Fig. 8: Onion salsa

i. **Raw in salads:** Thinly sliced raw onions can be added to salads for a crunchy and flavourful element.

ii. **Sautéed or caramelised:** Sautéed or caramelised onions can be used as a base for various dishes, such as soups, sauces and stir-fries.

iii. **Roasted:** Roasting onions brings out their natural sweetness and can be a delicious side dish on its own or as part of a roasted vegetable medley.

iv. **Pickled:** Pickled onions make a tangy condiment for sandwiches and burgers.

v. **Soups and stews:** Chopped onions are a common ingredient in soups and stews, adding depth and flavour to these dishes.

vi. **Grilled:** Grilled onions can be a delightful addition to burgers, sandwiches, or as a side dish.

vii. **Home Made Salsas:** Onions are a key ingredient in many salsas and can be customised to suit your taste preferences.

It is, however, important to note that onions have a strong and distinct flavour, and the choice of onion variety (yellow, red, or white) can impact the overall taste of a dish. Mostly, the Indians prefer red and pungent types, while in Japan, Europe and America, yellow-coloured varieties are preferred.

Conclusion

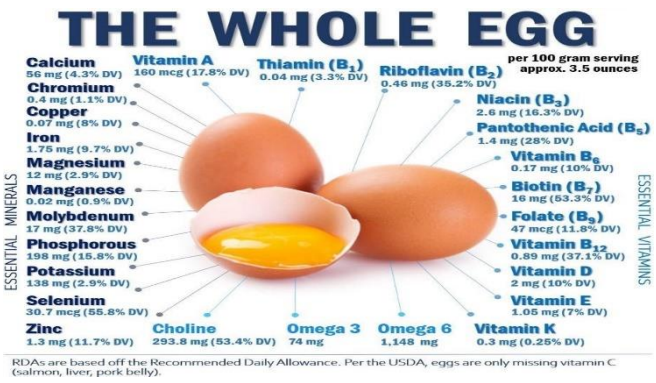
Onions, with their unique flavour and numerous nutritional benefits, are a valuable addition to a balanced diet. Their low calorie and fat content, combined with a rich supply of vitamins, minerals, fibre and antioxidants, make them an excellent choice for promoting overall health and well-being. Scientific research supports the positive effects of onions on heart health, antioxidant defence, immune support, digestive health and blood sugar regulation. Incorporating onions into your diet can be easily accomplished through a variety of cooking methods, whether they are sautéed, roasted, grilled, or enjoyed raw in salads and salsas. By making onions a regular part of your meals, you not only enhance the flavour of your dishes but also take a step toward better health.

* * * * * * * *

Egg: The Superfood

C. Devadarshini and Soumya Sucharita Sahoo
Dept. of Food and Nutrition College of Community Science, OUAT, Bhubaneswar
*Corresponding Author: chitramickey@gmail.com

'Superfoods' are the food items having exceptionally high nutrient density that providesnutritional as well as protective health benefits. Vegetables such as beans, spinach, kale, cauliflower, broccoli, parsley, lettuce leaves etc., oats, berries, salmon, egg are the most commonly known superfoods available in the market nowadays. Present day dietary pattern of people focuses on consumption of food from both vegetarian and non-vegetarian sources to lead a life with strong immunity protecting against the communicable diseasesand certain life style disorders. Also prevalence of COVID like pandemic has made people more conscious regarding their food choices. Hence, the focus is more on the intake of easily available and affordable superfoods.



Egg is one of the mostly preferred superfoods from animal origin consumable by all age groups of the society. An average egg weighs 45-50 g composed of 8-11 per cent calcareous shell made up of calcium carbonate, 56-61 per cent white part constituting the embryo and 27-32 per cent yellow yolk contributing towards the nourishment of the embryo.

Nutritional benefits

All nutrients such as proteins, carbohydrates, vitamins (except ascorbic acid), minerals, fat, trace minerals are present in adequate quantity in white and yolk part of egg.

Nutritive value of egg / 100 g

Nutrient	Amount	Nutrient	Amount
Energy	173.0 Kcal	Retinol	420 µg
Protein	13.3 g	Thiamine	0.1 mg
Fat	13.3 g	Riboflavin	0.4 mg
Calcium	60.0 mg	Niacin	0.1 mg
Phosphorous	220.0 mg	Folic acid	78.3 µg
Iron	2.1 mg	Vit- B 12	0.2 µg

- Egg protein also contains all 9 essential amino acids in amounts to support effective muscle growth, recovery, and maintenance.
- The yolk contains protein, minerals, vitamins, vital Omega-3 fatty acids, and powerful antioxidants. Antioxidants are essential to fight off free radicals in your bloodstream to reduce potential illnesses and diseases.
- Calcium and phosphorous are the most abundant minerals present in egg. Egg is a rich source of biologically available zinc that acts as an immunity enhancer as well as a reproductive growth promoter. Trace minerals like selenium is present in egg that helps in free radical scavenging action being a potent antioxidant.
- Egg contains all the fat-soluble vitamins such as vitamin A, D and E along with water soluble fractions of thiamine, riboflavin, niacin, folate and vit- B_{12}. Biotin present in yolk helps in hair growth. Egg protein contains choline that constitutes cell membrane and neurotransmitter acetyl choline.
- Eggs contain vitamin B2, B12, choline, iron and tryptophan are all associated with helping reduce the risk of anxiety, symptoms of depression and naturally aiding sleep.
- They also contain a significant amount of leucine, an amino acid that is important for ongoing muscle support, as well as other key nutrients including vitamin D and Omega-3 fatty acids, plus a little-known nutrient, choline, which is important for brain function.

Myths regarding egg consumption

1. **High cholesterol levels of eggs** –The myth prevails like that it's not good for health to consume eggs daily as it will rise blood

cholesterol level. In contrary, as egg contains proper proportion of essential fatty acids like linoleic acid and arachidonic acid, it will help in lowering LDL and total serum cholesterol level. Eggs help increase high-density lipoprotein (HDL) levels – or "good" cholesterol Three to four eggs per week can be consumed safely by anyone without having any adverse health effects.

2. **Brown and white eggs are nutritionally different** – Studies have proved the brown and white eggs to be nutritionally same; not different. Brown eggs cost more only because of the larger size of the egg laying hens, not because of more nutrient contents in it.
3. **Brown eggs are laid by brown hens** – The hen's feathers are not at all contributing factors for the colour of the eggs. Rather the egg colour is determined by the colour of the earlobes of the hens. Brown eggs are laid by hens possessing red earlobes and white eggs come from hens having white earlobes.
4. **Every egg is a baby chicken**- Most of the eggs available in retail stores are unfertilized, hence they can't be hatched into chickens.
5. **Egg carton dates reflect food safety-** The sell-by date on an egg carton serves as a guideline for food safety. More often, eggs are safe to eat up to 5 weeks after the printed date, but sometimes the retailers don't change the date that hampers the freshness of the eggs along with its safety level to consume.
6. **Pregnant women should not consume eggs-** Some misconceptions are there that eggs produce more heat that is not desirable during pregnancy. But in reality, the nutritional composition of egg is proved to be very beneficial for the growth and development of both the mother and the foetus.
7. **Eggs have to go on the refrigerator's egg shelf-** Though there are egg slots in fridge doors to store it, the slots are not the ideal place as the temperature of fridge door is always shifting because of its opening and closing. Eggs should be stored at a consistent temperature.
8. **Bad eggs more often have a bad smell –** It's not true always as an egg having good smell and taste can have *Salmonella* in it possessing health risks.
9. **Raw eggs are healthier than the cooked ones-** This concept is mostly prevalent in sports sector. But in actual, raw eggs possess biotin-avidin complex that is not a problem in cooked egg. Besides, raw eggs are not easily digestible and absorbable by body as the cooked ones. The risk of getting infected by *Salmonella* increases with intake of raw ones. No advantages of eating raw eggs are confirmed yet.
10. **Raw eggs have more protein –** It's completely a vague concept. Rather cooking makes changes in protein structure in eggs making it more available for digestion and absorption. Proteins of raw eggs are 50 per cent bio-available whereas that of cooked eggs are 91 per cent bio-available.
11. **Egg yolks facilitates the process of gaining weight-** The yolk is the store house of nutrients for the chick development. Lutein and zeaxanthin present in egg yolk help as antioxidants. Essential fatty acids help in increasing HDL level in blood imposing no risk of elevation of total cholesterol and body weight.
12. **Eating eggs every day is bad for us-** It is safe to have an egg in meal every day to get enough protein, fat, minerals and vitamins. No ill effect on health will occur on every day consumption of egg.

Eggs are a perfect single-ingredient food. Easy to prepare, they are a convenient and healthy source of protein, fat, and other nutrients such as biotin and iron, which are important for growth and a healthy body. Eggs are easily available and cost-effective food items that one can incorporate in every day diet to get a well-built, healthy body and sound mind. Its nutritive value proves it to be a superfood having much more health and nutritional benefits which we can afford easily. Hence, everyone should choose eggs in daily diet in sight of the dietary advantages of this superfood.

* * * * * * * *

Maximising Vitamin C Retention in Cooked Vegetables

Swagat Ranjan Behera[1*], Riya Pandey[1] and Shaili[2]
[1]Ph. D. Scholar, Department of Vegetable Science, College of Agriculture, G. B. Pant University of Agriculture and Technology, Pantnagar, Uttarakhand
[2]M. Sc. Scholar, Department of Horticulture, Babasaheb Bhimrao Ambedkar University, Lucknow, Uttar Pradesh
*Corresponding Author: swgtbehera@gmail.com

Vitamin C, also known as L-ascorbic acid (Fig. 1), is a water-soluble vitamin found in various fruits and vegetables. It is renowned for its essential role in human health, serving as a potent antioxidant, supporting the immune system, aiding in wound healing and promoting the absorption of non-heme iron from plant-based foods.

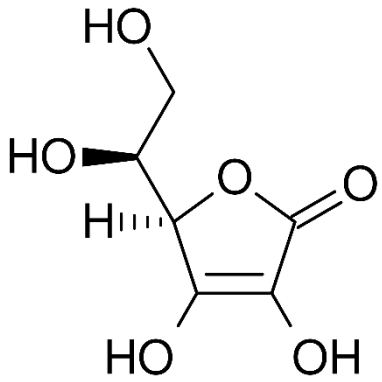


Fig. 1: Molecular structure of L-ascorbic acid

Understanding the importance of vitamin C

Before delving into the effects of processing, it is essential to understand the significance of vitamin C in the human diet. This water-soluble vitamin has a range of critical functions, *viz.*

i. **Antioxidant protection:** Vitamin C acts as a powerful antioxidant, neutralising harmful free radicals in the body, thus protecting cells from oxidative damage. This protective role is essential in preventing chronic diseases, including heart disease and certain types of cancer.

ii. **Immune system support:** It enhances the production of white blood cells and supports the immune system to resist infections.

iii. **Collagen production:** It is necessary for the synthesis of collagen, a major protein crucial for maintaining skin health, wound healing and the structural integrity of various connective tissues in the body (Pullar and Vissers, 2017).

iv. **Iron absorption:** Vitamin C enhances the absorption of non-heme iron from plant-based foods, making it especially valuable for individuals following vegetarian or vegan diets.

v. **Calcium absorption:** It promotes formation, growth and easy healing (when broken) of bones (Aghajanian *et al.*, 2015).

This vitamin cannot be synthesised in the human body, therefore, it needs to be taken through food or food supplements, like capsules or tablets. The recommended dietary allowance (RDA) for vitamin C as directed by FSSAI, is given below:

Group	Category/Age	Body weight (kg)	Ascorbic acid (mg/day)
Men	Sedentary work	60	40
	Moderate work		
	Heavy work		
Women	Sedentary work	55	40
	Moderate work		
	Heavy work		
	Pregnant		60
	Lactating (0-6 months)		80
	Lactating (6-12 months)		
Infants	0-6 months	5.4	25
	6-12 months	8.4	
Children	1-3 years	12.9	40
	4-6 years	18.0	
	7-9 years	25.1	
Boys	10-12 years	34.3	40
Girls		35.0	
Boys	13-15 years	47.6	40
Girls		46.6	
Boys	16-17 years	55.4	40
Girls		52.1	

Vegetables have a special and important position in human nutrition. A healthy balanced diet involving vegetables is the best way to get vitamin C. Vegetables like drumstick, bell pepper, chilli, tomato, broccoli and green leafy vegetables, like spinach, are a rich source of this vitamin. These vegetables are consumed both fresh and processed. It is important to note that much of the vitamin C is destroyed during processing operations like heat treatment (cooking), freezing and canning (Fabbri and Crosby, 2016).

With deficiency of vitamin C, scurvy disease develops. It occurs in people with unhealthy eating habits, indigestion problems, or when they have not consumed fresh fruits and vegetables for a long time (Al-Breiki and Al-Zoabi, 2014). The aim of this article is to explore the factors that influence the retention of vitamin C in vegetables during cooking and provide strategies to maximise its preservation.

Factors affecting vitamin C retention

The retention of vitamin C in vegetables during cooking is influenced by several factors, including temperature, cooking time, pH and the type of vegetable, as follows:

a) **Temperature:** Vitamin C is temperature-liable, *i.e.*, sensitive to heat, and its degradation accelerates as the cooking temperature increases. Ascorbic acid begins to degrade at temperatures above 70°C (158°F). The higher the cooking temperature and the longer the exposure to heat, the more is the loss of vitamin C. The loss of vitamin C can occur through various processes, including oxidation and thermal degradation. The extent of vitamin C degradation depends on the specific vegetable and cooking method.

b) **Cooking time:** The longer vegetables are exposed to heat, the more vitamin C is lost. Boiling vegetables for an extended period can lead to a significant reduction in vitamin C content, as the vitamin leaches into the cooking water and is susceptible to heat degradation (Lee and Kader, 2000).

c) **pH level:** The pH level of the cooking medium can also impact vitamin C retention. An acidic environment helps to stabilize vitamin C to some extent. However, cooking in alkaline conditions, such as when using baking soda or an excessive amount of water, can lead to increased vitamin C loss.

d) **Type of vegetable:** Different vegetables have varying levels of vitamin C and respond differently to cooking methods. For example, leafy greens like spinach and kale are more sensitive to heat and may lose vitamin C rapidly, while other vegetables like bell peppers and broccoli tend to retain more vitamin C when cooked.

e) **Cutting and peeling:** The surface area and the extent of cutting or peeling can influence the vitamin C content. Cutting vegetables into smaller pieces or peeling them can expose more of their surface to heat and oxygen, leading to greater vitamin C loss.

Strategies to maximise vitamin C retention in vegetables

Now that we understand the factors that affect vitamin C retention during cooking, let us explore the strategies to maximise its preservation:

i. **Use of gentle cooking methods:** One of the most effective ways to retain vitamin C in vegetables is to use gentle cooking methods. These methods minimise exposure to high temperatures and reduce the loss of vitamin C. Some recommended cooking methods include:

   a) **Steaming:** Steaming vegetables involves cooking them with the steam from boiling water. This method is particularly gentle on vitamin C as it avoids direct contact with water, which can leach the vitamin into the cooking liquid.

   b) **Microwaving:** Microwave cooking is a quick and gentle method that can help retain vitamin C in vegetables.

   c) **Sautéing or Stir-frying:** These methods involve cooking vegetables quickly at high temperatures in a small amount of oil. The short cooking time minimizes vitamin C loss.

When it comes to vitamin C retention, steaming appeared to be the most sparing method (Tincheva, 2019). According to Agbemafle *et al.* (2012), there was a reduction of 85% in vitamin C in boiled cabbage, while the highest loss of vitamin C was observed for boiling (52%) in cauliflower by Ahmed and Ali (2013). Tincheva (2019) recorded maximum retention of vitamin C in steamed red potatoes and the least levels in boiled red peppers.

ii. **Use of minimal water:** When boiling vegetables, it is essential to use as little water as possible. Excess water can leach vitamin C from the vegetables into the cooking liquid. To minimize vitamin C loss, these guidelines may be followed:

a) **Using small amount of water:** Add just enough water to cover the vegetables. This reduces the contact between the vegetables and the cooking liquid.

b) **Reusing the cooking water:** If you do boil vegetables, consider using the cooking water in soups, sauces, or gravies to retain some of the lost nutrients.

iii. **Cooking vegetables in their skin:** Leaving the skin on when cooking certain vegetables can help retain more vitamin C. For instance, potatoes and carrots have a significant portion of their vitamin C content in the skin. Boiling or steaming them with the skin intact can help preserve more of the nutrient.

iv. **Using an acidic cooking medium:** Cooking vegetables in an acidic medium can help stabilise vitamin C and reduce its loss during cooking. Adding a small amount of lemon juice or vinegar to the cooking water when boiling vegetables can help preserve the vitamin. Adding lemon juice to the blanching water significantly reduced the loss of vitamin C in *Amaranthus hybridus*, *Bidens pilosa* and *Cleome gynandra* (Mkandawire and Masamba, 2014). This could be due to the presence of organic acids present in the lemon juice which are known to minimise vitamin C losses.

v. **Minimising cutting and peeling:** Reducing the surface area of vegetables that are cut or peeled can minimize vitamin C loss. If you need to cut or peel vegetables, try to do so just before cooking to preserve more of the vitamin. Additionally, cutting vegetables into larger pieces can help reduce vitamin C exposure to heat and oxygen.

vi. **Consuming the cooking liquid:** In some cases, it may be beneficial to consume the cooking liquid along with the vegetables. The cooking liquid can contain some of the leached vitamin C, and incorporating it into soups, sauces, or other dishes can help maintain the nutrient's intake.

vii. **Choosing fresh vegetables:** The freshness of the vegetables can also impact their vitamin C content. Freshly harvested and stored vegetables generally contain more vitamin C than those that have been stored for extended periods. Fresh, locally-sourced produce should be opted for, whenever possible, to maximise vitamin C intake.

viii. **Avoiding overcooking:** Overcooking vegetables can lead to a significant loss of vitamin C. To prevent overcooking, the cooking time should be closely monitored and cooking of vegetables should be avoided until they become excessively soft. Vegetables should retain their vibrant colour and a slight crunch to indicate that they are adequately cooked while preserving the vitamin.

ix. **Proper storage:** The way vegetables are stored can also influence their vitamin C content. Exposure to air, light and heat can lead to vitamin C degradation. To maximise retention, vegetables should be stored in a cool, dark place, and airtight containers or plastic wrap should be used to minimise exposure to air.

Conclusion

Vitamin C is a vital nutrient found in vegetables, and it plays a crucial role in maintaining human health. However, the vitamin C content of vegetables can be significantly influenced by various

cooking methods. Gentle cooking methods like steaming, microwaving, and stir-frying are effective in retaining vitamin C, while using minimal water, keeping the skin on and adding acidic mediums can also help. Additionally, avoiding overcooking and consuming cooking liquid are practical strategies to preserve vitamin C. By understanding the impact of cooking on vitamin C content and making informed choices, individuals can continue to enjoy the nutritional benefits of vegetables while ensuring that their vitamin C intake remains adequate for a healthy diet.

References

Agbemafle, R., Obodai, E., Adukpo E., & Amprako, D. (2012). Effects of boiling time on the concentrations of vitamin c and beta-carotene in five selected green vegetables consumed in Ghana; *Pelagia Research Library Advances in Applied Science Research*, **3**(5): 2815-2820.

Aghajanian, P., Hall, S., Wongworawat, M. D., & Mohan, S. (2015). The roles and mechanisms of actions of vitamin C in bone: new developments. *Journal of Bone and Mineral Research*, **30**(11): 1945-1955.

Ahmed, F. A., & Ali, R. F. (2013). Bioactive compounds and antioxidant activity of fresh and processed white cauliflower. *BioMed Research International*.

Al-Breiki, S. H., & Al-Zoabi, N. M. (2014). Scurvy as the tip of the iceberg. *Journal of Dermatology & Dermatologic Surgery*, **18**(1-2): 46-48.

Fabbri, A. D., & Crosby, G. A. (2016). A review of the impact of preparation and cooking on the nutritional quality of vegetables and legumes. *International Journal of Gastronomy and Food Science*, **3**: 2-11.

Lee, S. K., & Kader, A. A. (2000). Preharvest and postharvest factors influencing vitamin C content of horticultural crops. *Postharvest Biology and Technology*, **20**(3): 207-220.

Mkandawire, K. T., & Masamba, K. G. (2014). Effect of lemon juice treatment and sun drying on vitamin C retention in three steam and water blanched indigenous vegetables over six weeks storage period. *African Journal of Food Science*, **8**(6): 316-321.

Pullar, J. M., Carr, A. C., & Vissers, M. (2017). The roles of vitamin C in skin health. *Nutrients*, **9**(8): 866.

Tincheva, P. A. (2019). The effect of heating on the vitamin C content of selected vegetables. *World Journal of Advanced Research and Reviews*, **3**(3): 027-032.

* * * * * * * *

Unleashing the Potential of Underutilized Herbs and Vegetables for A Nutritious World

Vasanthkumar S. S.[1]*, Pooja U. K.[2], Gowshika R.[3] and Rubika R.[4]

[1,4] M.Sc Scholar, Department of Plantation, Spices, Medicinal and Aromatic Crops, Horticultural college and Research Station - TNAU, Periyakulam.

[2] M.Sc Scholar, Department of Plantation, Spices, Medicinal and Aromatic Crops, Horticultural college and Research Station – TNAU, Coimbatore.

[3] M.Sc Scholar, Department of Vegetable science, Horticultural college and Research Station - TNAU, Periyakulam.

*Corresponding Author: kalaivasanth@gmail.com

In a world plagued by food insecurity and a lack of nutritional diversity, the potential of underutilized spice and vegetable crops to combat hunger is often underestimated. These unsung heroes of the plant kingdom possess immense nutritional value and bring a burst of flavor to our plates. By incorporating these crops into our diets, we can not only achieve zero hunger but also introduce a new dimension of taste and diversity to our meals. In this blog post, we will explore the untapped potential of these underutilized crops and understand how they can transform the way we eat.

What are underutilized spice and vegetable crops?

Underutilized crops are those that have been overlooked or neglected in terms of research, cultivation, and consumption. These hardy plants often possess unique characteristics that make them resilient and adaptable to various climates. Yet, due to limited awareness and market demand, their potential remains untapped. Examples of underutilized spice and vegetable crops include moringa, amaranth, sorrel, and jicama, among many others.

Nutritional diversity of underutilized crops

One of the key reasons why underutilized crops are gaining recognition is their exceptional nutritional content. These plants are often rich in essential vitamins, minerals, and antioxidants, providing a wide range of health benefits. For instance, moringa leaves are packed with vitamin C, iron, and protein, while amaranth is a great source of vitamins A and C, calcium, and dietary fiber. By incorporating these crops into our diets, we can combat micronutrient deficiencies and promote overall well-being.

Why underutilized crops are crucial for achieving zero hunger

The world is currently facing a dual challenge of hunger and malnutrition. By diversifying our food sources and promoting the cultivation and consumption of underutilized crops, we can address these issues. These crops are often more resilient to climate change and require fewer resources to grow, making them suitable for marginalized communities and regions facing food insecurity. Additionally, their potential for high yields and income generation can empower farmers, creating sustainable agricultural practices.

Incorporating underutilized crops into our diets

To introduce the nutritional diversity of underutilized crops into our daily meals, we can start by exploring new recipes and experimenting with different flavors. For instance, adding moringa leaves to soups and salads or using amaranth as a substitute for rice or wheat flour can significantly enhance the nutritional value of our meals. By supporting local farmers and markets that promote these crops, we can contribute to a more sustainable and nutritious food system.

Uses of Underutilized medicinal plants and spices

1. **Chives (*Allium schoenoprasum*),** part of the liliaceae family, are easily grown in kitchen gardens and can be used to flavor dishes like regular onion and garlic. Dried chives are commonly available and have a delicate flavor similar to scallions. They are used in baked potatoes, potato salads, and other

vegetable salads, and in dips, dressings, soups, and sauces when fresh chives are unavailable.

2. **Cilantro (*Coriandrum sativum*)**, also known as Spanish or Chinese parsley, is a pungent herb used in Mexican, Indian, and Asian cuisines to add flavor to dishes like pinto beans, Spanish-style tomato sauces, tacos, curried vegetables, and corn-stuffed peppers. Fresh cilantro is becoming more accessible.
3. **Marjoram (*Origanum majorana*),** closely related to oregano, is a slightly sweeter and sharper herb. It is used sparingly in vegetable dishes, Italian-style tomato sauces, bean stews, pizza sauces, soups, grain dishes, and vinaigrette salad dressings, and should be used sparingly.

4. **Rosemary (*Salvia rosmarinus*),** a small evergreen shrub with slender leaves, is a folklore-recognized herb of rememberance. Its strong piney flavor makes it versatile in vegetarian cuisine, particularly in vegetable stews, herb breads, tomato soups, and with beans and potatoes.

5. **Cress (*Lepidium sativum*)** Garden cress, also known as pepper cress or water cress, is a plant genetically related to watercress and mustard, with a peppery, tangy flavor. It belongs to the crucifer family and is used in dishes like soups, sandwiches, and salads. Seed pods can be used as pepper seasoning. In India, it is mainly grown for seeds with galactagogue properties.
6. **Bitter leaf (*Vernonia amygdalina)*** The plant is a small tree with petiolate leaves, elliptic in shape, and a bitter taste. It is used for human consumption as a vegetable after washing, stimulating the digestive system, reducing fever, and treating leech. It is also used in Nigerian beer production due to its antinutritional factors, including alkaloids, saponin, tannins, and glycosides.

7. **Scent leaf *(Ocimum gratissimum*)** This perennial herb is woody at base, with a stem ranging from 1 to 3 meters long. Leaves are broadly to narrow ovate, 5-13 cm long, 3-9 cm wide, and puberulent on veins. The plant is a weed in roadsides and wasteland but vital in pastures. It prefers moist, fertile soils during growth but can tolerate drought at flowering. Petiole is 1- 6 cm long.

8. **Garlic *(Allium sativum),*** a lily plant, is a medicinal herb with various uses including digestive stimulants, diuretics, and antispasmodics. It is known to prevent cancer and kill pathogenic bacteria, rotavirus infections, protozoa, and Helicobacter pylori. The presence of allicin in garlic disrupts cell membrane biosynthesis, inhibiting DNA polymerases and RNA synthesis, thus disrupting the enzyme system responsible for cell replication. It also destroys SH groups in proteins. Currently, no resistant pathogens have developed to allicin found in garlic.
9. **Ginger (*Zingiber officinale),*** a perennial herb with thick lobes, contains "gingerols" and "shogaols" when exposed to air and heat. It contains protein, lipids, carbohydrates, minerals, vitamins, trace nutrients, capsaicin, curcumin, limonene, and proteolytic enzymes. Ginger is a carrier herb that aids in digestive absorption by up to 200%. The study aimed to evaluate the potential of medicinal plants and spices for treating diseases in ruminant animals.

Nutritional and medicinal values of underutilized vegetables

1. ***Amarnathus spp.*, Amaranthus,** a perennial plant found in warm, humid regions, contains 17.5-18.3% protein and is rich in vitamins, including pro-vitamin A, vitamin C, K, and folate. It also contains high levels of carotene, micronutrients, and phytochemicals with antioxidant properties, helping prevent diseases like cancer, arteriosclerosis, and aging. Quercetin, among other offlavonoids, is a strong antioxidant. Amaranthus is recommended as a fiber source for patients with constipation.

2. **Pointed Gourd (*Trichosanthes dioica*)** Pointed gourd, a significant crop in India, is known as the "King of gourds" due to its high nutrient content and medicinal value. Its leaves are used as tonics, febrifuges, and in Ayurveda for various health benefits. T. dioca contains various chemical constituents, including vitamins A, C, tannins, saponins, alkaloids, and triterpenes.

3. **Gherkin (*Cucumis sativus* var. *anguria*)** Gherkin is a cucumber with a high content of essential nutrients, including beta carotene, vitamin K, and vitamin K. It helps maintain weight, reduces the risk of heart disease and cancer, and supports intake of essential vitamins like folate, iron, sodium calcium, and vitamin A. A medium size gherkin provides 12 miligrams of vitamin K, while a large sweet gherkin provides 16.5 micrograms.
4. **IVY Gourd (*Coccinia grandis*)**, also known as kundru, contains fruits rich in lycopene, β-carotene, protein, vitamin A, antioxidant properties, and is used in Ayurveda for skin eruption, tongue sores, and earache.
5. **Sweet Gourd (*Momordica cochinchinensis*)** Sweet gourd, a member of the Cucurbitaceae family, has edible fruits and leaves rich in protein, vitamin C, and A, and medicinal properties for ulceration, lumbago, and bone fracture, and seeds for wound and ulcer treatment.
6. **Karchikai (*M. cymbalaria*),** a perennial climbing plant found in South Indian states, is a rich source of Vitamin C, fiber, beta carotene, iron, and calcium. Initially considered a weed, its tubers have medicinal properties, making it a valuable vegetable. The crop is not commercially cultivated due to poor planting material quality. Its medicinal properties include antidiarrhoeal, hepatoprotective, antidiabetic, nephroprotective, antiallergic, and antimicrobial properties. The plant's calcium content is three times higher than bitter gourd, and its ascorbic acid content is two times higher than bitter gourd. The tubers and leaves contain flavonoids, steroids, tri-terpenes, and saponins, making it a valuable tool against malnutrition and hunger.

7. **Basella (*Basella Alba, Basella rubra*)** vine spinach, is a popular tropical leafy green vegetable grown in backyards. It belongs to the basellaceae family and has two chief cultivars: *Basella Alba* and *Basella rubra.* Basella alba has medicinal value due to its high content of vitamins, minerals, and antioxidants. It contains essential amino acids, vitamins, minerals, and a low percentage of soluble oxalates. Major biological activities of Basella alba are androgenic.
8. **Elephant foot yam (*Amorphophallus campanulatus*)** Amorphophallus campanulatus, also known as "Jimikand" or Elephant Foot Yam, is a tuberous, stout indigenous herb used in the Ayurvedic medicine system for treating various human ailments. Its dry, pungent corms increase appetite and taste, and are used in treating

conditions like vata and kapha, inflammations, and rheumatism. The corms contain betulinic acid, β-sitisterol, stigmasterol, triacotane, lupeol, and β-sitosterol palmitate. They also possess antibacterial, antifungal, and cytotoxic activities due to their presence of diterpenoid salviasperanol and amblyone. The plant's tuberous roots have blood purifier properties and are traditionally used for treating piles, abdominal disorders, tumors, spleen enlargement, asthma, and rheumatism.

9. **Drumstick (*Moringa oleifera)*** is a tropical tree known for its nutritional and medicinal properties. It has been consumed in various culinary ways throughout history and has been used to treat various illnesses. Moringa leaves are a good source of nutrition and exhibit anti-inflammatory, anti-ulcer, anti-atherosclerotic, and anticonvulsant activities. Moringa oil has been used in skin ointments since ancient Egypt. Epidemiological studies indicate that Moringa oleifera leaves are a good source of nutrition and have anti-inflammatory, anti-spasmodic, antihypertensive, anti-tumor, anti-oxidant, anti-pyretic, anti-ulcer, anti-epileptic, diuretic, cholesterol lowering, renal, antidiabetic, and hepatoprotective activities.

Conclusion

Incorporating underutilized spice and vegetable crops into our diets not only helps combat hunger and malnutrition but also adds a dash of excitement and diversity to our meals. By recognizing the potential of these crops and supporting their cultivation and consumption, we can contribute to a more sustainable and nutritious world. So, let's spice up our plates and embark on a culinary adventure that nourishes both our bodies and our taste buds.

References

Burnham, W. (2021). *School Gardens: Providing Improved Food Security and Nutrition for Students in Ecuador* (Doctoral dissertation, Worcester Polytechnic Institute).

Jena, A. K., Deuri, R., Sharma, P., & Singh, S. P. (2018). Underutilized vegetable crops and their importance. *Journal of Pharmacognosy and Phytochemistry*, *7*(5), 402-407.

Peter, K. V. (Ed.). (2008). *Underutilized and Underexploited Horticultural Crops: Vol. 04* (Vol. 4). New India Publishing.

Shembe, P. S., Ngobese, N. Z., Siwela, M., & Kolanisi, U. (2023). The potential repositioning of South African underutilized plants for food and nutrition security: A scoping review. *Heliyon*.

* * * * * * * *

Preserving Nutrients: How Minimal Processing Can Retain the Goodness in Food

Maneesh Sonkar
S.V. College of agricultural engineering and Technology and research station, Indira Gandhi Krishi Vishwavidyalaya, Raipur, C.G.-492012.
*Corresponding Author: sonkarmaneesh54@gmail.com

Preserving the inherent nutritional value of food is achievable through minimal processing, which involves novel (non-thermal) techniques. These methods aid in maintaining essential vitamins, minerals, and antioxidants found in fruits and vegetables. Furthermore, minimal processing contributes to enhanced nutritional profiles by minimizing the inclusion of unhealthy chemical additives and preservatives. By upholding the natural integrity of ingredients, minimal processing leads to elevated nutritional content, ultimately offering improved health benefits for consumers. Minimal processing involves employing techniques like High pressure processing (HPP), pulsed electric field (PEF), ultrasound, non-thermal plasma, light pulses, and enzyme-assisted extraction (EAE) to preserve natural food attributes, nutrients and extend shelf life.

Conventional thermal processing (high temperature) affects the functional and nutrients qualities of food product. Nonthermal or Minimal processing techniques effectively preserve foods by deactivating microorganisms and, in certain instances, enzymes, without substantial heat application. These methods have minimal impact on pigments, structural polymers, flavor compounds, and vitamins, allowing foods to maintain their nutritional integrity and sensory attributes to a significant extent. Consumer preferences align with a growing inclination toward "natural" products devoid of additives. The essence of minimal processing lies in the objective of reducing the processing of foods without compromising on quality. Products that undergo minimal processing are gaining traction in the market, driven by the widespread belief that they can fulfill the current need for essential nutrients. The increasing consumer demand for minimally processed foods presents a substantial market opportunity, fostering innovation in extraction, preservation, and packaging technologies

Despite the overall benefits, minimal processing may alter some sensory attributes or result in nutrient loss if not carefully controlled. The future

holds potential for continued innovation in technologies to further enhance the nutritional content and quality of minimally processed foods, aligning with the increasing demand for natural and clean-label products. Therefore, it is crucial to reassess concepts before selecting processing techniques for fruits and vegetables. Modern and innovative processing modules offer alternatives to thermal processing, helping mitigate nutrient losses and enhance nutritive quality, thereby gaining greater consumer acceptability.

Need of minimally processed vegetables and fruits

A minimally processed product involves the washing, peeling, trimming, and slicing of fruits and vegetables, treated appropriately, and then packaged in sterilized glass containers. The primary goal of adopting fresh-cut, minimally processed technology is to extend the availability of these products in the market in their fresh form for an extended period. In the contemporary context, heightened awareness and concerns about nutrition and food safety are evident among consumers. The 21st-century consumer, empowered by modern technology and widespread internet access, is more informed and discerning than ever. This demographic seeks food options that are not only safe, reliable, and of high quality but also possess the necessary nutrients, all while avoiding the use of preservatives. Products subjected to minimal processing exhibit high-quality attributes, including color, flavor, aroma, and overall acceptance.

the perishable nature of fruits and vegetables, careful handling is crucial before and during storage.

Inadequate handling of fruits and vegetables can significantly diminish its shelf life and market share, with nearly half of the harvested product going to waste. The use of proper postharvest technologies can mitigate decay issues, particularly those caused by pathogenic attacks. Consumers typically opt for minimally processed products due to factors such as convenience, freshness, nutritional value, food safety, and dietary preferences. The demand for quality parameters from consumers has positively influenced the minimally processed industry, offering consumers a convenient way to access a variety of foods in a single packet or box. But the minimal processing necessitates investments in technology, equipment, and management systems. Adhering to strict food safety principles and practices is crucial to ensure the quality of these products.

Health Advantages of Minimally Processed Vegetables and Fruits

The nutritional advantages of minimally processed vegetables and fruits are valuable. Vegetables and fruits, known for their rich mineral and vitamin content, are recommended by the World Health Organization with a guideline of consuming at least 3 servings of vegetables and 2 servings of fruits daily. The recommended choices include fresh, frozen, dried, or canned vegetables, with a particular emphasis on incorporating dark-green leafy vegetables. These vegetables and fruits also contain phytochemicals that serve as antioxidants, acting as detoxifying agents, preventing tumour growth, and contributing to the modification of metabolic processes. Antioxidants play a vital role in providing oxidative stability to larger amounts of lipids and DNA at minute concentrations, safeguarding cells from oxidation and reacting with radicals.

Nutritional changes in minimally processed vegetables

Vegetables contain varying amounts of essential nutrients, including carbohydrates, vitamins, and minerals. In addition to major nutrients, there are minor components such as organic acids that play a crucial role in enhancing the appearance, taste, flavor, color, and aroma of fruits by interacting with sugar content. The aroma of fruits and vegetables is produced by esters of aliphatic alcohols and short-chain fatty acids.

The nutritional composition of fruits and vegetables is influenced by vitamins, particularly vitamin A, B, C, thiamine, and niacin. Minerals and dietary fibers also contribute to their nutritional profile. Various compounds, including carotenoid pigments, polyphenols, flavonoids, and other phytonutrients, are found in plant tissues. These compounds have been linked to reducing the risk of cancer and cardiovascular diseases in humans, minimally processed fruits and vegetables may exhibit visual blemishes without experiencing nutrient loss. Looking ahead, there is an anticipation that plant-breeding techniques could be instrumental in developing cultivars with enhanced nutritional characteristics that can withstand the effects of processing.

Emerging technologies in minimal processing

High-pressure processing (HPP)

High-pressure processing (HPP) stands out as a non-thermal technique increasingly employed to eliminate microbial cells by disrupting noncovalent bonds. This method effectively maintains the organoleptic properties and nutritional value of food without the use of high temperatures. HPP involves subjecting food to elevated hydrostatic pressure, effectively eliminating pathogens and extending shelf life without the need for heat or preservatives. In this process, products undergo high pressure in the range of 3000–8000 bars to deactivate microorganisms and enzymes without degrading flavors and nutrients. HHP has found extensive applications in the food processing industries, improving the nutritional quality of diverse food products, including dairy items, vegetables, fruits, fish, meat, and meat products.

Pulsed electric field (PEF) processing

PEF, or pulsed electric field, is a preservation technology This technique utilizes short electrical pulses with high voltages between two electrodes, keeping thermal effects low, contributing to the retention of nutritional content and the extension of flavor. PEF, recognized as a promising preservation method, effectively safeguards volatile flavor

compounds and thermolabile nutrients in comparison to traditional heat pasteurization. PEF is primarily employed to reduce microbial activity, extract value-added compounds, enhance the extraction of plant materials, facilitate mass transfer through cell disruption, and minimize stress induction in cells.

Ultrasound processing

Ultrasound technology enhances nutrient extraction, improves texture, and refines the flavor of certain products. Ultrasound treatments are recognized for their ability to deliver reproducible outcomes, cost-effectiveness, simplicity, and the achievement of high-purity products. Ultrasound refers to a longitudinal wave with a frequency beyond the upper limit of human hearing (20,000Hz). It is a nonthermal, nondestructive, nonintrusive, and noninvasive technology suitable for Minimal Processing of Fresh Produce, effectively preventing biochemical and microbial spoilage. This high-energy application can effectively inhibit enzymes responsible for quality loss, such as browning.

Non-thermal plasma treatment

This emerging technology utilizes ionized gas for sterilizing and decontaminating food surfaces, extending shelf life while maintaining nutritional quality. This nonthermal technology operates at atmospheric pressure and does not involve the use of chemicals or water. It is generated by applying energy to a gas mixture, leading to ionization and the accumulation of active compounds like radicals, charged particles, and UV radiation. Among these, free radicals prove to be the most effective against microorganisms. While this technique is actively being researched and utilized as an antimicrobial treatment, certain drawbacks have been noted, including the variability in the formed plasmas, which is contingent on numerous parameters. Consequently, comparing the effectiveness of specific conditions with other studies poses a challenge.

High-intensity light pulses

Light-based processing methods sterilize and preserve food without heat, thereby safeguarding natural nutrients and flavors. Pulse light (PL) treatment involves the application of a series of high-intensity, short bursts of light pulses to eliminate microorganisms. PL technology is effective for sterilizing packaging materials and equipment surfaces. However, its application in food processing is limited due to challenges posed by the opacity of certain food products, their non-uniform surfaces, and the potential temperature rise, which could adversely affect organoleptic qualities. Nevertheless, concerning the nutritional quality of foods, PL has been shown to maintain the levels of phytochemicals during post-harvest storage, with demonstrated enhancements in phenolic compounds, carotenoids, and antioxidant activity.

Enzyme-assisted extraction

Enzymes play a crucial role in breaking down cell walls in plant-based foods, enhancing the efficiency of nutrient extraction and preserving the nutritional content. The advantages of employing enzymes in this context include higher recovery yields, minimal contamination, and a high selectivity rate. However, there are certain disadvantages, such as the high cost of enzymes, extended processing times, and lower efficiency rates. The use of enzymes in food processing contributes to increased shelf life by reducing oxidative spoilage and microbial activity, while also improving the textural properties of the final product.

Edible film and coatings

An edible film is described as a thin layer or solid sheets of edible material applied onto or in between food components. The utilization of edible coatings aims to extend the shelf life of fresh and minimally processed produce, shielding them from adverse environmental effects. This need is underscored by the growing demand for high-quality minimally processed foods and advanced storage technologies. Edible coatings, by regulating the transfer of moisture, oxygen, carbon dioxide, and taste compounds in a food system, have proven effective in enhancing food quality and prolonging the shelf life of fresh produce. Furthermore, edible coatings can incorporate functional ingredients such as antioxidants, antimicrobials, nutrients, and flavor.

Hurdle technology

Hurdle technology represents an innovative approach to producing foods that are not only safe and

stable but also nutritious, flavorful, and cost-effective. This method involves the strategic combination of diverse preservation techniques to decontaminate fruits and vegetables. Hurdle technology is also referred to as combined processes, combined methods, combination preservation, combination techniques, or barrier technology. The key hurdles employed in food preservation within this approach include temperature variations (high or low), water activity, acidity, redox potential, preservatives, and the presence of competitive microorganisms. These efforts are driven by consumer concerns for healthier and improved food products that retain their natural nutritional characteristics.

Conclusion

In conclusion, minimal processing techniques play a pivotal role in preserving the nutritional integrity of fruits and vegetables. Technologies such as High-Pressure Processing (HPP), Pulsed Electric Field (PEF), ultrasound, non-thermal plasma, light pulses, enzyme-assisted extraction, and edible films contribute to maintaining essential nutrients, flavors, and textures while extending shelf life. These methods offer alternatives to traditional thermal processing, aligning with the contemporary consumer preference for natural, additive-free products. Despite potential drawbacks such as sensory alterations or nutrient loss, ongoing research and innovation continue to enhance the nutritional content and quality of minimally processed foods. The rising demand for minimally processed products reflects a consumer-driven shift towards convenient, fresh, and nutritionally rich food options. As the food industry embraces these technologies, the future holds promise for further advancements in preserving nutrients and meeting consumer expectations for healthier and high-quality food choices.

References

Ali, A., Wei, S., Ali, A., Khan, I., Sun, Q., Xia, Q.,Liu, S. (2022). Research Progress on Nutritional Value, Preservation and Processing of Fish—A Review. Foods, 11, 3669.

Fellows P. J. (2017). Food Processing Technology Woodhead Publishing Series in Food Science, Technology and Nutrition Principles and Practice Fourth Edition.

Inam M., Raheem, Saeed M., Aslam H., Shakeel A., Raza M.S., and Afzal F. (2015). Effect of various minimal processing treatments on Quality characteristics and nutritional value of spinach. J. Glob. Innov. Agric. Soc. Sci., 3(2-3), 76-83.

Mandal, R., Mohammadi, X., Wiktor, A., Singh, A., & Singh, A. P. (2020). Applications of Pulsed Light Decontamination Technology in Food Processing: An Overview. Appl. Sci., 10, 3606.

Medina, M. S., Tudela, J. A., Marin, A., Allende, A., & Gill, M. I. (2012). Short postharvest storage under low relative humidity improves quality and shelf life of minimally processed baby spinach (*Spinaciaoleracia L.)*. J. Postharvest Biol. Technol., 67, 1-9.

Pasha I., Saeed F., Sultan M.T., Khan M.R., and Rohi M. (2014). Recent developments in minimal processing: a tool to retain nutritional quality of food. Critical reviews in food science and nutrition, 54, 340–351.

Sharma S., Bandral J.D., Sood M., and Gupta N. (2018). Effect of minimal processing and packaging on quality and shelf-life of carrots (Daucus carota). The Pharma Innovation Journal, 7(5), 295-300.

Velderrain-Rodrı´guez, G. R., Lo´pez-Ga´mez, G. M., Domı´nguez-Avila, J. A., Gonza´lez-Aguilar, G. A., Soliva-Fortuny, R., & Ayala-Zavala, J. F. (2019). Minimal Processing. Postharvest Technology of Perishable Horticultural Commodities.

* * * * * * * *

Food Processing Impact on the Nutritional Content of Food

Muneshwar Prasad Mandal
Asstt. Prof. -cum- Jr. Scientist, Department of Plant Physiology & Biochemistry,
Bihar Agricultural University, Sabour, Bhagalpur, Bihar - 813210
*Corresponding Author: mpmbotany64@gmail.com

Food processing plays a significant role in shaping the nutritional content of the foods we consume. This impact can be both positive and negative, depending on the processing methods used. In this article, we will delve into how food processing affects the nutritional value of our food. Food processing refers to a wide range of techniques and methods employed to transform raw ingredients into consumable products. These processes can be broadly categorized into several types, including mechanical, thermal, chemical, and biological processes. Each of these categories has its unique impact on the nutritional content of food.

One of the primary objectives of food processing is to enhance the shelf life of food products. This is often achieved through various methods like canning, freezing, drying, and pasteurization. While these methods are highly effective in preventing spoilage and ensuring food safety, they can also lead to some loss of nutrients. For instance, the heat used in canning and pasteurization can destroy heat-sensitive vitamins like vitamin C and some B vitamins. Freezing, while preserving many nutrients, can lead to the loss of some water-soluble vitamins and the degradation of the texture and flavour of certain foods.

Similarly, drying is a method that significantly reduces the moisture content of food, which helps prevent microbial growth and spoilage. However, this process can cause the loss of vitamins and minerals, as well as alter the texture of the food. For instance, dried fruits and vegetables, while still nutritious, may have reduced vitamin C content compared to their fresh counterparts. On the other hand, some food processing techniques can have a positive impact on the nutritional content of food. For example, milling whole grains into flour makes them more versatile for cooking and baking, but it can also lead to the loss of some bran and germ layers, which contain essential nutrients, such as dietary fibre, vitamins, and minerals. To combat this, many food manufacturers enrich their products by adding back some of these lost nutrients, such as iron and B vitamins, creating enriched or fortified foods.

Fermentation is another food processing method that can be beneficial for nutrition. During fermentation, beneficial microorganisms, such as bacteria and yeast, break down carbohydrates and proteins in food, making nutrients more bioavailable and sometimes even increasing the levels of certain vitamins and minerals. Yogurt, for instance, is a fermented dairy product that contains probiotic bacteria and is easier to digest for some individuals with lactose intolerance. The impact of food processing on the nutritional content of food can also vary depending on the specific processing methods used. For example, the canning process, which involves heating food to high temperatures and sealing it in airtight containers, can lead to the loss of certain nutrients, as previously mentioned. However, the extent of nutrient loss can vary depending on factors like temperature and duration of heating, as well as the type of food being canned. Some nutrients, like lycopene in tomatoes, may become more bioavailable during canning, which can be considered a positive effect.

In contrast, certain cooking methods, such as steaming or microwaving, can help preserve the nutritional content of food. These methods involve minimal contact with water and shorter cooking times, which can help retain heat-sensitive vitamins and minerals. Steaming, in particular, is known for preserving the colour, texture, and nutritional value of vegetables. Food processing can also impact the fat content of foods. For example, frying is a common method that can significantly increase the fat content of foods. However, the type of fat used (e.g., vegetable oil vs. saturated fat) and the frying temperature can influence the nutritional quality of the final product. On the other hand, the extraction of oils from seeds and nuts through methods like cold-pressing can yield unrefined, healthy oils that are rich in beneficial fats like monounsaturated and polyunsaturated fats.

Furthermore, food processing can lead to the addition of various ingredients, including preservatives, sweeteners, and flavour enhancers. While these additives can improve the taste and shelf life of food products, they can also introduce concerns about the impact on overall health and nutrition. High levels of added sugars, for instance, are associated with various health issues, including obesity and diabetes.

It is essential to be aware of these added ingredients and their potential health implications when making food choices. Reading nutrition labels and ingredient lists on packaged foods can help consumers make informed decisions about the nutritional value of processed foods.

Food processing can also have implications for food safety. Some methods, such as pasteurization and canning, are highly effective in destroying harmful microorganisms that can cause foodborne illnesses. This contributes to improved food safety, which is a vital aspect of public health.

In conclusion, food processing has a profound impact on the nutritional content of food. The effects can be both positive and negative, depending on the processing methods employed and the specific food product in question. While some methods may lead to nutrient loss, others can enhance the availability of certain nutrients or extend the shelf life of food. It is crucial for consumers to be aware of these effects and make informed choices when it comes to their diets. Balancing the consumption of processed foods with whole, minimally processed foods can help individuals maintain a nutritious and well-rounded diet. Additionally, regulations and labelling requirements play a critical role in ensuring transparency and providing consumers with the information they need to make healthy choices in the supermarket.

* * * * * * * *

Solar Drying Technologies for Agricultural Produce– An Overview

Preeti
Ph.D. Scholar, Department of Renewable Energy Engineering, College of Agricultural Engineering and Technology, Dr. BSKKV, Dapoli (MS)
*Corresponding Author: preetihj039@gmail.com

Conversion and utilization of solar energy is one of the most important strategies being proposed to mitigate the foreshadowed global energy crisis and environmental issues. Agricultural produce is the backbone of food security and economic stability for many regions around the world. However, a significant portion of this produce is lost due to inadequate post-harvest handling and preservation techniques. Solar dryer has a significant potential in the agricultural sector, where it used for drying vegetables, fruits and medicinal plants. Solar energy translates to heat during the drying process, so whether product is laid out in the sun (ambient) or placed in a dryer, the heat for drying comes from the same source. In traditional drying methods, agricultural produce is exposed to direct sunlight or air-dried in open fields, which is not only time-consuming but also susceptible to contamination, pests, and unpredictable weather conditions. Solar drying provides an efficient and controlled environment for dehydration, ensuring that the produce retains its quality and nutritional value. In this article, we will explore various solar drying technologies and their applications in agricultural sector. In recent years, with the rapid development of drying technology and the application of drying equipment, drying industry is making great development.

Solar Energy

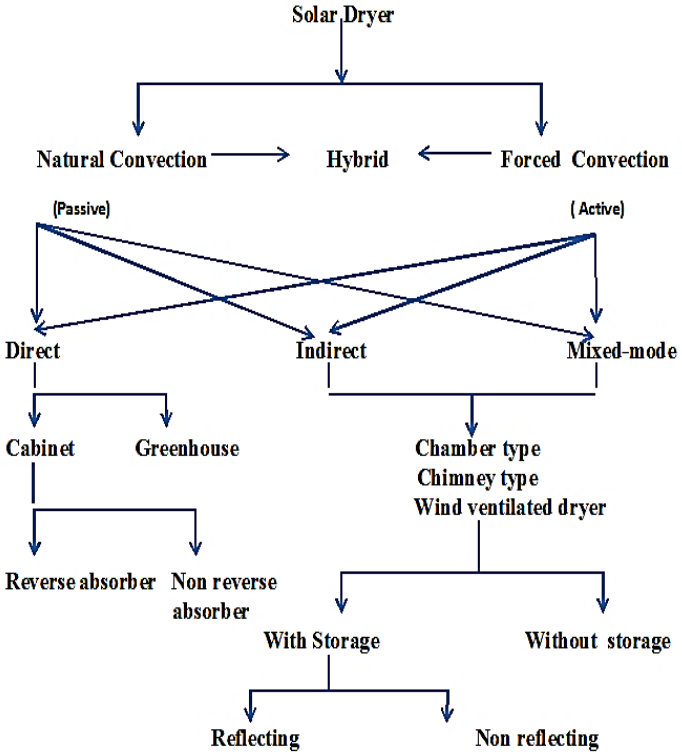
Depletion of natural fuel resources, rising fossil fuel costs and emission have led to use renewable energies. Various innovations are undergoing to make the use of sources of renewable energy like wind, solar, tidal etc. Among these sources, solar energy is available in enormous quantity and can be directly used which is continuous, safe, free and environment friendly. Increasing population is the major problem of the entire world. Increase in the population increases the consumption of food. To fulfil this demand either that amount of food must be produced on a regular basis or produced food can be stored after some processing. Therefore, continuous production is not possible but food can be stored for a certain period by drying it. For drying agricultural and non-agricultural products, solar energy can be used directly or indirectly (Singh *et al.,* 2018).

Solar dryer

Solar dryer has a significant potential in the agricultural sector, where it used for drying vegetables, fruits and medicinal plants. Thereby minimize dependency on sun drying and industrial drying, hence save huge quantities of fossil fuels (Agrawal and Sarviya, 2016). Drying involves extraction of moisture from the product by heat and removal of that moisture by a flowing air mass. Solar dryer is the best alternative option to avoid disadvantages of conventional drying methods (Sontakke, and Salve, 2015). Traditionally all the agricultural products were dried only by utilizing solar energy which requires large area for drying and availability of the sunlight throughout the day. The chances for contamination of the drying product with dust, insects, birds, fungi etc. are more in the open sun drying. The above said challenges have led to the development of solar drying systems. Many solar driers have been developed in the past two decades for drying various products by utilizing the solar energy efficiently and innumerable studies has been reported on solar drying of agricultural products (Leon *et al.*, 2002). Agricultural products, especially fruits and vegetables require hot air in the temperature range of 45–60˚C for safe drying. When any agricultural product is drying under controlled condition at specific humidity as well as temperature it gives rapid superior quality of dry product (Gutti *et al.*, 2012; Sontakke, and Salve, 2015). Solar drying is one of the best methods to preserve crops for a long time. Greenhouse solar dryer operating in active mode is better as compared to passive mode. Quality, taste, colour, and nutritious value of the dried product are better in greenhouse solar drying than open sun drying.

Types of solar dryers

Solar dryers are mainly classified into natural convection dryers, forced convection dryers and hybrid type. In natural convection or active solar dryer, the circulation of solar heated air is through buoyant force. A forced convection or passive solar dryer utilizes motorized fans or pumps for forced circulation of the drying air in to the solar dryer in which solar energy is used to heat the pumped air. In a Hybrid dryer solar energy is combined with conventional or auxiliary source of energy for heating the air. Classification of solar dryers (Fudholi *et al.*, 2010).



Conclusion

To capture and efficiently utilize the solar energy in today's energy market requires multistage integration of several factors, including proper matching of the solar energy resources and energy demands of a particular region. Use of solar energy for drying is one of the most effective methods due its renewable nature and availability. Solar drying technologies represent a significant advancement in agricultural post-harvest handling and preservation. By harnessing the sun's energy, farmers can reduce post-harvest losses, improve the quality of their produce, and contribute to a more sustainable food system. In recent years, with the rapid development of drying technology and the application of drying equipment, drying industry is making great development. With proper training and support, solar drying has the potential to revolutionize the way we approach food preservation, benefiting both farmers and consumers alike.

References

Agrawal, A. and Sarviya, R.M., 2016. A review of research and development work on solar dryers with heat storage. *International Journal of Sustainable Energy*, 35(6):583-605.

Fudholi, A., Sopian, K., Ruslan, M.H., Alghoul, M.A. and Sulaiman, M.Y., 2010. Review of solar dryers for agricultural and marine products. *Renewable and sustainable energy reviews*, *14*(1):1-30

Gutti, B., Kiman, S. and Murtala, A.M., 2012. Solar dryer-an effective tool for agricultural products preservation. *Journal of Applied Technology in Environmental Sanitation*, *2*(1).

Leon, M.A., Kumar, S. and Bhattacharya, S.C., 2002. A comprehensive procedure for performance evaluation of solar food dryers. Renewable and Sustainable Energy Reviews, **6**(4):367-393.

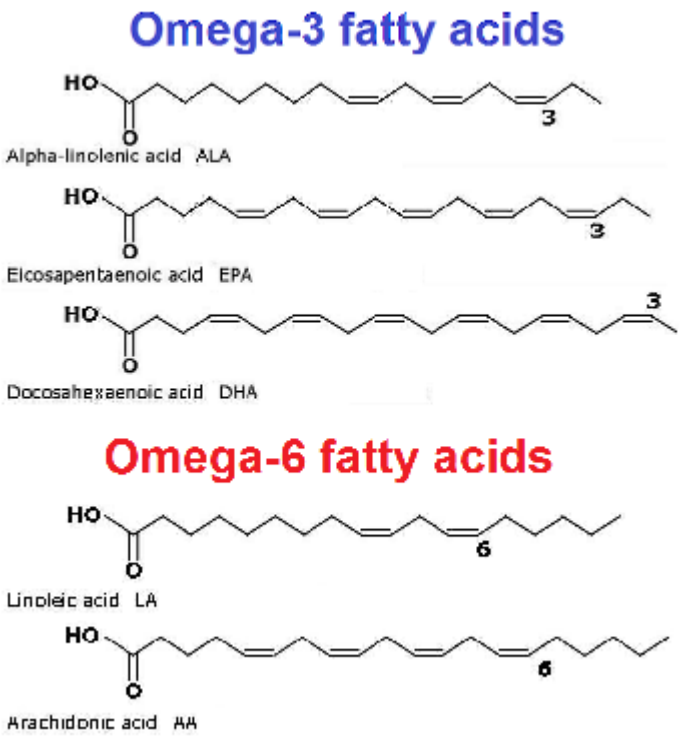
Singh, P., Shrivastava, V. and Kumar, A., 2018. Recent developments in greenhouse solar drying: A review. *Renewable and Sustainable Energy Reviews*, *82*: 3250-3262.

Sontakke, M.S. and Salve, S.P., 2015. Solar drying technologies: A review. *International Journal of Engineering Science*, *4*(4): 29-35.

* * * * * * * *

Cultivating Healthier Fats: The Quest for Sustainable Plant-Based Omega-Fatty Acids

IbandalinMawlong*, M. S. Sujith Kumar, Reema Rani, Lalit Krishna Meena and Babli Mog[1]
ICAR-Directorate of rapeseed mustard research, Bharatpur 321303, Rajasthan.
[1]ICAR-Directorate of Cashew Research, Puttur, Karnataka-574202
*Corresponding Author: iban02@gmail.com



Chemically, vegetable lipids, commonly known as fats and oils, constitute a significant energy and nutritional source in the human diet. They are primarily composed of a wide variety of fatty acids (FAs) in the form of triacylglycerol (TAG), a major storage component in the seeds of various plant species (Schmid and Ohlrogge, 2002). Dietary lipids encompass various types of fatty acids, which can be categorized into three main groups: saturated fatty acids (SFA), monounsaturated fatty acids (MUFA), and polyunsaturated fatty acids (PUFA). The PUFA category includes two classes: omega-3 (ω-3) and omega-6 (ω-6). The two most crucial fatty acids for human health are linoleic acid (C18:2) and linolenic acid (C18:3), belonging to the ω-6 and ω-3 classes, respectively. These essential fatty acids are only obtainable from vegetable lipids (along with certain fish lipids) as they are not synthesized by the human body. The quantity and quality of fatty acids present in dietary fats determine their suitability for human consumption (Bhattacharya et al., 2012).

Vegetable oils such as palm kernel or coconut oil are rich in short-chain saturated fatty acids, whereas soybean and canola oils are abundant sources of polyunsaturated fatty acids (ω-3 and ω-6). However, oils rich in polyunsaturated fatty acids, despite being considered healthy, are inherently less stable due to the presence of additional double bonds. To enhance the shelf life and maintain the flavor and consistency of oil-containing foods, edible vegetable oils are often subjected to hydrogenation or partial hydrogenation, which removes double bonds (Stauffer, 1996).

Very long-chain polyunsaturated fatty acids (VLC-PUFA) like eicosatetraenoic acid (EPA) and docosahexaenoic acid (DHA) play a significant role in human nutrition, with marine fish being their primary source. The rising demands in the pharmaceutical industry have created pressure on the aquaculture sector due to the limited supply of marine stocks. Overfishing and environmental marine pollution underscore the need for alternative sources of VLC-PUFA (Mansour et al., 2014; Ruiz-López et al., 2012). With advancements in genetic engineering, progress has been made in synthesizing and accumulating VLC-PUFA in the seed oils of transgenic plants. In recent decades, numerous genes encoding the VLC-PUFA biosynthetic pathway have been identified and characterized, enabling the reconstruction of VLC-PUFA pathways in oilseed crops, approaching the levels found in native marine organisms (Ruiz-López et al., 2012). The production of EPA and DHA in important oilseed crops represents a significant achievement, as all fish oils contain a mixture of these fatty acids, making it a plant-based substitute for fish oil. However, challenges persist in achieving a plant-based oil that closely matches commercially available fish oils. While EPA has been genetically produced in oilseeds at levels approaching those found in natural fish oil, other hurdles must be addressed to create a viable commercial product. Maintaining low levels of omega-6 fatty acids, pathway intermediates, and

pathway by-products, which are not typically found in fish oil, while further increasing the EPA content, is of paramount importance (Damude and Kinney, 2008).

Health benefits of omega fatty acids

Oilseed crops were domesticated over a millennium ago, and the presence of primary fatty acids like linoleic acid (LA) and alpha-linolenic acid (ALA) in most plant seed oils has played a crucial role in human history for thousands of years (Mansour et al., 2014). The need for these essential fatty acids in higher animals arises from the absence of genes encoding key fatty acid desaturases found in plants and lower eukaryotic animals like insects and nematodes. A significant portion of research efforts is motivated by the desire to enhance the composition of vegetable oils. While vegetable oils are rich in LA and ALA, they lack some of the other longer polyunsaturated fatty acids associated with optimal human nutrition (Napier and Graham, 2010).

List of the health benefits of omega fatty acids:

Conversion of Essential Fatty Acids (LA and ALA)

In the body, essential fatty acids such as linoleic acid (LA) and alpha-linolenic acid (ALA) are converted into very-long-chain polyunsaturated fatty acids (VLCPUFA), specifically arachidonic acid (ARA) and eicosapentaenoic acid (EPA) (Sprecher 2000).

Inflammatory Response Regulation

ARA and EPA serve as precursors for the production of eicosanoids, which are critical in regulating inflammatory responses (Funk 2001). ARA-derived eicosanoids induce robust inflammation, while those derived from EPA help attenuate this response (Calder 2003, Simopoulos 2006, Smith 2005).

Physiological Roles in Human Health

VLCPUFA, particularly docosahexaenoic acid (DHA), are essential components of cell membrane phospholipids. DHA plays a significant role in the composition of mammalian retinal and brain membranes and has been linked to cognitive development in infants (Iribarren et al. 2004, Stoll et al. 2001, Willatts and Forsyth 2000).

Cardiovascular Health

Studies have shown that the consumption of EPA and DHA is associated with positive effects on cardiovascular health (Ruxton et al. 2007).

Inflammatory Disease

Omega-3 fatty acids, particularly EPA, have been linked to the alleviation of inflammatory diseases (Smith 2005).

Mental Health

Research suggests potential benefits for mental health through the consumption of omega-3 fatty acids, especially EPA and DHA (Ruxton et al. 2007).

Blood Clotting and Blood Pressure Regulation

Eicosanoid molecules derived from ARA and EPA play a role in regulating blood clotting and blood pressure, critical metabolic functions in the human body (Yaqoob 2003).

Modulation of Inflammatory Response

The balance between different eicosanoids derived from ARA and EPA is crucial in modulating the inflammatory response (Calder 2003, Simopoulos 2006, Smith 2005).

Pharmaceutical Potential

Highly purified or enriched VLC omega-3 oils are sought after for their bioactive function and potential use as pharmaceutical products (Damude and Kinney 2008).

Omega Fatty Acid Engineering

Transgenic Plants for Fatty Acid Synthesis

VLCPUFA (Very-Long-Chain Poly unsaturated Fatty Acids) contain 20 or 22 carbon atoms and 4, 5, or 6 methylene-interrupted cis double bonds and can be categorized into ω-6 and ω-3 families based on the position of the first double bond (Venegas et al. 2010). ARA (Arachidonic Acid, ω-6), EPA (Eicosapentaenoic Acid, ω-3), and DHA (Docosahexaenoic Acid, ω-3) are essential VLCPUFA for human nutrition, primarily obtained through marine fish consumption (Venegas et al. 2010). VLCPUFA are vital for human nutrition due to limited endogenous synthesis from essential precursor ALA (Alpha-Linolenic Acid) (Venegas et al. 2010).

To meet the growing population's demand for VLCPUFA, transgenic plants have been explored as an alternative, sustainable source (Venegas et al. 2010). Engineering oilseed plants rich in ω-6 fatty acids (e.g., soybean and canola) to produce EPA and DHA has been a focus of research efforts (Venegas et al. 2010).

Balancing Fatty Acids for Health: Genetic Manipulation of Fatty Acid Profiles

Maintaining a proper balance of various fatty acids, including saturated, unsaturated, ω-3, and ω-6, is crucial for overall health (Lands 2005). Successful attempts have been made to manipulate the fatty acid profiles of ω-6 oilseed crops, with a focus on redirecting fatty acid biosynthesis to improve oxidative stability and solid fat content in vegetable oils (Kinney and Knowlton 1998, Del Vecchio 1996).

Advanced Genetic Technologies

Recent advances in plant transformation and gene expression technologies enable the introduction of complex, multigene metabolic pathways (Damude and Kinney 2008). Transferring the metabolic pathway for EPA and DHA from marine algae to oilseed crops, containing LA and ALA, is now feasible and offers a sustainable source of ω-3 VLCPUFA (Damude and Kinney 2008).

Commercial Viability

Producing VLCPUFA in oilseed plants such as soy, flax, or canola is seen as a cost-effective and sustainable alternative to fish- or microalgal-derived oils (Damude and Kinney 2008).

A suitable target for commercial production is an oil with low omega-6 fatty acid content (2-5%) and a combined omega-3 VLCPUFA content (EPA, DHA) of 10-25% (Damude and Kinney 2008).

Conclusion

In conclusion, the multifaceted applications of plant oils extend beyond their significance in the nutritional industry, encompassing their growing role as alternatives to petrochemicals for fuel and chemical feedstock purposes. Substantial efforts have been dedicated to tailoring the fatty acid composition of seed oils and elevating triacylglycerol levels through transgenic metabolic engineering, culminating in the development of "designer oils." Notably, this pursuit has yielded oils rich in ω-3 long-chain polyunsaturated fatty acids, rivaling levels found in native marine organisms. For industrial use, the enrichment of plant oils with very-long-chain polyunsaturated fatty acids (VLCPUFA) needs to be extensive, but in the realm of edible plant oils, comparatively modest VLCPUFA percentages suffice to meet nutritional needs. Production of VLCPUFA in vital oilseed crops like soy, flax, or canola emerges as an economically viable and sustainable alternative to oils derived from fish or microalgae, which are rich in VLCPUFA. While substantial progress has been made in achieving target levels of eicosapentaenoic acid (EPA), the pursuit of oils containing blends of EPA and DHA approaching the composition of marine oils is ongoing. Technological advancements hold the promise of tripling DHA levels while maintaining EPA content in the 10–15% range, offering an effective substitute for marine oils (Damude and Kinney, 2008). The significance of polyunsaturated fatty acids, including linoleic acid (C18:2 ω-6), linolenic acid (C18:3 ω-3), and longer ω-3 fatty acids like eicosapentaenoic acid, docosapentaenoic, and docosahexanoic acid, cannot be overstated. Both the ω-6 and ω-3 families of essential fatty acids play pivotal roles in health, particularly cardiovascular well-being, underlining the importance of a balanced dietary fat with an ideal ω-6 to ω-3 ratio of 6:1 (Bhattacharya et al. 2012; Wijendran and Hayes 2004).

Selected References

Bhattacharya, S., Sinha, S., Dey, P., Das, N., and Maiti, M. K. (2012). Production of nutritionally desirable fatty acids in seed oil of Indian mustard (Brassica juncea L.) by metabolic engineering. *Phytochemistry reviews*, *11*(2-3), 197-209.

Damude, H. G., & Kinney, A. J. (2008). Engineering oilseeds to produce nutritional fatty acids. *Physiologiaplantarum*, *132*(1), 1-10.

Mansour, M. P., Shrestha, P., Belide, S., Petrie, J. R., Nichols, P. D., and Singh, S. P. (2014). Characterization of oilseed lipids from "DHA-producing Camelina sativa": A new transformed land plant containing long-chain omega-3 oils. *Nutrients*, *6*(2), 776-789.

Ruiz-López, N., Sayanova, O., Napier, J. A., and Haslam, R. P. (2012). Metabolic engineering of the omega-3 long chain polyunsaturated fatty acid biosynthetic pathway into transgenic plants. *Journal of experimental botany*, *63*(7), 2397-2410.

Napier, J. A., & Graham, I. A. (2010). Tailoring plant lipid composition: designer oilseeds come of age. *Current opinion in plant biology*, *13*(3), 329-336.

Venegas-Calerón, M., Sayanova, O., & Napier, J. A. (2010). An alternative to fish oils: metabolic engineering of oil-seed crops to produce omega-3 long chain polyunsaturated fatty acids. *Progress in lipid research*, *49*(2), 108-119.

Abbadi, A., Domergue, F., Bauer, J., Napier, J. A., Welti, R., Zähringer, U. and Heinz, E. (2004). Biosynthesis of very-long-chain polyunsaturated fatty acids in transgenic oilseeds: constraints on their accumulation. *The Plant Cell*, *16*(10), 2734-2748.

* * * * * * * *

Lab Grown Meat: Future Sustainable Alternative to Meat

MS. Rosalin sahoo[1] and C. Devadarshini[2]
[1]M. Sc Community Science (Food and Nutrition)
[2]Asst. Prof (FN), College of Community Science
Odisha University of Agriculture & Technology, Bhubaneswar
*Corresponding Author: chitramickey@gmail.com

Seventy billion land animals, and possibly trillions of marine animals, are killed for human consumption each year. Meat intake around the world in both developed and developing countries are increasing rapidly during the second half of the 20th century, worldwide meat consumption grew by five times as much, increasing from 45 million tonnes of meat eaten in 1950 to nearly 300 million tonnes now. As a consequence of estimated population increase and growth in welfare, meat demand is expected to grow by 75 per cent around 2050, whilst production of meat through livestock could stay sluggish, more food will be required to satisfy the demand of the increasing population, which is a big challenge because of the resources and agricultural land limitations.

A majority of these animals are raised in factory farms, where they experience brutal forms of abuse. Major meat producers often defend factory farming as the most efficient way to meet the global demand for meat. But evidence shows that these facilities are disastrous for the environment, nearby communities, consumer health, and animal welfare. It shouldn't have to be this way. It's time to fix our broken food system. It's time to look for alternatives. Lab-grown meat could hold the key.

Cultured or Lab-grown meat has its place in the developing field of cellular agriculture and constitutes a hopeful technology. This innovative technology seeks to offer decreasing negative impacts on animal as well as on humans, the environment, and livestock. Lab-grown meat provides a safe and infection-free path to meet the growing meat necessity without the involvement of animal killing while at the same time decreasing greenhouse emissions, caused by meat derived from animal abuse.

What is Lab Grown Meat

Lab grown meat is the cultured, cultivated, cell-based clean meat. Lab-grown meat is a invention of modern science and technology. Scientists can now harvest a small sample of cells from a living animal and cultivate the sample to grow outside of the animal's body, shaping the fully formed sample into cuts of meat.

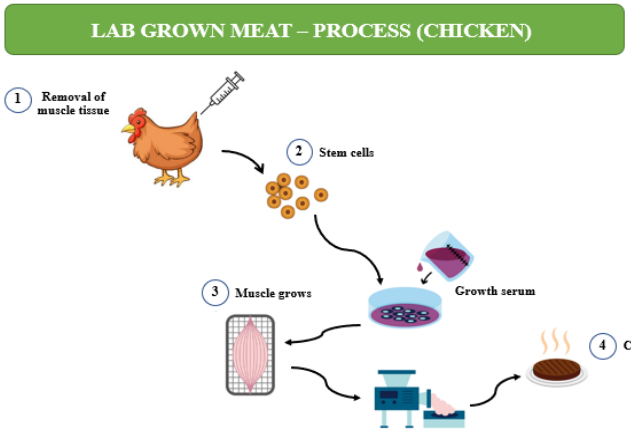
Process of Lab Grown Meat

Instead of killing animals for their meat, the process of making lab-grown meat starts with the careful removal of a small number of cells from a living animal, typically using local anesthesia to provide relief from pain. A sample of stem cells is taken from a live animal (stems cells are cells that can develop into other specialized types of cells found in the body, for example, blood, liver or muscle cells). The stem cells are put in large tanks called bioreactors, containing culture media that recreate a similar environment for the cells in the animal's body and are provided with the nutrients that they need to multiply. The culture media is changed according to the requirement so that stem cells can differentiate into the three main components of meat: muscle, fat, and connective tissue. The cells grow and multiply, producing real muscle tissue, which scientists then shape into edible "scaffoldings." A scaffold is an edible material .These cells are separated and arranged to "build" the type of meat that is being produced and give it a desirable shape. It also carries nutrients and helps them differentiate even further. Using these scaffoldings, they can transform lab-grown cells into steak, chicken nuggets, hamburger patties, or salmon sashimi. The final product is a real cut of meat, ready to be marinated, breaded, grilled, baked, or fried—no animal slaughter required.

Nutritional Aspects of Lab Grown Meat

When lab-grown meat reaches the shelves, it could be healthier than meat reared from livestock. According to researchers in the Journal of Scientific Research, Lab grown meat could be an excellent functional food that can be modified and enrich the content of essential amino acids and fats, vitamins, minerals and bioactive compounds so that not only equivalent to natural meat but also exceeds it to meet

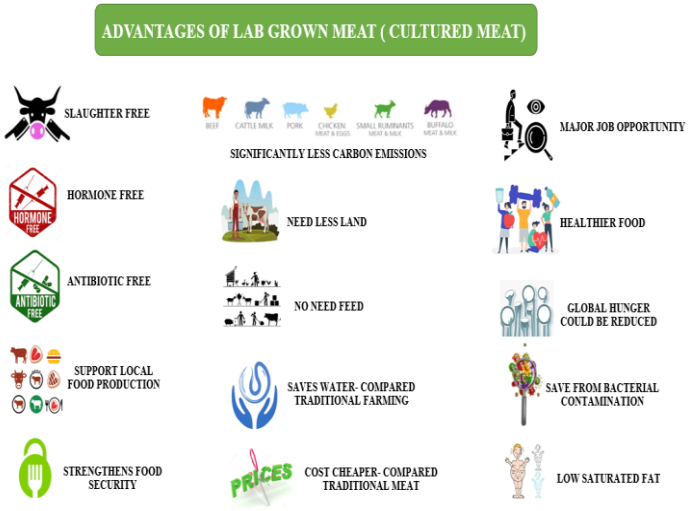
specific dietary needs for people with various ailments.



Additionally, after the introduction of functional and fortified foods, consumers are more willing to use the products that have been modified to have particular functional and nutritional characteristics according to their needs. Controlling the amount of fat or reducing cholesterol or even adding in heart -healthier fats instead, such as omega -3 fats (derived from fatty fish).

The cultured meat could help alleviate certain nutritional deficiencies in these populations and support the physical and mental development of children.

Strictly controlled hygiene conditions in sterile systems applied to the production of lab grown meat contribute significantly in improving its safety by minimizing the risk of zoonotic and food-borne pathogens, viruses such as avian influenza, swine flu or prions for transmissible spongiform encephalopathies. Scientists also hope that the need for pesticides, fungicides, growth factors and antimicrobials which are used in excess for conventional meat production, may be significantly reduced as the consumption of culture meat increases. In the future, the ever-growing production and cost reduction of lab grown meat, possibly below traditional animal husbandry, would make its consumption more affordable and could increase access to meat even in developing countries.



Lab-grown meat production is an innovative technology with several advantages. This is a great future sustainability for natural meat. The lab-grown meat is definitely a benefit to humanity and will play an important role in food, dietary as well as ecological sustainability and security. Consumer acceptance, safety, and security of lab-grown meat as well as consumer education will have to be concentrated for the use of lab-grown meat. Lab-grown meat is going to be a powerful environmentally sustainable tool for businesses, cities, as well as nations to build a healthier, more effective, and efficient, as well as a more civilized food system.

* * * * * * * *

Gender-centred Approach for Food and Nutritional security: A Way Forward

Marneni Divya Sree
Department of Agricultural Extension, College of Agriculture, Vellanikkara, Kerala Agricultural University, Thrissur, Kerala- 680656.
*Corresponding Author: marnenidivyasree@gmail.com

Despite decades of global development efforts to combat food and nutrition insecurity, the problem of hunger and undernourishment persists, particularly in the developing world. Reports indicate that the number of undernourished people has been increasing since 2015 (UN, 2021; FAO, 2020). However, policymakers and practitioners remain committed to finding solutions to this ongoing and critical issue, which causes suffering for millions worldwide.

Certain groups are more affected by food and nutrition insecurity. Smallholder farmers in developing countries are known to be among the most food-insecure populations (Ogutu and Qaim, 2019; FAO, 2019; Fanzo, 2018; Sibhatu and Qaim, 2017). Within this group, youth, indigenous people, and especially women face even greater challenges. In 2019, food insecurity was more prevalent among women than men on all continents, and 60% of the chronically hungry population consisted of women and girls.

Evidence demonstrates that gender inequality contributes to food insecurity, with hunger being more prominent in countries with lower gender equality levels. Increasing gender equality and women's empowerment have positive effects on food security and nutrition (CARE, 2020b). Women play crucial roles in the agricultural sector, representing over 37% of the global rural agricultural workforce. This percentage rises to 48% in low-income countries and reaches as high as 80% in Sahelian countries (FAO, 2016). Additionally, women make up nearly half of the world's 600 million small-scale livestock farmers and about half of the workforce in small-scale fisheries. However, their work, often conducted informally within family settings, is frequently undervalued.

It is worth noting that if women in rural areas had the same access to productive activities as men, agricultural production would increase, potentially providing sustenance for an additional 150 million people (FAO, 2011). This underscores the recent call in the State of Food and Nutrition Security in the World report for the inclusion of women in discussions and actions concerning the future of food systems (FAO, 2021).

This paper argues that in developing countries, a stronger gender perspective should be at the forefront of the food systems, given women's pivotal role in ensuring food security, nutrition, sustainability, and resilience of agrifood systems.

Understanding gender duality in Food Systems

Oxfam (2019) points out that "women are vulnerable on all dimensions of food security: availability, access, utilization, and stability." This underscores the importance of integrating a strong gender perspective in discussions about food systems. Women are central to food systems, serving as both producers and the primary caretakers of households.

Women's roles in food production range from being direct producers on their account, wage workers, to unpaid labour on family farms (UNDP, 2016; Raney *et al*., 2011).

Women's food production role

While significant strides have been made toward achieving the fifth goal of the Sustainable Development Goals (SDGs), gender inequality remains a persistent challenge, even in advanced economies (UN, 2019; IISD, 2019). This article delves into specific obstacles that women encounter within local food systems and their food security needs.

In the realm of agriculture, deeply ingrained gender norms impose limitations on women in various ways. These norms often designate men as the heads of households, granting them control over household decision-making, which encompasses the allocation of resources, including household income and expenditures (Hillenbrand and Miruka, 2019). Another prevalent gender barrier experienced by women in rural areas is mobility restrictions, which confine them to their home areas (Diiro et al., 2018). Additionally, within the economic system, women face inherent gender biases that restrict their access to

credit. Smallholder female farmers, in particular, encounter challenges in obtaining loans due to societal norms and the absence of collateral (FAO, 2019).

It is essential to recognize that different households, and consequently women from various households, encounter varying levels of constraints in economic resources and opportunities based on their socio-economic characteristics. A secure source of livelihood is paramount for individual and household food and nutrition security, making it an integral component of local food systems.

Women's reproductive role

Gender disparities influence food dynamics not only on a global and community level but also in households. Women across the world undertake a disproportionate amount of reproductive work in addition to their productive responsibilities, often performing nearly two and a half times as much work as men (OECD, 2014). This includes caring for children and family members, cleaning, gathering food, fetching water and firewood, preparing meals, and feeding the family. UN-Women (UN, 2012) highlights that women in sub-Saharan Africa collectively spend up to 40 billion hours annually fetching water, a task that significantly impacts their employment opportunities. Notably, the health and general well-being of children is closely tied to the role of mothers (Halim et al., 2011; Quisumbing et al., 1996). This influence begins during women's pregnancies, as their nutritional status during pregnancy and breastfeeding plays a crucial role in the nourishment and health of their children.

Furthermore, in comparison to men, women tend to allocate a higher proportion of their income toward family expenditures related to food, health, and education (Quisumbing et al., 1996). UN-Women (UN, 2012) emphasizes that when more income is placed in the hands of women, it leads to improvements in child nutrition, health, and education. It is estimated that at least 90% of women's income is reinvested into their households and families (FAO, 2016; CGI, 2021). Paradoxically, despite being the primary caregivers and food providers in their households, women often find themselves eating last and receiving the smallest portions (CARE, 2020a).

Nutrition knowledge is a critical component of an effective food system as it contributes to the adoption of healthy diets. Notably, reports indicate that the majority of the world's illiterate individuals (75%) are women (UN, 2012). Limited access to nutrition knowledge contributes to food insecurity among women. As proposed by the Committee on World Food Security (CFS, 2021), promoting healthy diets and sustainable food systems involves empowering key actors by supporting them in enhancing their knowledge, awareness, education, the quality of information available, motivations, skills, and sustainable practices. Furthermore, evidences shows that gender-based violence is a systematic barrier to women's empowerment in food systems.

Conclusion

The existing gender gap and challenges in access to productive resources, markets, and agricultural services pose a challenge to the sustainability and resilience of these food systems. Addressing gender inequality, particularly in enabling women's access to and control over land and productive resources, is perceived as a pivotal step toward enhancing food access and availability at both the community and household levels.

While there is a growing awareness of women's roles in food security, as Clement *et al.* (2019) point out, this has not translated into "actual investments dedicated to women's empowerment and resulting outcomes on gender equality and enhanced food security." It is time to systematically incorporate a robust gender perspective into food systems.

To achieve this, there are several key recommendations:

Incorporating a strong gender perspective

Include a robust gender perspective, supported by accurate sex-disaggregated data at the individual level. Additionally, data should be disaggregated by other socioeconomic characteristics such as age, race, class, and geographical location. Current monitoring and evaluation approaches often fall short by primarily collecting household data and failing to delve into individual-level dynamics. Given that men often serve as the heads of households in

many rural areas, it is vital to investigate the factors influencing women's food security individually (Visser & Wangu., 2021). Much of the literature on gender focuses on social norms that are specific to local contexts. More targeted research is needed to identify patterns and pathways to advance women's empowerment across different geographies.

Placing women at the center of food security solutions

Women's decision-making power is a cross-cutting issue, but is often studied at the individual, household, or community level. It remains understudied at the level of food systems. Research at this level would focus on strategies to increase women's voices and preferences in agricultural solutions, including technology design, extension, and adoption, and in setting research and policy priorities for food systems transformation.

Contextual analysis of gender inequality

Gender disparities in impoverished communities are interconnected with other challenges faced by these communities, including poverty, health and well-being issues, access to clean water and sanitation, decent work, and the impacts of climate change. There is also a link between women's mental health and household nutrition. While the evidence on this is mixed and limited, some studies suggest that maternal depression can lessen household food security, and interventions that improve food security can also improve mental health. To start building this evidence, IFPRI researchers in 2021, added indicators on sexual harassment and violence against women to the Women's Empowerment in Agriculture Index for Market Inclusion (pro-WEAI+MI) (Njuki, *et al*., 2021. More research is needed on these psychosocial indicators of women's health and the links between mental health and food insecurity.

Gender inequalities must be analyzed within the broader context of these challenges, highlighting the intersectionality of these issues. Different individuals within seemingly homogenous communities have varying abilities, needs, and capacities, necessitating solutions that reflect these diverse realities. This approach will contribute to a more nuanced and effective policy and practice framework for resilient and sustainable food systems that can lead to food security for all.

References

CARE, 2020a. Left out and left behind: Ignoring women will prevent us from solving the Hunger crisis. In: Policy Report. CARE, London.

CARE, 2020b. COVID-19, Food & Nutrition Security, and Gender Equality. CARE, London.

CFS, 2021. The FCS Voluntary Guidelines on Food Systems and Nutrition. Committee on World Food Security (CFS), Rome.

CGI, 2021. Empowering Girls & Women. Clinton Global Foundation, New York.

Clement, F., et al., 2019. From women's empowerment to food security: revisiting global discourses through a cross-country analysis. Global Food Security 23, 160–172.

Diiro, G.M., et al., 2018. Women's empowerment in agriculture and agricultural productivity: evidence from rural maize farmer households in western Kenya. PLoS One 13 (5), e0197995.

Fanzo, J., 2018. The role of farming and rural development as central to our diets. Physiol. Behav. 193, 291–297.

FAO, 2011. The State of Food and Agriculture 2010–2011, Women in Agriculture: Closing the Gender Gap for Development. Food and Agricultural Organization, Rome.

FAO, 2016. Women Hold the Key to Building a World Free from Hunger and Poverty [cited 2021 May 10]; Available from: http://www.fao.org/news/story/en/item/460267/icode/.

FAO, 2016. Women Hold the Key to Building a World Free from Hunger and Poverty [cited 2021 May 10]; Available from: http://www.fao.org/news/story/en/item/460267/icode/.

FAO, 2019. FAO Framework on Rural Extreme Poverty: Towards reaching Target 1.1 of the Sustainable Development Goals. Food and

Agriculture Organization of the United Nations, Rome.

FAO, 2019b. Women's Access to Rural Finance: Challenges and Opportunities. Food and Agricultural Organization, Rome.

FAO, et al., 2020. The State of Food Security and Nutrition in the World 2020. Transforming Food Systems for Affordable Healthy Diets. Food and Agricultural Organization, Rome.

FAO, et al., 2021. The State of Food Security and Nutrition in the World 2021: Transforming Food Systems for Food Security, Improved Nutrition and Affordable Healthy Diets for All. FAO, Rome.

Halim, N., Bohara, A.K., Ruan, X., 2011. Healthy mothers, healthy children: does maternal demand for antenatal care matter for child health in Nepal? Health Policy Plan. 26 (3), 242–256.

Hillenbrand, E., Miruka, M., 2019. Gender and Social Norms in Agriculture: A Review. IFPRI Book Chapters, pp. 11–31.

IISD, 2019. SDG Knowledge Weekly: Gender Gaps [cited 2021 May 12]; Available from: https://sdg.iisd.org/commentary/policy-briefs/sdg-knowledge-weekly-gender-gaps/.

Njuki, J., Eissler, S., Malapit, H., Meinzen-Dick, R., Bryan, E., Quisumbing, A., n.d. Food Systems Summit Brief Prepared by Research Partners of the Scientific Group for the Food Systems Summit, May 11th 2021.

OECD, 2014. Unpaid Care Work: The Missing Link in the Analysis of Gender Gaps in Labour Outcomes. Organisation for Economic Co-operation and Development, Paris.

Ogutu, S.O., Qaim, M., 2019. Commercialization of the small farm sector and multidimensional poverty. World Dev. 114, 281–293. Oxfam, 2019. Gender Inequalities and Food Insecurity: Ten Years after the Food Price Crisis, Why are Women Farmers Still Food-Insecure? Oxfam, Oxford.

Quisumbing, A., et al., 1996. IFPRI food policy statement. Women: the key to food security. Food Nutr. Bull. 17 (1).

Raney, T., et al., 2011. The Role of Women in Agriculture.

Sibhatu, K.T., Qaim, M., 2017. Rural food security, subsistence agriculture, and seasonality. PLoS One 12 (10), e0186406.

UN, 2012. UN Women - Facts and Figures [cited 2021 May 12]; Available from: https ://www.unwomen.org/en/news/in-focus/commission-on-the-status-of-women-201 2/facts-and-figures.

UN, 2019. Progress, gaps and obstacles: are we on track for leaving no one behind?. In: High-Level Political Forum on Sustainable Development. United Nations, New York.

UN, 2021a. Goal 2: Zero Hunger [cited 2021 April 22]; Available from: https://www.un. org/sustainabledevelopment/hunger/.

UNDP, 2016. Gender and Climate Change. Gender, Climate Change and Food Security. United Nations Development Programme, New York.

Visser, J., Wangu, J., 2021. Women's dual centrality in food security solutions: The need for a stronger gender lens in food systems' transformation. Current Research in Environmental Sustainability 3, 100094.

* * * * * * * *

Supercritical Fluid Extraction: Green Solution to Conventional Extraction

Amruta Dandwate[1], Anil Ghorband[2] and B. H. Joshi[3]
College of Food Processing Technology & Bioenergy, Anand Agricultural University, Anand, Gujarat, India
*Corresponding Author: amrutadandwate01@gmail.com

Supercritical Fluid Extraction (SFE) is a novel and environmentally benign separation technology represents a green alternative to the conventional extraction methods to produce natural extracts. The use of a green solvent (supercritical carbon dioxide), a quick and more efficient procedure, and a relatively low rate of chemical compound degradation make the supercritical fluid extraction (SFE) a fascinating alternative. Supercritical fluid extraction (SFE) may be defined as separation, moreover extraction of compounds of interest (from coffee, tea, hops, herbs, and spices) using supercritical fluid as an extracting solvent/mobile phase.

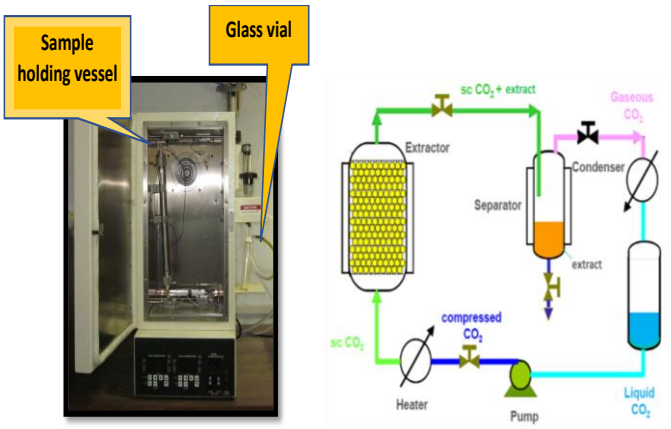
- It resembles Soxhlet extraction except the solvent here being supercritical fluid.
- In this process, the mobile phase is subjected to pressures and temperatures near or above the critical point for the purpose of enhancing the mobile phase solvating power.
- The process begins with fluid in vapor form. It is then compressed into a liquid before becoming supercritical. While supercritical, the extraction takes place.

Principle of SCFE

The principle consists in circulating supercritical CO2, through the raw material (e. g. natural plants), and depressurizing the mixture to recover the extract. Indeed, after depressurization the CO2 is released in gaseous form (re-usable) and lose its solvent property leading to condensation of the extract into liquid or solid form.

Supercritical fluid extraction is the most effective and efficient method for extracting important component phytochemicals. The method of supercritical fluid extraction (SFE), which uses CO2 as the extracting solvent, separates one component (the extractant) from another (the matrix). The king of botanical extraction solvents is CO_2.

The critical temperature and critical pressure for supercritical CO2 extraction are higher than 31°C and 74 bar, respectively. Carbon dioxide is odourless, non-toxic, non-flammable, inexpensive, easy to remove from the product. Also, it is eco-friendly and generally recognized as safe (GRAS) by FDA.



Supercritical Fluid Extraction assembly and cycle

Supercritical fluids are extremely compressed gases that have intriguingly mixed properties of both gases and liquids. Reactions that are challenging or perhaps impossible to achieve in normal solvents can occur in supercritical fluids. Analyte and a supercritical fluid are easily separated releasing pressure can separate the critical fluid from the analyte, leaving almost no residue and producing a pure residue.

Phase diagram of supercritical fluid

Critical temperature (tcr)

Highest temperature at which gas can be converted to liquid by an increase in pressure

Critical pressure (tpr)

Highest pressure at which liquid can be converted to gasy an increase in temperature

Triple point (ttp)

A point at which gas, liquid and solid phases exists in equilibrium.

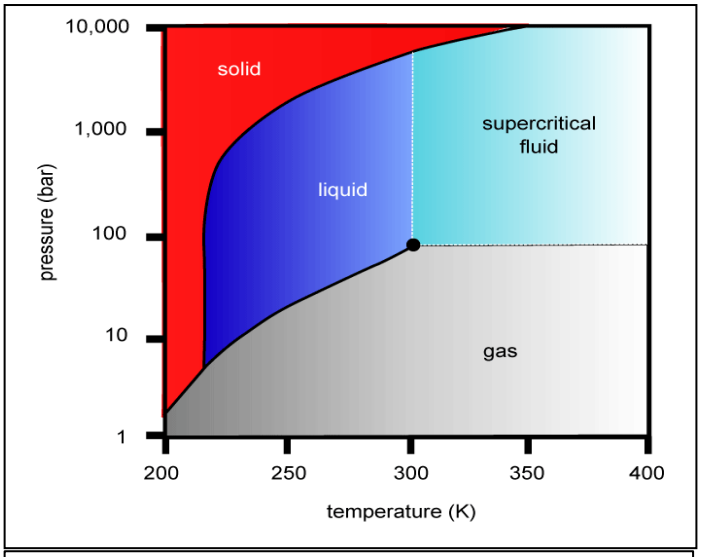
Common Super-critical Fluids:

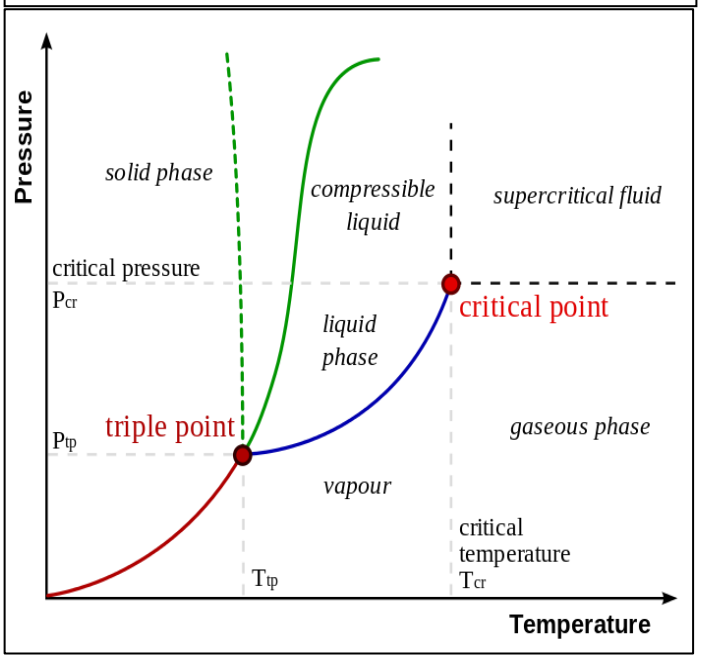
- Water and Carbon Dioxide

Carbon dioxide

- Its low critical temperature, 31.1 °C, and low critical pressure, 72.9 atm, are relatively easy to achieve and maintain.

- Environmentally friendly and generally recognized as safe (GRAS) by FDA.
- Odourless, non-toxic, Non-flammable, inexpensive, easy to remove from the product.





Phase diagram of Super critical fluid extraction

Advantages

- SFE have higher selectivity because the solvation power of the Supercritical fluid can be adjusted by changing temperature and pressure.
- Supercritical fluids have lower viscosity and higher diffusivity which allow faster mass transfer of solutes from porous plant materials.
- SFE can be performed at low temperatures making the process ideal for the extraction of thermally labile compounds.
- In SFE can easily separate supercritical carbon dioxide which is dissolved in extract by depressurization with little to no solvent residue left behind.
- SFE units can be coupled to a GC-MS or NMR allowing extraction, analysis, and quantification of extracted molecules instantaneously.

Limitations:

- Prolonged time (diffusion of SCF into solid is rapid but diffusion of solute into SCF sometime takes time)
- Scale is not possible (due to lack of fundamental, molecular- based model of solute in SCF
- Very expensive: Due to requirement of very high pressure for extraction
- Polar substances cannot be extracted. (As CO2 itself is non-polar)
- High power requirement
- Use of organic solvents as modifiers makes it less green.

Applications

- Extraction of essential oils and its derivatives for use in food, pharma and cosmetics
- Extraction of flavours from natural resources.
- Extraction of fat from food products
- Decaffeinating of tea and coffee
- Separation of lecithin from oil
- Extraction of hop constituents
- Extraction of bioactive compounds from different commodity like beta carotene from carrots, lycopene from tomato
- Extraction of oils is used to produce fat-free and reduced fat potato chips and other snacks.
- Removal of alcohol from wine, beer, and similar products

Conclusions

Supercritical technology is a promising alternative technology for extracting unusual compounds due to its selectivity, efficiency, and speed of operation. It is eco-friendly method as it uses Carbon dioxide which is non-toxic, and FDA considered as GRAS (Generally recognized as safe). Extracts from natural sources are key elements in the

manufacturing of health-promoting functional foods and ingredients. Thus, the development and use of "green" separation processes and technologies will likely continue to be widely employed in the processing of bioactive components, especially for use as supplements for health-promoting foods.

References

Soong Y. Y., and Barlow P. J. (2004). Antioxidant activity and phenolic content of selected fruit seeds. Food Chemistry, 88(3), 411-417.

Straccia M. C., Siano F., Coppola R., La Cara F. and Volpe M. G., (2012). Extraction and characterization of vegetable oils from cherry seed by different extraction processes, Chemical Engineering Transactions, 27, 391-396.

Sapkale G. N., Patil S. M., Surwase U. S. & Bhatbhage P. K. (2010). Supercritical fluid extraction. International Journal of Chemical Science, 8(2), 729-743.

* * * * * * * *

Wood Apple: A Fruit Rich in Nutritional and Medicinal Values

Thirumalaisamy P. P.[1]*, Anuradha Sane[2], Suma A.[1], Pradheep K.[1], Latha M.[1] and Venkatesan K.[1]
[1]ICAR-National Bureau of Plant Genetic Resources Regional station, Thrissur
[2]ICAR-Indian Institute of Horticultural Research, Bengaluru
*Corresponding Author: thirumalaisamypp@yahoo.co.in

Abstract

Wood apple is native to India and Sri Lanka. The tree is primarily wild, naturally distributed in forest and rarely found as single tree in farmer's field. It is distributed in the dry deciduous and semi-arid regions of Southern India, states of Gujarat, Madhya Pradesh, Orissa, West Bengal, Assam and Andaman & Nicobar Islands. The productive age of plant is 12-70 years. The fruit is rarely grown commercially in India but has enormous potential to be a major fruit. Existence of diversity in phenotypic characters of trees and fruits and quality parameters in fruit pulp provides a lot of scope for improvement of the species. Fruits contains an innumerable number of phytochemicals such as polyphenols, vitamins, saponins, coumarins, amino acids, tri-terpenoids, phytosterols, tannins, etc. In Indian traditional system of medicine, leaves, bark, rind of the fruit and pulp are used to prepare medicine. It is known to cure diseases like dysentery, diarrhoea, asthma, ulcer, wounds, tumours, hepatitis, cardiac debility etc. The trees are in threat of becoming an endangered species, as the wild trees are being cut without replanting. To conserve the species, efforts should be initiated to plant the tree in roadsides, social and community forest areas. Awareness among people may be created for its conservation.

Keywords: Wood apple, Medicinal values, Nutritional properties

Introduction

Wood apple (*Limonia acidissima* L. = *Feronia limonia* (L.) Swingle), belonging to the family, Rutaceae is only species within the monotypic genus *Limonia*. Common names are wood apple, elephant-apple, curd fruit, Indian wood apple and monkey fruit. The tree is native to India and Sri Lanka. Outside, the species is grown in fields, forests and along roadsides in Bangladesh, Cambodia, Malaysia, Thailand, Indonesia, and Pakistan. The tree is primarily wild, naturally distributed in forest and have not been selected for commercial cultivation. Fruit is labelled in fresh markets, based on its size. Larger size fruits are the most common in markets as they are valued for their sweet taste. Smaller size fruits are acidic and sour, making them less desired for culinary preparations. The trees were found mostly as single tree in farmer's field, whereas, in the forest, the population are scattered. The productive age of plant is believed to be 12-70 years. The fruit is rarely grown commercially in India but has enormous potential to be a major fruit. As ethnic value, the fruit is a customary offering to Lord Ganesh in India. It is important to note that wood apple is sometimes confused with bael fruit and may be called bael in some markets, but the two fruits are different species and should not be considered the same.

Tree bearing wood apple fruits

Distribution

Throughout the dry deciduous and semi-arid regions of Southern India, wood apple is distributed. Mainly, it is found in North-Western part of Tamil Nadu, Eastern Ghats of Andhra Pradesh, Northern, Central, and Southern parts of Karnataka, Northern region of Telangana and Central region of Kerala. It is also found in the states of Madhya Pradesh, Gujarat, Orissa, West Bengal, Assam and Andaman & Nicobar Islands.

Propagation and planting

It is a climate resilient fruit crop and can tolerate extreme dry conditions during flowering and fruit set. At the same time, it can tolerate wet condition

Fruiting in wood apple

during fruit set. Wood apple can be grown in fallow and barren waste land which is even devoid of essential elements as well. It is propagated by seeds or by soft wood grafting and patch budding. Buds taken from mature trees budded on seedlings are said to produce dwarf trees which fruit early. Planting is done in the rainy season at a spacing of 10m x 10m. Wood apple starts bearing at an age of 5-6 years.

Flowering in wood apple

Flowering and fruiting

Flowering stars in the month of March-April. Fruits are ready to harvest after 225 to 245 days after fruit setting. The fruits ripen from November to March, sometimes appearing later in the summer, depending on the region and growing environment. Ripe fruits drop from the trees, and as they have a hard shell outside, the inner pulp keeps well for some days. Pulp of immature fruit is cream in colour whereas, pulp of ripened fruit is chocolate brown or light brown or orange in colour. An average tree yields 250-500 fruits per year; bigger and more vigorous trees may yield more. Each fruit weighs about 150-500 g.

Training and pruning

Wood apple is not trained at its natural habitat. Cross branches should be removed during initial 2-3 years. Also, lanky and spreading branches are trained and staked properly. Normally pruning is done in the month of December to January.

Pest and diseases

1. Fruit borer (*Deudorix isocrates*): Caterpillar bores into young fruits and feeds on internal contents (pulp and seeds) leads to fruit rotting and dropping. Larvae is dark brown, short and stout, covered with short hairs. Adult is bluish brown butterfly, female has 'V' shaped patch on forewing.

2. Citrus butterfly (*Papilio demolious*): Caterpillar feed on the leaves causes defoliation. Early-stage larva resembles bird dropping. Grown up larva is

cylindrical, stout, green with brown lateral bond. Adult looks dark brown swallowtail butterfly with numerous yellow marking.

3. Leaf cutter bee (*Megachile* sp.): Adult bees cut the tender leaves and causes semi-circular notches.

After harvest, oozes and eruptions at fruit stalk-fruit joining region, reduces the consumers preference. Besides, monkeys, squirrels and elephants damage the fruits, in its natural habitat.

Genetic improvement

Parameters consisting of tree height, age, stem girth, length, and breadth of branches in all the directions, canopy coverage, number of fruits per plant in a year, fruiting period, fruit weight, size, shape, pulp taste and colour are considered for the selection of trees to improve the species. Besides thorny and non-thorny variants are available in nature. ICAR-Indian Institute of Horticultural Research (IIHR), Bengaluru, Karnataka, Tamil Nadu Agricultural University-Horticultural College and Research Institute (HC&RI), Periyakulam, TNAU-

Regional Research Station (RRS), Aruppukottai, Tamil Nadu and Central Horticultural Experiment Station (CIAH), Godhra, Gujarat are working in this line to improve the wood apple. ICAR-NBPGR is collecting variable resources of this species across the country and depositing at cryopreservation unit. It also shares accessions to institutes working for the improvement of the species.

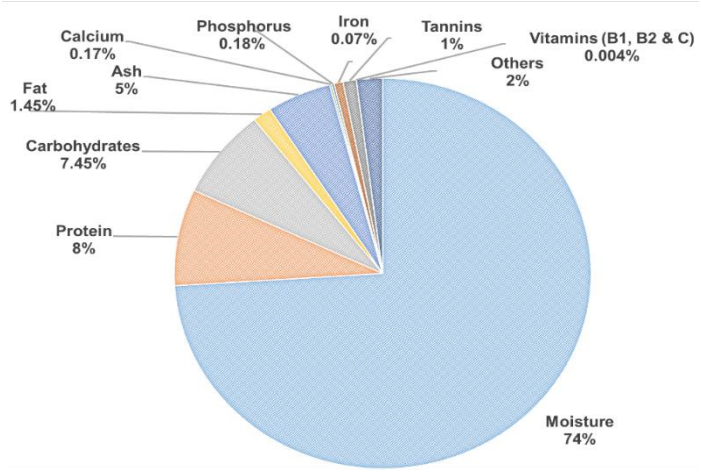
Nutritional properties

Wood apple is known to possess excellent amount of nutrients. Fruits contain an innumerable number of phytochemicals such as polyphenols, vitamins (A, B1, B2 and C), saponins, coumarins, amino acids, tri-terpenoids, phytosterols, tannins, tyramine derivatives, etc. The fruit is an enormous source of antioxidants and has potential to scavenge free radicals in human body. The fruit has 55-58% edible part, which contains 74% moisture, 8% proteins, 1.5% fat, 1.9% minerals, 5.2% fibre, 7.5% carbohydrates, 170 mg/ 100g riboflavin, 2 mg/100 g vitamin C, 0.13% calcium and 0.11% phosphorus. The seeds contain non-bitter oil high in unsaturated fatty acids.

Medicinal properties

In Indian traditional system of medicine, wood apple is known to cure diseases like dysentery, diarrhoea, asthma, ulcer, wounds, tumours, hepatitis and cardiac debility. Both ripe and unripe fruit is known to possess excellent medicinal properties. Ripe fruit is known to cure liver problems and is good for heart. It has good cholesterol lowering potential as well. Unripe fruit is having enormous potential to cure diarrhoea and dysentery. Ripe fruit consumption can reduce problems and cure in longer run the problems associated with gums and teeth, hiccough, sore throat and diseases of the gums. Ripe fruit, leaves, stem, bark and root have anti-venomous capability against snake bite. The essential oils which are extracted from fruits and seeds are effective against bacteria causing human disease. Fruit pulp is also known to possess antipyretic, anti-inflammatory and analgesic activity. The pulp of wood apple when used for the preparation of face cream can remove lesions and small spots from the skin. Fruits are also known to be larvicidal property and can kill insect larvae. Wood-apple is believed to be hepato-protectant with some adaptogenic activity like cleansing of blood impurities, leucorrhoea, dyspepsia and jaundice. Acidic hetero-polysaccharide extract of wood apple fruit surprisingly exhibited cell growth inhibition of *in-vivo* carcinoma. Wood apple fruits and seeds are also known to be anti-diabetic.

The leaves and bark have medicinal values. It is antiscorbutic. It is an antidote for poisons and helps in curing sore throat. After the rains, the trunk and branches give off a gum called' Feronia gum', which counteracts diarrhoea, dysentery and diabetes. Even



Composition of wood apple

juice extracted from young leaves of wood-apple when consumed solely or with milk can cure intestinal problems associated with worms. It is also good against piles.

The pulp and rind are poulticed onto bites and stings of venomous insects. Leaves, bark, roots and fruit pulp are used against snakebite. The spines are crushed with those of other trees and an infusion taken as a remedy for menorrhagia. The bark is crushed with that of Barringtonia and applied on venomous wounds.

Post-harvest processing and other applications

Wood apple is consumed in fresh or processed to make jam, jelly and squash or incorporated into Ayurvedic practices as a natural medicine. The fruit have a complex sweet, sour, musky, and fermented flavour. The hard shell must be cracked open before consumption. Once opened, the pulp can be consumed straight. or sprinkled with sugar for a sweeter flavour. Wood apples are a culinary

ingredient in select regions of India and Sri Lanka, and the fruits are added to chutney, sauces, and salad dressings. In India, it is frequently added to rasam, a soup-like dish and pachadi, a fresh pickle side dish. The flesh is popularly mixed with coconut milk and palm sugar to create a sweet, slightly acidic beverage, a favourite drink during summer. The pectin content of the pulp is 3 to 5% (16% on the basis of dry weight) and forms an excellent material for making jelly. The jelly is purple and much similar to that made from black currants. Pulp is also used to flavour smoothies and shakes, blended into ice-cream, or cooked with coconut milk or palm syrup for sweet desserts. In rural villages, immature wood-apple is sometimes sliced thin and dipped into a sauce of shrimp paste, shallots, spices, and chilli peppers. Wood apple pair well with citruses such as limes, calamondins, oranges, and lemons, aromatics such as chilli peppers, onions, garlic, and tamarind, and spices including cardamom, curry leaves, and mustard seed. Whole, unopened wood apple can be kept at room temperature for up to ten days until mature. Once ripe, the fruits should be stored in the refrigerator for 1 to 2 months. Opened fruit pulp should be eaten immediately for the best quality, or it can be frozen in a mixture of lemon juice for up to six months.

Threats and way overcome

Wood apple trees are found mostly in forest as wild and rarely in farmer's field. The trees are in threat of becoming an endangered species, as the wild trees are being cut without replanting, and the fruits are being foraged unsustainably for sale in markets. In order to conserve the species, efforts should be initiated to plant the tree in roadsides, social & community forest areas, public parks, botanical gardens, zoo and in educational institutes. Further, awareness among people may be created for its conservation.

Pulp colour in matured wood apple fruit

Summary

Wood apple trees are found naturally in scattered manner in the forest of dry deciduous and semi-arid regions of India. The fruit has enormous potential to be a major fruit. Existence of diversity in wood apple provides a lot of scope for the improvement of this species. Fruits contains number of phytochemicals. Leaves, bark, rind of the fruit and pulp are used in Indian traditional system of medicine to cure diseases like dysentery, diarrhoea, asthma, ulcer, wounds, tumours, hepatitis, cardiac debility etc. The species is in the edge of becoming an endangered species as the wild trees are being cut without replanting. Therefore, serious efforts should be initiated to plant the tree in roadsides, social and community forest areas. Also, awareness among people may be created for conservation of this species.

For further interaction, please write to: Dr. P. P. Thirumalaisamy (Senior Scientist), ICAR-National Bureau of Plant Genetic Resources – Regional Station, Vellanikkara, KAU P. O., 680656, Thrissur, Kerala.

* * * * * * * *

3D- Food Printing: A Boom in Food Processing

Keshav Kaiwartya[1], Aastha Vithalkar[1] and Yashwant Kumar Patel[2*]
[1]Guest Faculty, Dept of FPT, UTD, Atal Bihari Vajpayee Vishwavidyalaya, Bilaspur, Chhattisgarh, India
[2]Asstt. Prof. and Head, Dept of FPT, UTD, Atal Bihari Vajpayee Vishwavidyalaya, Bilaspur, Chhattisgarh, India
*Corresponding Author: profykpatel@gmail.com

Since the 1980s, additive manufacturing, often known as 3D printing, has been developed and used in a wide range of applications for several industries. Additive manufacturing constructs models by layering on materials from a computer-generated 3D solid model. The ability to build a complicated model without the need of fixtures, cutting tools, or coolants is a benefit of additive manufacturing. The usage of construction Additive manufacturing models is widespread in a variety of industries, including the automotive, architectural, medical, and fashion design sectors. This technology is used in the food industry to create food designs. However, the global agenda and major issues that are taken into account while using 3D food printing include sustainable nutrition and food security.

A 3D printer is used in the technique known as "3D food printing" to produce food in a variety of forms. In this method, the "ink" for the printer is made from edible elements like dough, chocolate, or pureed fruits and vegetables. The required form or pattern is then produced by extruding these materials through a nozzle. A digital model or design of the food item to be printed is often the first step in the 3D food printing process. The 3D printer employs a variety of methods to build the food item layer by layer when this design is fed into it. A food item is first scanned or developed using computer-aided design software, and then it is printed in three dimensions by being divided into thin layers. A digitally controlled XYZ-robotics system is instructed by the layer template to build the object from the bottom up in a series of layers. Phase changes or chemical interactions, either during building or in a different post-construction stage, join the layers together.

The ability to customise food in terms of shape, colour, flavour, texture, and nutrition is another benefit of 3D food printing. Food 3D printing technology is gaining attention. Three-dimensional food printing technology can process and produce different designs using ingredients such as meat, chocolate, candy, pizza dough, cotton, and sauce, which have been mainstream in the restaurant industry.

Classification of 3-D Food Printing

Several criteria, such as the printing procedure, the kinds of food components employed, and the intended uses, may be used to categorise 3D food printing. According on these criteria, here is a classification:

Printing Process

a. Extrusion-based 3D food printing: It is the most popular method, and it works by extruding food ingredients via a nozzle or syringe-like device to build layers. It works well with a variety of substances, including pastes, dough, and chocolate.
b. Inkjet-Based 3D Food Printing: This technique uses edible inks to produce food products by dotting tiny droplets of food substance onto a substrate, much like conventional inkjet printing. It's frequently used to decorate pastries and cakes.
c. Powder-Based 3D Food Printing: In this method, food powders are layer by layer and frequently heated before being fused together. It is frequently employed to produce intricate forms and textures.

Food Material Types

a. Bakery goods, including bread, cookies, and pastries, may be made with detailed patterns using 3D printers as food materials.
b. Chocolate and confectionery: Custom chocolate shapes and decorations may be made using the popular 3D food printing technique using chocolate.
c. Meat and Plant-Based Meat replacements: Some 3D food printers can produce meat items with distinctive textures and flavours using meat or plant-based meat replacements.

d. Pureed meals: These soft meals may be 3D printed for people with special dietary requirements and include pureed veggies, baby food, and other soft foods.

e. Fruits and Vegetables: For ornamental purposes, 3D printers may produce visually appealing fruit and vegetable forms.

Complexity of Products

a. Simple forms: Simple forms or decorations, like patterns on cakes, may be produced with basic 3D food printing.

b. Complex Structures: Advanced 3D food printers can create complex structures with fine details, like sugar sculptures.

Industrial vs. Consumer: Some 3D food printers are made for industrial usage, while others are made for consumer use and are utilised by professional chefs and food producers.

Printing medium: The printing medium can range from edible pastes and gels to powders and liquid materials, depending on the printer.

History of 3-D Food Printing

The ability to print food in three dimensions is a relatively recent invention that has been under development for many years. In the early 2000s, the first well recognised food printing technology was developed using cookie dough, cheese, and chocolate. However, the technique didn't start to take off and become more extensively used until the middle to late 2000s, when businesses began to experiment with a larger variety of meals.

The technology behind 3D food printing was first largely employed for the study and development of space food. In 2006, the Mechanical and Aerospace Engineering Team at Cornell University created the first open-source, multi-material 3D printer. In order to give astronauts food alternatives while in space, NASA started testing 3D food printing in 2013. As the technology advanced, it was used for a variety of other purposes, including the creation of individualised meals for patients with swallowing or digestion issues in the medical field and, of course, the creation of delicious foods by chefs and food manufacturers using 3D printing.

Source: https://www.3dnatives.com/en/food-3d-printing220520184/

The technology has considerably improved in recent years. Today, 3D food printing is an interesting and quickly developing topic with numerous potentials uses in the food business. Several firms are currently making 3D food printers for commercial usage. With customised meals, sophisticated patterns, and environmentally friendly choices, this technology is paving the way for the future of food.

Foods that are 3-D Printed

1. **Chocolate**: Complex chocolate sculptures, embellishments, and uniquely shaped chocolates have all been made using 3D printing.
2. **Pasta**: Due to its dough-like consistency and suitability for layer-by-layer extrusion, pasta is a well-liked material for 3D printing.
3. **Pizza**: A few businesses were experimenting with 3D-printed pizza, which layers the dough, sauce, and cheese in a certain design.
4. **Sweets & Confections**: Expensive sugar-based embellishments for cakes and pastries can be made using 3D printing.
5. **Burgers**: Layer-by-layer printing of the meat, buns, and toppings on customised burgers has been tried.
6. **Snacks**: We can 3D print a variety of snacks, including crackers, chips, and cookies.
7. **Fruit and vegetable purees**: For those with dietary limitations, pureed fruits and vegetables can be utilised to make dishes that are aesthetically pleasing and nutritionally sound.

8. **Cheese**: Goat cheese is one type of soft cheese that may be printed with the proper consistency.
9. **Alternatives to meat**: Plant-based and lab-grown meat substitutes have also been investigated for use in 3D printing to produce textures that resemble flesh.
10. **Customised nutrition bars**: Using precise ingredients and nutritional profiles, 3D printers can produce unique nutrition bars.

Food Materials Imprinting

Three categories have been established for the printing materials used in culinary applications. All substances that can be extruded smoothly from a syringe, such as hydrogel, cheese, cake icing, hummus, and chocolate, are considered to be natively printed materials. Some materials that can be printed without post-processing are stable enough to maintain their form after deposition. A post-deposition cooking procedure can be necessary for other composite compositions, such batters.

The usual food items in the second category—meat, rice, fruits, and vegetables—are not inherently printable but may be transformed into printable materials by adding hydrocolloids to give them the necessary structural stability. For instance, vegetables that print have been created using agar. Additionally, Cornell University researchers in collaboration with Dave Arnold and the French Culinary Institute in New York were successful in printing turkey puree using the enzyme transglutaminase, which catalyses the formation of covalent bonds between lysine and glutamine residues in a calcium-dependent reaction. The proteins in the beef purée and scallops were enzymatically crosslinked to create self-supporting hydrogels that could be cooked or fried after printing.

Alternative components, such as insects, make up the third category. Insects Au Gratin is a project being worked on by London South Bank University that investigates the nutritional and environmental benefits of using insects as meals for humans. To promote the adoption of the insects as a food source, 3D food printing may be utilised to combine the insects with other food items. The project involves drying and powdering edible insects. In order to get the ideal consistency for printing with the 3D printer nozzle, the bug flour is then combined with icing, butter, cream cheese, or water, a gelling agent, and flavouring.

Advantages and Disadvantages of 3-D Food Printing

The food sector may undergo a change thanks to the growing technology of 3D food printing. Like every technology, it has advantages and drawbacks of its own.

Benefits of 3D printing food

1. The printing of 3D food enables a great degree of personalization. It is great for personalised nutrition since consumers may modify their food selections to match certain dietary demands, tastes, and nutritional requirements.
2. Chefs and food designers may utilise 3D food printers to make sophisticated and aesthetically pleasing dishes that would be challenging or impossible to do by hand. New design and presentation options for food are made possible by this technology.
3. Using 3D food printing, it is possible to precisely and repeatedly reproduce the same foods, guaranteeing consistency in flavour, texture, and appearance. In situations involving mass production, this is very useful.
4. To produce original and distinctive food products that pique customers' attention and spur innovation in the food sector, 3D food printing may be employed.

Drawbacks of 3D food printing include

1. At the moment, the sorts of ingredients that 3D food printers can employ are constrained. The variety of meals that may be printed is constrained by the fact that they generally function best with purees, pastes, and gels.
2. Some claim that 3D printed foods may not have the same flavour and texture as dishes that have been conventionally cooked. This may be a disadvantage for persons who place a high value on these gastronomic sensory qualities.
3. The initial equipment investment as well as continuous maintenance for 3D food printing

technology is rather pricey. Small-scale food producers and restaurants may find it to be less accessible as a result.

4. A hurdle to adoption for certain organisations might be the complexity of operating and maintaining 3D food printers, which calls for specialised training and technical skills.
5. The framework for regulations governing 3D printed meals is still being developed, thus issues with food safety and labelling requirements may arise.
6. Because 3D food printing needs energy to function, its energy use might have an influence on the environment depending on its scope and frequency of use.

Future Prospects For 3D Food Printing

A new technique called 3D food printing promotes product innovation, on-demand production, and customisation. With the use of technology, consumers may create novel dining experiences and tailor their food preferences in terms of appearance, flavour, texture, and nutritional value. The technique is still in the development phase, though. Productivity in processes, manufacturing flexibility, and product innovation and functionality are the primary difficulties. Only a few research teams are actively investigating this technology right now. Through a better understanding of the properties of food materials and the effects of food variability on end products, this novel technology is anticipated to significantly advance in the years to come. This will enable the commercial design and production of novel food products with higher production rates and functionality.

Conclusion

In conclusion, the combination of technology and culinary expertise represented by 3D food printing is exciting and unique. By enabling personalization, accuracy, and innovation in food manufacturing, this developing technology has enormous promise for the food business. It has the ability to fundamentally alter how we see food, from individualised nutrition to elaborate gourmet creations. Although 3D food printing is still in its infancy, continuous research and development are expected to broaden its uses and increase its accessibility, perhaps paving the way for a future when customers may easily acquire customised and aesthetically pleasing foods. To completely alter the way, we prepare and consume food, 3D food printing will need to overcome issues with flavour, texture, and broad acceptance.

Biblography

https://savoreat.com/the-world-of-3d-food-printing/

https://www.3dnatives.com/en/food-3d-printing220520184/

https://www.ift.org/news-and-publications/food-technology magazine/issues/2017/april/columns/processing-3d-food-printing?gclid=CjwKCAjwgZCoBhBnEiwAz35RwjIc2AiUs9NYKVxJQNj8LXBFYz_BwCfzgJIGTvXSLVS6jubWMdsHYRoC06YQAvD_BwE

J.Y. Lee, Jia An and Chee Kai Chua. (2017). Fundamentals and applications of 3D printing for novel materials. Applied Materials Today 7, 120-133. 5. Nguyen, Tuan C. "Hungry? A Startup Wants You to 3D Print Your Next Meal.

Jayakumar, Amrita. "Home-Baked Idea? Nasa mulls 3D printers for food replication." The Guardian. https://www.theguardian.com/technology/2013/jun/04/nasa-3d-printer-space-food (accessed September 18, 2017).

Lili, L. Yuanyuan, M. Ke and C. Yang, Z (2018). 3D Printing Complex Egg White Protein Objects: Properties and Optimization. Food Bioprocess Technol. 1, 1–11.

M. Annoni, H. Gilberti and M. Strano. (2016). Feasibility Study of an Extrusion-based Direct Metal Additive Manufacturing Technique. 44th Proceedings of the North American Manufacturing Research Institution of SME http:// www.sme.org/namrc. Volume 5, 2016, Pages 916- 927.

Park, H.J. and Kim, H.W. (2020), Global Food 3D Printing Technology and Industry Trends and Future Prospect. World Agr. 147–168.

Shannon E. Bakarich, R. Gorkin III, R. Gately, S. Naficy, Marc in het Panhuis and Geoffrey M. Spinks. (2017). 3D printing of tough hydrogel composites with spatially varying materials properties. Additive Manufacturing 14 (2017) 24-30.

Teresa F. Wegrzyn, Matt Golding, Richard H. Archer. (2012). Food Layered Manufacture: A new process for constructing solid foods. Trends in Food Science & Technology 27, 66-72.

* * * * * * * *

Dragon Fruit Processing in India

B. Manjula[1], R. Aruna[2], P. Jayamma[2] and Sindhumathi
[1]Assistant Professor, Department of Processing and Food Engineering, College of Agricultural Engineering, Madakasira
[2]Assistant Professor, College of Food Science and Technology, Pulivendula, Acharya N.G. Ranga Agricultural University, Lam, Guntur, 515 301 (A.P.).
*Corresponding Author: b.manjula@angrau.ac.in

The Dragon Fruit Market is forecast to grow at a 3.9 percent annual rate. The dragon fruit market is increasing as a result of rising demand for fresh dragon fruit. Furthermore, demand for exotic tropical fruit has risen in recent years as a result of a variety of health benefits as well as an overall increase in consumer disposable income, particularly in developing countries. Despite the fact that the dragon fruit is still relatively new and not well-known in Europe, the market is quite promising and attracting a growing number of customers. These are the most important factors driving the dragon fruit market ahead. The dragon fruit is gaining popularity among health-conscious clients, especially in the United States. Dragon fruit is abundant in iron, magnesium, vitamin B, phosphorus, protein, calcium, and fibre, as well as a good supply of water. The fruit's edible seeds are also healthy and have been demonstrated to lower the risk of cardiovascular disease. Dragon fruit is a low-calorie fruit that also has a lot of fibre and a lot of vitamins and minerals. As a result of the aforementioned benefits, as well as a changing food pattern among the Chinese people, demand for dragon fruit is increasing, leading in a rise in imports.

Dragon Fruit Products Processing

The fruit can also be processed into a variety of items, increasing its value. Energy and fruit bars, ice cream, jelly, marmalade and preserves, juice, croissants, pulp, and yoghurt are among the processed foods. Processing is necessary to create value-added products from both edible and non-edible sections of the fruit and plant while also reducing perishability and waste disposal issues. To improve wine production from fruit pulp, betacyanin and jam production from fruit peel, soft drink production from plant stems, and tea production from flowers.

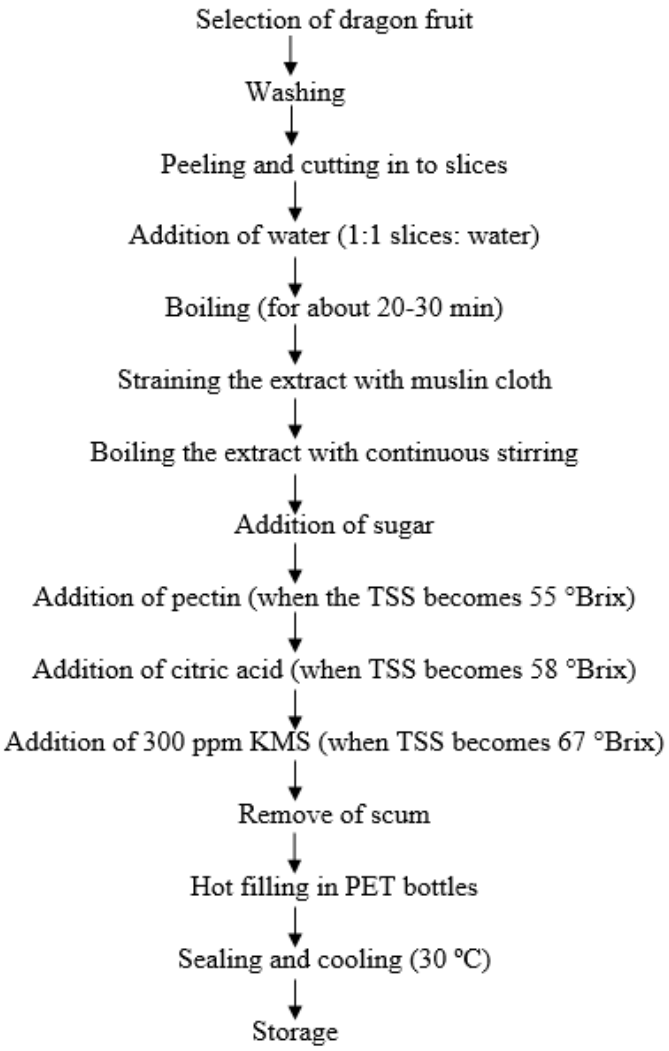


Fig. Process flowchart for the preparation of jelly from dragon fruit

Dragon Fruit Market in India

Farmers in Maharashtra, Gujarat, Andhra Pradesh, Karnataka, and Tamil Nadu have been aggressively farming the fruit in recent years, and the industry in India is gradually improving. Because of the multiple benefits associated with it, domestic production of this fruit is extremely encouraging in

various parts of the country. Growing dragon fruit and doing business with it has various advantages. For starters, it can thrive in any sort of soil. Second, the plant requires very little maintenance and water. Third, Dragon Fruit has the ability to resist the climate in India. Another advantage is that commercial returns can be expected as early as the second- or third-year following planting. There aren't many businesses that pay off their debts immediately. Cuttings from the plant can be sold or used for further growth. On the worldwide and international markets, the product is in high demand. The fruit of the plant has a good flavor, so there is a lot of demand for it. Because it has a specialist market and is high in vitamin C, dragon fruit is in great demand for a specialized segment. It contains betalains, which are beneficial anti-oxidant elements for the body. The fruit is also high in magnesium, iron, calcium, and phosphorus, all of which are essential for the correct functioning of the immune system.

* * * * * * * *

Shortening, a mystery: Unravelling the Effects on Baked Delights

[1]Babli Waribam, [1]Silvya Mario, [1]R. Sasikumar and [1]I. B. Mangang*
[1]Department of Agri-Business Management and Food Technology,
North Eastern Hill University (NEHU)- Tura Campus, Meghalaya
*Corresponding Author: 12barunmangang@gmail.com

Shortening is an agent that is used in baking to provide aeration and make the baked products more tender. Shortening is a semisolid food product and it usually consists of 100% fat which is solid at room temperature. Shortening usually does not contain water and ensures that the baked good remains sturdy and crunchy. The fat is mixed with the other ingredients of baking and it forms an emulsion. Water when added to flour forms gluten which are elastic fibers and give food a chewy texture. The fat in the shortening reduces the formation of gluten and breaks it down into smaller pieces which gives a crumbly texture after baking. Shortening coats fat crystals that entrap air bubbles formed during the emulsification process (Demirkesen and Mert 2020). The fat crystals melt during baking and release the entrapped air which results in a light and airy texture of the baked goods. The high-fat content in shortening also prevents the product from going stale and helps to extend its shelf life. The functional ability of a shortening is determined by the ratio of solid to liquid phase in the shortening and the oxidative stability of the shortening. SFI or solid fat index is an analytical tool which is used to determine the content of solid fat in oils. SFI is a good index for determination of the plasticity of a shortening (Yazar and Rosell 2022). Shortenings can be formulated with vegetable oil and animal fat. Lard and ghee are traditional products that contain 100 % animal fat in comparison to margarine which contains 80 % fat. The most used shortening agent is margarine. Margarine can either be used alone or in combination with other vegetable shortenings to achieve the desired effects. Today most of the shortenings used are derived from vegetable oils like palm, vegetable, or cottonseed oil and they undergo hydrogenation to remain solid at room temperature.

Classification of shortenings

The majority of shortenings have a considerable amount of saturated fatty acids and trans-fat and they widely contribute to the rising obesity and a number of lifestyle diseases. Vegetable shortening is subdivided into all-purpose shortening, emulsified shortening, and high-stability shortening on the basis or form of the product. It is subdivided into baking, frying, confectionery, pastry, and others on the basis of application. It is subdivided into Butter, Margarine, Vegetable oils, Lard and other processed shortening fats based on the type. Shortenings are classified based on the functional requirements into different types (Ghotra, Dyal, and Narine 2002).

1. All-purpose shortening
2. Fluid shortening
3. Cake shortening
4. Icing shortening
5. Filler fat shortening
6. Bread shortening
7. Frying shortening
8. Pie crust shortening
9. Pastry shortening
10. Confectioner's fat
11. Dry shortenings

Effect of shortenings in bakery products

A series of physiochemical changes happen in baking along with the formation of various compounds. Some changes are desirable such as improvement of texture, water retention as well as flavour enhancement. Undesirable compounds which may be potentially carcinogenic, mutagenic, or cytotoxic are also formed. Shortening agents contain MCPD esters and glycidyl ester which are potentially carcinogenic (Goh et al. 2021). Under favorable conditions during the baking process, it can decompose and form harmful components.

Future prospects

There is an increasing demand for bakery products among customers. The rise in demand is the driving force behind the vegetable shortening market. Moreover, the changing preferences of consumers for healthy baked goods have created a positive impact on the worldwide vegetable shortening market. The

surge in demand for low-calorie foods among health-conscious people and the rising trend of people embracing a vegan lifestyle will also create an impact in the shortening market.

Table 1. Composition of different types of shortening and effect on its properties (Manaf et al. 2019; Pădureț 2021)

Properties	Vegetable shortening	Butter	Lard	Margarine
Water content	No water	18 %	12-18 %	10-20 %
Fat content	100 %	80 %	82-88 %	80-90 %
Source of fat	Hydrogenated vegetable oil	Butter fat	Animal fat	Hydrogenated vegetable oil
Protein content	0 %	1-2 % of milk protein	0 %	0 %
Flavor	Flavorless	Creamy and rich	Slightly similar to pork	Flavorless
Texture	Crunchy & crumbly	Tender & thin	Extra crispy	Soft and dense

The manufacturers of shortenings should work on formulating the trans fatty acids content which are used in baked goods. In the end, the functionality of shortening is one of the most important reasons why shortenings are used in baking. The growth curve in the market and the future development of shortening depends on formulations of shortenings that are easily accessible, which do not compromise the health of the consumers and the functionality of the shortening. There is a rise in the popularity in the use of vegetable oil which is polyunsaturated and free of cholesterol among health-conscious people. Vegetable oil fortified with a surfactant system appears to be on the rise in the foreseeable future because it does not pose much of a health risk and there is no compromise in the functionality.

Conclusion

The concern over trans fats in shortening is growing due to their adverse health effects. The challenge lies in discovering trans-fat-free alternatives that maintain product quality without compromising health.

References

Demirkesen, Ilkem, and Behic Mert. 2020. "Recent developments of oleogel utilizations in bakery products." *Critical reviews in food science and nutrition* 60 (14):2460-2479.

Ghotra, Baljit S, Sandra D Dyal, and Suresh S Narine. 2002. "Lipid shortenings: a review." *Food research international* 35 (10):1015-1048.

Goh, Kok Ming, Yu Hua Wong, Chin Ping Tan, and Kar Lin Nyam. 2021. "A summary of 2-, 3-MCPD esters and glycidyl ester occurrence during frying and baking processes." *Current Research in Food Science* 4:460-469.

Manaf, YN, JMN Marikkar, S Mustafa, Filip Van Bockstaele, and BP Nusantoro. 2019. "Effect of three plant-based shortenings and lard on cookie dough properties and cookies quality." *International Food Research Journal* 26 (6).

Pădureț, Sergiu. 2021. "The effect of fat content and fatty acids composition on color and textural properties of butter." *Molecules* 26 (15):4565.

Yazar, Gamze, and Cristina M Rosell. 2022. "Fat replacers in baked products: Their impact on rheological properties and final product quality." *Critical Reviews in Food Science and Nutrition*:1-24.

* * * * * * * *

Starch: Botanical Sources and Modification Through Extrusion

Ranjani M, Gouthami Shivaswamy, Abarna S and Shalini Gaur Rudra*
Division of Food Science and Postharvest Technology, Indian Agricultural Research Institute, New Delhi, India
*Corresponding Author: shalinirudra@icar.gov.in, gaurshalini@gmail.com

Starch, the primary storage carbohydrate found throughout the plant kingdom, is a vital energy source in the human diet. It is synthesized within plastids in both photosynthetic and non-photosynthetic cells, forming insoluble, semi-crystalline granules. These granules consist of amylose and amylopectin, two crucial components. Although starch is widely used in various sectors, including food, pharmaceuticals, and industry, its functional properties vary significantly between plant species, leading to challenges in processing and nutrition. Globally, the industrial starch market is valued around 90 billion USD in 2024 at a compound annual growth rate (CAGR) of 5.8%.

Understanding the intricate structure of starch, particularly the roles of amylose and amylopectin, is essential. Both are homopolysaccharides made of α-D-glucose units and feature specific glycosidic linkages. Amylopectin, the predominant component, has a highly branched structure that gives rise to the semi-crystalline nature of starch granules. Despite its significance, native starch has limitations such as poor solubility, retrogradation, and high viscosity after gelatinization. To overcome these limitations and unleash its full potential, diverse starch modification techniques have been developed.

Amylose & Amylopectin

Amylose and amylopectin, the structural pillars of starch, are both composed of α-D-glucose units. Amylose consists of linear chains linked by α-1,4-glycosidic bonds, while amylopectin is highly branched due to additional α-1,6-glycosidic linkages at branching points. The heavily branched structure of amylopectin forms crystalline lamellae interspersed with amorphous regions. Amylopectin's intricate architecture arises from multiple short chains, each containing α-(1,4)-linked D-glucose residues and interconnected through α-(1,6)-linkages. The ratio of amylose to amylopectin varies among plant genotypes, impacting the granule's properties. These granules, stored in different plant parts, exhibit wide variations in size, shape, and composition, influenced by the plant's tissue and origin.

Characteristics of Starch Granules

Starch granules, found in various plant parts, exhibit diverse characteristics. Ranging from less than 1 µm to over 100 µm, these granules can assume spherical, oval, discoid, polygonal, angular, or irregular shapes. The size, shape, structure, and composition of starch granules are intricately linked to the plant's tissue and organ. Understanding these characteristics is pivotal for tailoring starch for specific applications, addressing challenges related to solubility, viscosity, and thermal stability. (Apriyanto *et al.*, 2022).

Need for Starch Modification

Despite its versatility, native starch faces inherent limitations, hindering its widespread industrial applications. Issues such as poor solubility, retrogradation (the tendency to revert to a more ordered state upon cooling), syneresis (release of water after gel formation), thermal decomposition, low resistance to shear stress and high viscosity post-gelatinization pose challenges. To overcome these limitations and harness starch's potential in various industries, diverse modification techniques have been developed. These methods aim to enhance solubility, stability, and functionality, making starch more adaptable to a myriad of applications, from food to pharmaceuticals. By modifying starch, researchers and industries are working towards unlocking its full potential, revolutionizing its applications and ensuring it remains a cornerstone biomaterial in a rapidly evolving world.

The major market drivers for application of starch in industries include:

1) The multiple functionalities of starch and its derivatives that can be tailored for use in a diverse range of industries,

2) Increasing demand for biodegradable plastics or packaging materials

3) Rising avenues of starch in various non-food applications, and

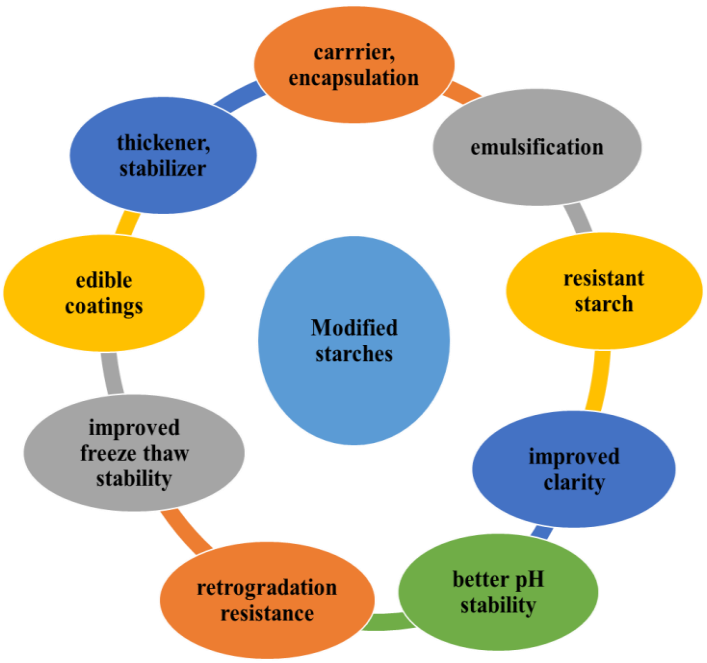
4) Increased availability of alternative sources of starch.

Modified starches as food additives

As per Codex standards, the chemically modified starches are approved as permitted food additives and are assigned with E-numbers. They are regulated under the terms of the EC Miscellaneous Additives Directive 95/2/EC, on food additives other than colours and sweeteners. Under the provisions of this Directive, modified starches have been defined as 'substances obtained by one or more chemical treatments of edible starch, which may have undergone a physical or enzymatic treatment and may be acid or alkali thinned or bleached'. The E numbers for modified starches are as follows

E1404	Oxidised starch
E1410	Monostarch phosphate
E1412	Distarch phosphate
E1413	Phosphated distarch phosphate
E1414	Acetylated distarch phosphate
E1420	Acetylated starch
E1422	Acetylated distarch adipate
E1440	Hydroxypropyl starch
E1442	Hydroxypropyl distarch phosphate
E1450	Starch sodium octenyl succinate
E1451	Acetylated oxidised starch

Food Applications of Modified Starches



Non-food applications of modified starches

Modified starches are important in the fields of paper making, textiles, packaging, regenerative medicine, 3 D printing, nanotechnology etc.

Botanical Sources of Starch

Starch is sourced from common crop plants such as corn, wheat, cassava, sweet potato, rye, barley, oats, rice, and pulses. Additionally, novel sources, including medicinal plants and fruits, contribute to starch production. (Table 1 & 2)

Type of Modification and their Applications:

Starch modification is a pivotal process in the food industry, enhancing starch's functional versatility in various products through diverse techniques. Physical modifications, including extrusion for altered texture and heat-moisture treatment for environmentally friendly films, find applications in noodles, convenience foods, and sauces. Chemical modifications such as cross-linking and acetylation provide stability and solubility, utilized in coatings, confectionery, and emulsion stabilizers. Enzymatic modifications like amylase treatment reduce viscosity for gelling agents, while genetic modifications engineer starch compositions for a wide range of applications. Dual modifications, combining physical and chemical methods, yield multifunctional starch used in diverse food products like puddings and frozen foods. These modified starches continue to innovate the food industry, meeting various consumer demands by enhancing texture, stability, and overall quality in products ranging from noodles to low-calorie beer and beyond. One of the major restraints to industrial starch applications is the intensive use of water and wastewater pollutants generated during the processing of starch which impact sustainable production of products downstream. Physical modification processes like heat mediated modification and extrusion processing offer some respite to these problems.

Extrusion Process

Extrusion disrupts the molecular order within starch granules by subjecting a starch suspension in water to temperatures exceeding the gelatinization temperature (TG). Gelatinization, a pivotal step, involves the irreversible destruction of the crystalline

order within starch granules. Gelatinization, influenced by factors such as moisture content, pH, and pressure, precedes irreversible changes in starch properties. During extrusion, the crystallinity of corn starch decreases gradually with increasing moisture content, leading to enhanced gelatinization and granule expansion. Extrusion also affects proteins, lipids, and non-starch polysaccharides, forming a complex matrix with improved nutritional and functional properties (Yang *et al.*, 2020; Zhang *et al.*, 2015). Extrusion offers versatility in processing, low-cost requirements, the production of high-quality products, energy efficiency, and environmental friendliness.

Effect of Extrusion on Gelatinization

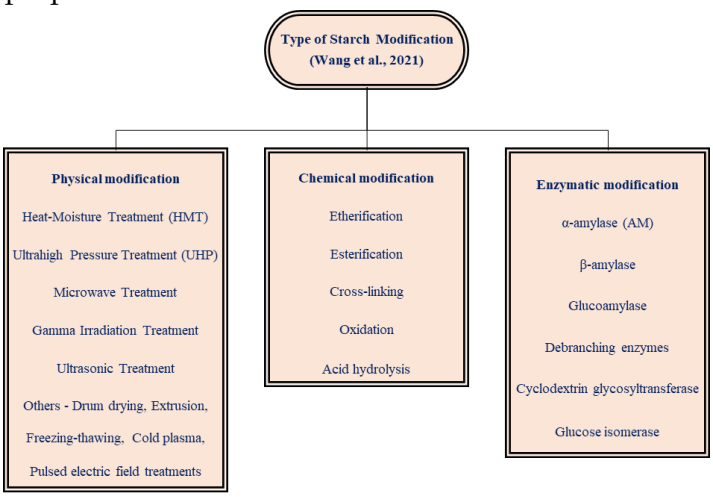
Gelatinization, a critical aspect of the extrusion process, involves the destruction of the crystalline regions of starch. Extrusion significantly increases the water absorption of starch, denoting enhanced gelatinization. Higher moisture content in raw corn starch facilitates water absorption, leading to increased gelatinization and decreased crystallinity. The gelatinization process is accompanied by the destruction of the crystal structure and the dissociation of amylopectin double helices. Extrusion-induced gelatinization is influenced by both temperature and moisture content, leading to profound structural changes in starch granules (Wang et al., 2021).

Effect on Starch Degradation

During extrusion, starch degradation is influenced by factors such as temperature, pressure, and shear forces. Extrusion-induced starch degradation facilitates interactions with other components, including citric acid anhydride, leading to cross-linking in starch citrate (Ye et al., 2019). Additionally, extrusion disrupts the integrity of starch granules while preserving certain characteristics desirable for sensorial and nutritional acceptance, making it a promising technology in the food industry (Arslan et al., 2019).

Role of Extrusion in Starch Modification

Extrusion, a thermomechanical process, is a revolutionary technique known for its capability to disrupt the molecular bonds of starch, inducing starch gelatinization, melting, and degradation. This process induces significant structural and physicochemical alterations in starch, profoundly impacting its properties.



Structural Changes of Starch following Extrusion

Extrusion leads to notable modifications in the crystalline structure, granule morphology, and molecular arrangement of starch. For instance, native corn starch granules, when subjected to extrusion, undergo a drastic transformation. Initially polygonal and relatively smooth, the granules become irregular and rough due to the combined effects of high temperature and shear forces (Wang et al., 2021). This transformation results from the thermal effects and shear forces, leading to a fragmented, disrupted structure (Wang, Shogren, & Willett, 1997).

Physicochemical Properties of Starch following Extrusion

1. Expansion Ratio: The extrusion process causes starch to expand significantly, leading to a noticeable increase in volume.

2. Water Absorption Index and Water Solubility Index: Extrusion alters starch's water absorption and solubility characteristics. Extruded corn starch exhibits increased water absorption due to gelatinization reactions during extrusion (Wang et al., 2021).

3. Texture: Starch undergoes gelatinization, melting, and degradation during extrusion, resulting in changes in texture parameters such as hardness, cohesiveness, and springiness.

4. Pasting Properties: The pasting properties of starch are modified by extrusion, influencing characteristics like viscosity and gelatinization temperature.

5. Digestibility of Starch: Extrusion affects the digestibility of starch, influencing its nutritional properties. Amylopectin, a major component of starch, undergoes alterations during extrusion, leading to changes in the starch's digestibility (Garcia-Valle et al., 2021).

Conclusion

The extrusion process has revolutionized starch modification by inducing significant structural and physicochemical alterations in starch, profoundly impacting its properties. When subjected to extrusion, native corn starch granules undergo drastic transformations, becoming irregular and rough due to high temperatures and shear forces. These alterations include changes in crystalline structure, granule morphology, and molecular arrangement. Extrusion expands starch significantly, increasing its volume and altering water absorption and solubility characteristics. Additionally, extrusion affects texture parameters such as hardness, cohesiveness, and springiness, as well as pasting properties like viscosity and gelatinization temperature. Importantly, it influences the digestibility of starch, impacting its nutritional properties. Gelatinization, a pivotal step in extrusion, involves the irreversible destruction of the crystalline order within starch granules, significantly increasing water absorption and denoting enhanced gelatinization. The process also induces starch degradation, facilitating interactions with other components and offering advantages such as versatility in processing, low-cost requirements, production of high-quality products, energy efficiency, and environmental friendliness. These modifications enhance starch's functionality, making it a cornerstone biomaterial in various industries, ensuring its continued importance in a rapidly evolving world.

References

Apriyanto, A., Compart, J., & Fettke, J. (2022). A review of starch, a unique biopolymer—Structure, metabolism and in planta modifications. Plant Science, 318, 111223.

Ashogbon, A. O., & Akintayo, E. T. (2014). Recent trend in the physical and chemical modification of starches from different botanical sources: A review. Starch – Stärke, 66(1–2), 41–57.

Chung, H.-J., Li, X.-Q., Kalinga, D., Lim, S., Yada, R., & Liu, Q. (2014) Physicochemical properties of dry matter and isolated starch from potatoes grown in different locations in Canada. Food Research International, 57, 89–94.

Compart, J., Li, X., & Fettke, J. (2021). Starch-A complex and undeciphered biopolymer. Journal of Plant Physiology, 258–259, 153389.

Garcia-Valle, D. E., Agama-Acevedo, E., Nuñez-Santiago, M., Alvarez-Ramirez, J., & Bello-Pérez, L. A. (2021). Extrusion pregelatinization improves texture, viscoelasticity and in vitro starch digestibility of mango and amaranth flours. Journal of Functional Foods, 80, 104441.

Gomez, M. H., & Aguilera, J. M. (1984). A physicochemical model for extrusion of corn starch. Journal of Food Science, 49(1), 40–43.

Kumar, P. S., Saravanan, A., Sheeba, N., & Uma, S. (2019). Structural, functional characterization and physicochemical properties of green banana flour from dessert and plantain bananas (Musa spp.). LWT, 116, 108524.

Liu, Y., Chen, J., Luo, S., Li, Ch., Ye, J., Liu, Ch., & Gilbert, R. G. (2017). Physicochemical and structural properties of pregelatinized starch prepared by improved extrusion cooking technology. Carbohydrate Polymers, 175, 265–272.

Moorthy, S. N. (2015). Physicochemical and functional properties of tropical tuber starches: A review. Starch-Stärke, 54(12), 559–592.

Ribotta, P. D., & Rosell, C. M. (2010). Effects of enzymatic modification of soybean protein on the pasting and rheological profile of starch–protein systems. Starch – Stärke, 62(7), 373–383.

Wang, B., Bin, Yu, Bin, Yuan, Chao, Guo, Li, B., Liu, & Pengfei. (2021). An overview on plasticized biodegradable corn starch-based films: the physicochemical properties and gelatinization process. Critical Reviews in Food Science and Nutrition, 1–11.

Wang, B., Dong, Y., Fang, Y., Gao, W., Kang, X., Liu, P., Yan, S., Cui, B., & Abd El-Aty, A. M. (2022). Effects of different moisture contents on the structure and properties of corn starch during extrusion. Food Chemistry, 368, 130804.

Wang, Shujun & Guo, Peng. (2020). Botanical Sources of Starch.

Waterschoot, J., Gomand, S. V., Fierens, E., & Delcour, J. A. (2015). Production, structure, physicochemical and functional properties of maize, cassava, wheat, potato and rice starches. Starch – Stärke, 67(1–2), 14–29.

Yang, W., Zheng, Y., Sun, W., Chen, S., Liu, D., Zhang, H., Fang, H., Tian, J., & Ye, X. (2020). Effect of extrusion processing on the microstructure and in vitro digestibility of broken rice. LWT, 119.

Ye, J., Hu, X., Luo, S., Liu, W., Chen, J., Zeng, Z., & Liu, C. (2018). Properties of starch after extrusion: A review. Starch – Stärke, 70(11–12), 1700110.

Ye, J., Luo, S., Huang, A., Chen, J., Liu, C., & McClements, D. J. (2019). Synthesis and characterization of citric acid esterified rice starch by reactive extrusion: A new method of producing resistant starch. Food Hydrocolloids, 92, 135–142.

Zhang, P., & Hamaker, B. R. (2012). Banana starch structure and digestibility. Carbohydrate Polymers, 87(2), 1552–1558.

Table 1 Characteristics of Cereal and Pulses Starches

Cereal	Starch Content (%)	Amylose Content (%)	Granule Shapes	Granule Size (µm)	Crystalline Pattern
Corn	~75	~25 (variable)	Spherical to Irregular	<1 to >100	A-type (Normal, Waxy) B-type (High-amylose)
Wheat	60-75	Varies (5-40)	Lenticular A-granules, Round B-granules	2-38	A-type (Normal, Waxy) B1-type (High-amylose)
Rye	22-25	~24.6-48.7	Large (A-type), Small (B-type)	23-40 (A-type), <10 (B-type)	A-type
Barley	75-80	23.1-30.0	Disc-shaped (A-type), Spherical (B-type)	-	-
Oat	~60	25.2-29.4	Irregular to Polygonal	7.0-7.8	A-type
Rice	>80	Varies (2-5 to 5-6)	Round, Angular, Polygonal	3-10	A-type (Short A chains)
Lentil	~50	17-52	Round or spherical, oval, or irregular shapes		C-type (CC-type, CA-type, or CB-type polymorphs)
Bean		17-52	*-do-*		*-do-*
Pea		48.8-49.6%	*-do-*		*-do-*

(Source: Wang *et al.,* 2022; Wang & Guo, 2020; Waterschoot *et al.,* 2015; Ashogban *et al.,* 2014)

Table 2 Characteristics and Uses of Horticultural Crops Starches

Crops	Starch Content (%) (d.w.)	Amylose Content (%)	Granule Size Range	Crystalline Pattern	Main Uses
Potato	66-80	25.2- 29.1	5 - 100 µm	B-type	Food processing, thickening agent, pharmaceutical filler
Cassava	70	25.2- 29.1	5 - 100 µm	B-type	Food processing, thickening agent, pharmaceutical filler
Yam	60-80	1.4- 50	1 - 90 µm	B- or C-type	Food products, cultural dishes
Sweet Potato	50-80	38	2 - 12 µm	A-type, C-type	Limited industrial applications, potential for growth
Winter Squash	65	-	-	C-type	Extensive study for post-harvest storage technology.
Tomato	20	-	-	C-type	Important site for starch storage; different starch features in columella and pericarp.
Apple	44-53.2	40-48	2-12 µm	CA-type	Starch increases during maturation; used in various cultivars.
Banana	69-82	15-23	-	A-, B-, or C-type	Highly resistant to enzymatic hydrolysis; potential for various applications.
Fritillaria	80	18.8-30.2	5-50 µm	B-type	Traditional Chinese medicine; mainly oval granules with various sizes.
Chinese Yam	20-60	10-23	5-60 µm	C-type (B-type in center, A-type at periphery)	Important invigorant in traditional Chinese medicine; decreases cholesterol levels in rats.

(Sources: Wang & Guo, 2020; Kumar *et al.,* 2019; Moorthy *et al.,* 2015; Chung *et al.,* 2014; Rollandsabaté *et al.,* 2012; Huang *et al.,* 2012)

* * * * * * * *

Sinapine: Nature's Multi-Purpose Compound

M.S. Sujith Kumar*, Ibandalin Mawlong, Reema Rani and Babli Mog[1]
ICAR-Directorate of Rapeseed Mustard Research, bhartpur321303, Rajasthan
[1]ICAR-Directorate of Cashew Research, Puttur, Karnataka
*Corresponding Author: sujithkumaragri@gmail.com

Sinapine hydrogen sulfate is a natural compound found in mustard plants (genus Brassica) and belongs to the class of phenolic compounds known as sinapates. It is primarily found in the seeds and leaves of mustard plants, including Indian mustard (Brassica juncea) and brown mustard (Brassica nigra). Sinapine hydrogen sulfate, also known as sinapine or sinapoylcholine, is a conjugate of choline and sinapic acid. It is typically present in mustard seeds as a salt form, with hydrogen sulfate (sulfate) being the most common counterion.

Characteristics features

Chemical Structure

Sinapine hydrogen sulfate has the chemical formula $C_{20}H_{23}NO_6S$ and a molar mass of approximately 413.46 g/mol. It consists of a choline molecule esterified with sinapic acid and a sulfate group.

Biological Role

Sinapine is involved in the defense mechanisms of mustard plants. It plays a role in protecting the seeds against pathogens, pests, and environmental stressors. It has antimicrobial and antifungal properties, which help in seed protection.

Health Benefits

Sinapine has gained attention for its potential health benefits. It exhibits antioxidant properties, which can help neutralize harmful free radicals and protect against oxidative damage in the body. Additionally, sinapine may have anti-inflammatory and anticancer properties, although further research is needed to fully understand its effects on human health

Food and Industrial Applications

Sinapine is predominantly present in mustard seeds, and its content can vary among different mustard varieties. In the food industry, mustard seeds are commonly used as a spice, condiment, or as a source of mustard oil. Sinapine may contribute to the flavor and aroma of mustard products.

Distribution of Sinapine in oilseeds brassica

It's important to note that these are general estimates, and the actual sinapine content may vary among different cultivars and growing conditions. Additionally, sinapine levels can be influenced by various factors such as agronomic practices, geographic location, and seed developmental stage.

***Brassica napus* (rapeseed/canola):** Sinapine content in rapeseed can range from approximately 0.1% to 2% of the seed weight, with some cultivars having higher levels.

***Brassica juncea* (Indian mustard):** Indian mustard seeds generally have higher sinapine content compared to rapeseed. Sinapine levels in Indian mustard can range from about 1% to 3% of the seed weight.

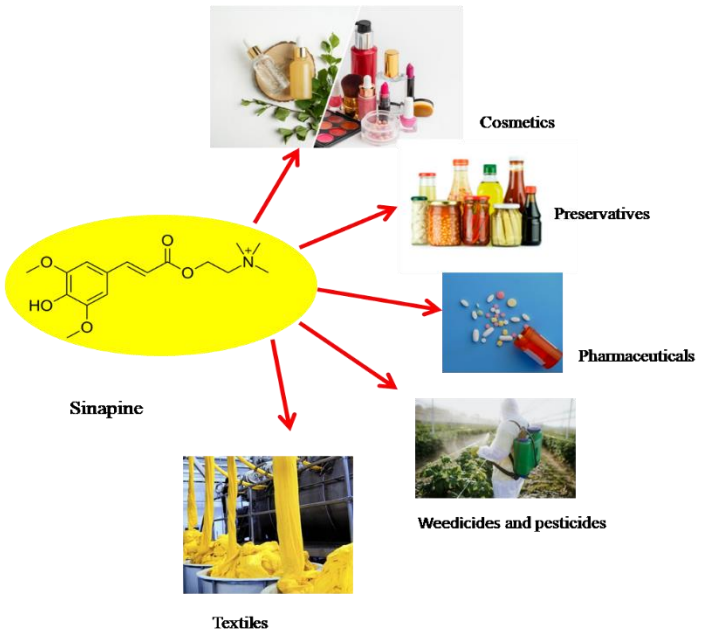
***Brassica rapa* (turnip rape):** Sinapine content in turnip rape can vary, but it is generally lower compared to rapeseed and Indian mustard. The estimated range is around 0.1% to 1% of the seed weight.

***Brassica carinata* (Ethiopian mustard):** Ethiopian mustard seeds are known to have relatively higher sinapine content compared to some other Brassica species. The estimated range is around 1% to 3% of the seed weight

***Brassica nigra* (black mustard):** Black mustard seeds typically have higher sinapine content compared to other Brassica species. The estimated range is around 1% to 3% of the seed weight.

***Brassica hirta* (white/yellow mustard):** White/yellow mustard seeds generally have lower sinapine content compared to black mustard. The estimated range is around 0.5% to 1.5% of the seed weight.

***Brassica campestris* (field mustard):** Sinapine content in field mustard can vary, but it is generally lower compared to black mustard. The estimated range is around 0.5% to 1.5% of the seed weight.



Outline on the value products of sinapine

Selected references

Uzunova, M., Stefanova, V., & Georgieva, V. (2015). Study on the chemical composition of rapeseed (Brassica napus L.) seed meal from Bulgarian cultivars. Journal of Agricultural Science and Technology, 17(3), 653-662

Singh, S., Singh, P., & Sharma, T. R. (2014). Biological Activities of Sinapine Derivatives: A Review. International Journal of Food Properties, 17(6), 1180-1193.

Kumar, D., Singh, S., Chakrabarty, D., & Trivedi, P. K. (2019). Sinapine: A Promising Bioactive Compound with Medicinal Properties. In Medicinal Plants: Utilization and Conservation (pp. 47-65). Springer

Table 1: Value added products of Sinapine

Value added products		References
Cosmetic Industry	Sinapine is utilized in cosmetic formulations for its skin-brightening and anti-aging effects.	Lee, S.Y. et al. (2015). Effect of sinapine on melanogenesis in B16F10 melanoma cells. Biological and Pharmaceutical Bulletin, 38(3), 405-411.
Food and Beverage Industry	Sinapine is used as a natural antioxidant and antimicrobial agent in food preservation and packaging.	Wei, H. et al. (2017). Antioxidant and antimicrobial activities of sinapine extracted from Brassica napus L. Journal of Food Science and Technology, 54(3), 604-611.
Pharmaceutical Industry	Sinapine exhibits potential therapeutic effects, including anti-inflammatory, anticancer, cardioprotective, and neuroprotective properties.	Wang, T. et al. (2013). Sinapine, a potential anti-inflammatory agent, attenuates colon inflammation in a mouse model of acute colitis. Food and Chemical Toxicology, 59, 533-541
Agricultural Industry	Sinapine can be used as a biopesticide or allelopathic compound to control weed growth and protect crops from pests.	Zhu, Z. et al. (2015). Allelopathic effects of sinapine on the germination and growth of wheat (Triticum aestivum) and radish (Raphanus sativus). Pesticide Biochemistry and Physiology, 118, 9-14.
Textile Industry	Sinapine can be used as a natural dye for textile coloring due to its yellowish-brown colour.	X. et al. (2019). Dyeing properties and fastness of sinapine extracted from rapeseed meal. Textile Research Journal, 89(2), 283-293.

* * * * * * * *

Increased revenue from Cashew: Focusing on cashew apple utilization

Babli Mog[1]*, J. D. Adiga[1], Vanitha K[1], Ibandalin Mawlong[2], M. Sujith Kumar[2] and Rajkumar Dagadkhair[3]

[1] ICAR-Directorate of Cashew Research, Darbe post, Dakshina Kannada, Puttur-574202, Karnataka, India
[2] ICAR- Directorate of Rapeseed-Mustard Research, Sewar, Bharatpur-321303, Rajasthan, India
[3] ICAR-Directorate of Onion and Garlic Research, Rajgurunagar, Pune - 410 505 (MS), India
*Corresponding Author: bablicph@gmail.com

Cashew nut (*Anacardium occidentale* L.) is one of the most important agro-industrial crops in India, Brazil, Vietnam, and African countries. It is primarily cultivated for its nut, and widely grown in tropical areas. However, due to the high value of the nut, another important produce from cashew i.e., cashew apple, has been neglected all along without any utilization. Cashew apple has several medicinal properties and is highly nutritious. The production of cashew apple in India alone is estimated to be around 60 lakh tonne per annum. The cashew apple is not commercially utilized in India, except in Goa where it is profitably used for the production of feni. The cashew apple, weighing about 8-10 times that of the nut, is an equally valuable produce from the crop, if it is economically exploited. By effective utilization of cashew apple on Cashew Apple botany (*Anacardium occidentale* L.)

Cashew is found in two parts; the nut and the commercial scale, the farmers can be assured of increased income which will encourage them to take up cashew cultivation with renewed interest.

peduncle. The nut is of greater economic interest. The peduncle region i.e., cashew apple, also a pseudo-fruit, is juicy fibrous fruit. Cashew apples are derived from a tissue called thalamus or receptacle or stalk present outside the ovary. The distinct layers like exocarp, mesocarp and endocarp are absent in cashew apple. Thus, it is called as pseudocarp or false fruit. The development and maturity of cashew apple is in consistent with nut maturation. The matured cashew apples are spherical or cylindrical in shape without or with medial depression and look like a pyriform shaped hypocarp. During maturation and ripening, the firm, fragile and green, immature cashew apples are turned to soft and juicy with the different outer spectrum (red, orange and yellow) depending on the varieties (**Fig.1**).

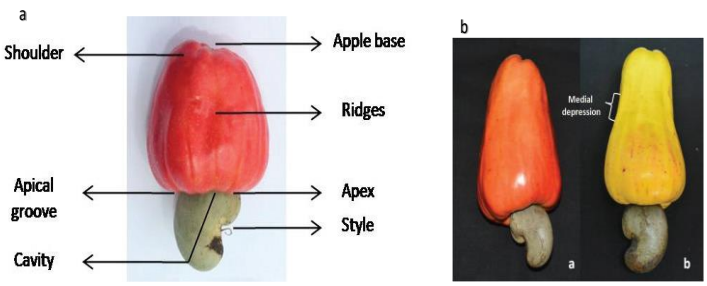


Fig. 1: Botany of cashew apple (a) and cashew apple without and with medial expression (b) (Source: Preethi P et al, 2019).

Biochemical properties of cashew apple

Cashew apple is rich in ascorbic acid (240mg/100g) which is almost six times that of citrus fruits (40mg/100 g) (Nagaraja, 2007). It is also a good source of fibre and contains free soluble sugars which are mostly reducing sugars. On a dry weight basis, the crude fibre content varies from 15 to 18%. Vitamin B2 content of cashew apple is about 5-fold when compared to pineapple and grapes. The vitamin C content of cashew apple is 5 to 10-fold more than of pineapple, banana, orange and grapes (Nagaraja, 2007).

Utilization of cashew apple

Large number of technologies that are economical and effective, have been developed for the production of various value-added products from cashew apple (**Fig.2**)

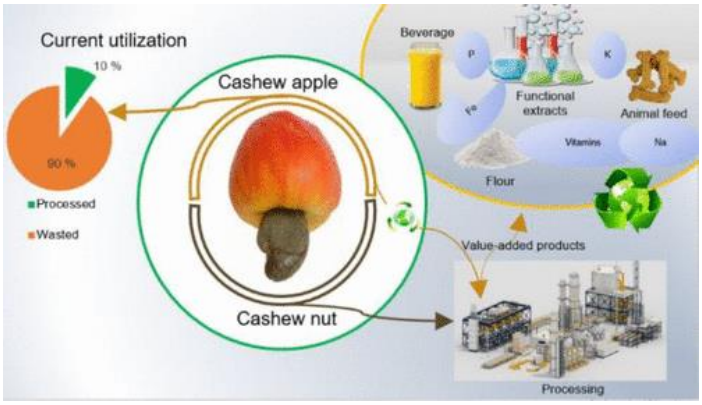


Fig.2: over view of multiple uses of cashew apple (Source: Raphael Aidoo et al, 2022)

Fresh apple beverages

Clarified and cloudy juice, juice concentrate, syrup, squash and ready- to- serve drink are some of the nutritious and refreshing beverages that can be made from the unfermented juice of cashew apple by adding varying concentrations of sugar, citric acid and preservative.

ICAR-Directorate of Cashew Research, Puttur has developed a read to serve (RTS) from cashew apple called as 'CashLime.' CashLime is a cashew apple and lemon juice blend RTS prepared using cashew apple pulp. The nutrient rich drink can be stored under refrigerated conditions for maximum of five months with maximum retention of nutrients and biochemical quality parameters (TSS- 10.5°Brix, vitamin C - 72 mg/100 ml, Tannins- 76 mg/100 ml, Total Phenols - 58 mg/100 ml).

Fig.3: Cashew apple products developed at ICAR-DCR, Puttur (Source: Preethi P et al, 2019).

Fermented beverages

Cashew apple can be utilized for the manufacture of fermented products like wine, vinegar, liquor and alcohol. Cashew apple vinegar can be prepared by alcoholic and subsequent acetic fermentation of juice, which is perhaps the oldest known fermentation product (Sobhana, 2019). Cashew liquor is not made by blending of spirits as done in case of foreign liquor, it is prepared from pure cashew apple juice only. One litre of 60-62% ethyl alcohol can be obtained from eight litres of cashew apple juice.

Cashew apples are utilized widely in Goa for the preparation of the liquor, 'feni' by distillation. Cashew apple juice is extracted and kept for fermentation for a few days. Fermented juice is then double distilled and the resulting beverage is called feni or fenny. Feni has about 40-42% alcohol. The single-distilled version is called urrac, which has about 15% alcohol (Sobhana, 2019). Feni is primarily considered as country liquor and it has a strong fruity flavour, peculiar taste, strong aroma and astringent smell. Feni liquor has been registered as the first geographical indication (GI) product from cashew (Elsy et al, 2009). Cashew wine is a product of fermentation of hexose sugar of cashew apple juice by intact yeast cells to form ethyl alcohol and carbon dioxide. Kerala Agricultural University has developed methods for producing four grades of wine such as soft, medium, hard and sweet, based on the alcohol percentage and sweetness.

Products from Cashew Apple Pulp

Jam is the most important pulp product of cashew. It can be prepared by boiling the cashew fruit pulp with sufficient quantity of sugar and a pinch of citric acid to a reasonably thick consistency firm enough to hold tissues in position. Mini et al (2007) reported that cashew apple can be mixed with pineapple, mango or combination of mango, pineapple and apple in 50:50 ratio for preparation of jam. The Madakkathara Centre is commercially producing Cashew apple- Mango mixed jam named Cashewman (Sobhana, 2019).

Osmo-dehydrated products

Candied fruit is prepared from cashew apple by impregnating with cane sugar with subsequent draining and drying. One kilogram of cashew apple on processing gives 745 g candies. The syrup left over from the candying process can be used for sweetening chutneys, in vinegar making or for candying another batch of fruits. Cashew apple can also be utilized for the preparation of tutty fruity. One kilogram of cashew apple on processing gives 715 g tutty fruity (Sobhana, 2019).

Osmotically dehydrated cashew apple is a novel value-added product developed from the cashew apple. Sugar has been completely replaced with honey in preparation of this product, hence having medicinal property with no side effect of sugar. Thus, it is possible to make the seasonal fruit available to the consumers throughout the year. One Kg of good quality fresh cashew apple on processing gives about 200g of osmotically dehydrated cashew apples (Sobhana, 2019).

Culinary uses

Sliced raw green fruit can be used to prepare pickle using chili powder, gingelly oil, fenugreek powder, asafoetida, turmeric powder, garlic, mustard powder, a pinch of sodium benzoate and salt to taste. Chutney can be prepared from sliced cashew apple using sugar, onion, ginger, cumin, pepper, cardamom, cinnamon, coriander powder, salt, vinegar etc. (Sobhana, 2019).

Potential uses of cashew apple

Considerable amount of cashew apple residue is obtained as waste after utilization of cashew apples for the manufacture of soft drinks or fermented beverages. Nutrient content of cashew apple residue includes total ash (1.6%), total tannin (5.2%), calcium (20.6mg/100g), phosphorus (152.7 mg/100g), crude fibre (8.4%), protein (8.8%) etc. The cashew apple residue has several agricultural, industrial, medicinal and nutraceutical uses.

Agricultural uses

Vermicompost

The cashew apple waste which is highly perishable and seasonal, can be converted to vermicompost with good manurial value of 1.69% N, 0.44% P and 0.58% K using *Eudrilus euginae*. The pH of the compost from cashew apple is 8.9 and hence it can be used as a good ameliorant for acidic soils.

Animal feeds

The cashew apple residue can be utilized for the preparation of cattle feed, pig feed and poultry feed. Cashew peel (7.6% protein, 12.3% fat and 59.2% carbohydrate) is a good poultry feed. Cashew apple residue after fermentation can be blended up to 20% to prepare animal or poultry feed without any adverse effect on milk yield (Nagaraja et al, 2007).

Industrial uses

Bio fuel

The potentials to utilize cashew apple for production of alcohol to be used as a bio fuel are immense. Fresh cashew apple contains 9.5 to 10% carbohydrate in addition to varying quantities of fat, mineral and vitamins. It is estimated that cashew apple can yield 8 to 10% of ethanol. Every kilogram of raw nut generates apple equivalent to produce 500 to 600 ml of ethanol of about 70% purity. There is a huge potential of generating ethanol from cashew apple.

Bio gas

Ripened cashew apples can be used as raw material for biogas plant.

Medicinal uses

Cashew apple is used as a curative against scurvy and stomach ailments like dysentery and diarrhoea. Cashew apple juice without removal of tannin is prescribed as a remedy for sore throat and chronic dysentery. Fresh or distilled, it is a potent diuretic, possessing anti scorbutic properties and is useful for kidney problems and in advanced cases of cholera.

Use in nutraceuticals

Ascorbic acid, fibre, carotenoid pigments, minerals and other chemicals which are of significance to human health are present in cashew apple. A valuable by product that can be obtained from cashew apple waste is pectin (1.6 to 2.03%). Pectin is used in manufacturing jams, jellies, marmalades, preserves etc. It is useful in thickening, texturizing and emulsifying agent and finds numerous applications in pharmaceutical preparations and cosmetics. The cashew apple pomace or fruit waste has been identified as the ideal medium for pectinase enzyme production for *Aspergillus foetidus* through solid state fermentation.

Economics and marketing of cashew apple products

Economics of processing of cashew apple for syrup production has been worked out (Mini et al, 2006). By processing one tonne of cashew apple, a net profit of Rs. 10,368/- can be obtained. Considering that the average yield of nut in India is 800 kg/ha, a production of 6.4 t/ha of cashew apple can be anticipated. A production of about 2t/ha of cashew apple can be ensured, taking 30% of the total production as good for processing. Thus, the additional income from a hectare of cashew orchard from the processing of cashew apple worked out to be Rs. 20,736/-, if a farmer or farmers group can venture into this endeavour. The income can be further enhanced by processing cashew apple for high value

products like alcohol and wine. Compared to other fruits, the advantage of cashew apple is that it is available free of cost and hence, the price of cashew apple can be fixed by about 20% less than that of conventional fruit drinks like mango and pineapple.

Way forward

Economic utilization of cashew apple has not progressed to the desired level in spite of excellent qualities of cashew apple and the availability of technologies for its processing to various value-added products. Processing of cashew apple is to be considered as a programme of agricultural waste utilization, adding income to the growers. Commercial exploitation of cashew apple is the need of the hour considering its vast potential in enhancing the income from cashew plantations. However, the financial and policy support of the state and central governments are vital in promoting the economic utilization of cashew apple. Additional income from cashew apple processing will make cashew cultivation more attractive to farmers, thereby enabling the country to achieve self-sufficiency in raw nut production.

Reference

A Sobhana. 2019. Cashew Apple Utilization-Generating Wealth from Waste. Advances in Nutrition & Food Science. 4(4): 1-5

Elsy, C.R., Jose Mathew and Arun S. 2009. Protection of geographical indication of cashew products for enhancing market potential. Proc. 7th National seminar on Cashew development in India-enhancement of production and productivity, Bhubaneshwar, 2-3, pp. 79-81

Mini C, Mathew J. 2007. Multi uses of cashew apple. Proceedings of 6th National Seminar on Indian Cashew in the next decade- challenges and opportunities, Raipur pp: 45-52.

Mini, C., Jose Mathew and Jesy Thomas, K. 2006. Economic potential of cashew apple. Cashew Bulletin XLIV (6): 5-8

Nagaraja, K.V. 2007. Antioxidants in cashew (Anacardium occidentale). The Cashew XXI 4:6-20

Preethi P, Rajkumar A. Dagadkhai, Shamsudheen Mangalassery, M.G. Nayak. 2019. Prospects of cashew apple: A compilation report. ICAR-DIRECTORATE OF CASHEW RESEARCH Darbe (P.O), Puttur – 574 202 Dakshina Kannada, Karnataka

Raphael Aidoo, Ebenezer Miezah Kwofie, and Michael O. Ngadi. 2022. Circularity of Cashew Apples: Examining the Product-Process Pathways, Techno-Functional, Nutritional/Phyto molecular Qualities for Food Applications. ACS Food Sci. Technol. 2(7): 1051–1066.

Table 1: Vitamin and mineral contents of various tropical fruits (mg /100g) (Source: Nagaraja, 2007)

Constituent	Cashew apple yellow	Cashew apple red	Pineapple	Avocado	Banana	Lime	Mandarin	Orange
Riboflavin	99	124	20	150	60	Traces	30	30
Vitamin C	240	186	24	16	10	45	31	49
Calcium	41	41	16	10	8	14	33	33
Phosphorus	11	11	11	38	29	10	23	23
Iron	3	3	0.3	0.3	0.6	0.1	0.4	0.1

* * * * * * * *

Zero Hunger, Boost Nutrition and Advance Sustainable Agriculture to End Hunger

Devendra Kumar Kurrey
Ph.D. Agricultural Economics, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.)
*Corresponding Author: drdevendrakurrey95@gmail.com

By 2030, SDG-2 seeks to eradicate all forms of hunger and malnutrition and guarantee that everyone, especially children, has access to enough food throughout the year. This entails encouraging small-scale farming, assisting sustainable agriculture, and guaranteeing equitable access to markets, technology, and land. To assurance infrastructure and technology investments that will increase agricultural productivity, international cooperation is also necessary. In 2020, it was thought that 149 million children under 5 were stunted (too short for their age), 45 million were wasted (too thin for their height), and 38.9 million were overweight or obese. About 45% of deaths in children under age 5 years are caused by not getting enough food. Most of these happen in countries with low and middle income. At the same time, more and more kids in these same countries are becoming overweight. In 2022, the UN's Food and Agricultural Organization (FAO) reported that 16% of India's population, or 224.3 million people, were undernourished. In 2022, the UN's Food and Agricultural Organization (FAO) reported that 16% of India's population, or 224.3 million people, were undernourished.

Longer-term trends are dragging down the global food system as well. Countries have yet to rebound from the setbacks of the COVID-19 pandemic, which both pushed more people into poverty, making it harder for them to afford food and harmed the ability of farmers to bring crops to harvest in the first place.

The climate crisis has been exerting pressure on the food system for decades and the rising prevalence of heat waves, droughts, floods, and extreme storms is making it more difficult and expensive to farm, with entire regions losing the capacity to grow certain crops.

Then there is how corporate power distorts the structure and priorities of the global food system. Rather than focusing on growing foods that nourish people and sustain the land, food production is too often shaped by profit motives. Companies guided by the profit principle decide how land gets used, what gets planted, where those crops end up, and who can afford what.

The result is a system in which nearly 40% of food gets wasted, vast amounts of land get degraded, water sources get polluted and depleted, nutrient-empty processed foods fill grocery store shelves, and hunger, which doesn't need to exist, continues to plague communities.

Sustainable Agriculture to End Hunger

Sustainable agriculture can help end hunger by producing safe, healthy, and high-quality agricultural products in a way that is environmentally, economically, and socially sustainable. It can also help communities sustain themselves by increasing the amount of available food.

Environmental conditions: Sustainable agriculture can improve soil fertility, freshwater availability, and adaptation to adverse weather conditions.

Crop yield: Sustainable agriculture can increase crop yield and crop diversity.

Farmer's income: Sustainable agriculture can increase farmer's income.

Food security: Sustainable agriculture can relieve hunger and create lasting change.

Unpredictable weather conditions and gradually depleting natural resources are major factors responsible for diminishing agricultural produce. Goal 2 aims to enhance a farm's resilience to external factors and promote economic means as part of sustainable farming. Sustainability implies the overall betterment of environmental conditions such as soil fertility, freshwater availability, and adaptation to adverse weather conditions.

Action Against Hunger

Empowering small-scale farmers and prioritizing the production of healthy, sustainable, and affordable foods, food security and nutrition will

not improve in any meaningful sense, the report's authors warned. However, the ongoing stinginess of governments worldwide means that it's unlikely for new funds to be disbursed to solve this problem. Instead, countries must change how they allocate existing funds, the report argued. New models for existing public funds can be prepared that could make food more affordable, increase access to healthy foods, protect land and water resources, and empower smallholder farmers.

Countries like India are dependent on agriculture, and funding from wealthy nations will be key as they transition to more sustainable food systems. Foreign aid for climate adaptation, especially as it relates to smallholder farmers, needs to be rapidly scaled up to both meet and go beyond existing pledges.

focus can be placed on taking decisive action against the causes and effects of malnutrition. We can equip people with knowledge and awareness, so they can see their children grow up strong, and for whole communities to prosper.

The Indian government has launched several programs to address malnutrition:

- National Nutrition Mission (NNM):
- Poshan Abhiyaan
- Integrated Child Development Services (ICDS) Scheme
- Pradhan Mantri Matru Vandana Yojana (PMMVY):
- Anemia Mukt Bharat Abhiyan
- Mid-day Meal (MDM) scheme
- National Food Security Act (NFSA), 2013
- National Children's Fund
- National Health Mission

The government also announced Mission Poshan 2.0 in the 2021-2022 budget. This program aims to improve nutritional content, delivery, outreach, and outcomes. It also focuses on developing practices that nurture health, wellness, and immunity to disease and malnutrition.

The government has also released guidelines for an Integrated Nutrition Support Programme. This program includes Saksham Anganwadi and Poshan 2.0.

A sizeable proportion of the country's population are malnourished and anaemic, and for this, numerous factors are responsible. Some of these factors directly cause malnutrition among people, whereas many others affect indirectly. Significant among these are poverty; unemployment; ignorance and lack of education; unhealthy lifestyle; lack of access to nutritious food, safe water, sanitation and hygiene; non-availability of reliable and timely data, and sufficient funds; and unimpressive performance by the government in the implementation of schemes.

Many of the reasons for the occurrence of malnutrition, as well as the solutions to overcome the challenge, are known. Attention, however, needs to be paid to understanding what prevents the nation from achieving its goals related to nutrition. Undoubtedly, the agencies of State governments have to adopt a comprehensive and coordinated multi-sectoral approach which is formulated by taking into account the varied nature of local-level challenges. They have to demonstrate better governance, too. For its part, civil society must respond responsibly. In particular, attention needs to be paid to building neighborhood health and nutrition profiles and carrying out interventions based on identified needs.

In all contexts, reforms to repurpose support to food and agriculture must also be accompanied by policies that promote shifts in consumer behaviors along with social protection policies to mitigate unintended consequences of reforms for vulnerable populations, Finally, these reforms must be multisectoral, encompassing health, environment, transport and energy policies."

* * * * * * * *

Exploring Sucrose Alternatives for Bakery: A Comprehensive Analysis

[1]Silvya Mario, [1]Babli Waribam, [1]R. Sasikumar and [1]I. B. Mangang*
[1]Department of Agri-Business Management and Food Technology,
North Eastern Hill University (NEHU)- Tura Campus, Meghalaya
*Corresponding Author: 12barunmangang@gmail.com

Sweeteners are bounteously available in nature as constituents of organic matter and can also be fetched from plant-origin sources that are abundant in starch molecules. They can be endowed in fair amounts in cereals and grains as well as in fruits; leaves containing glycosides of steviol; milk and its products; sugarcane and its derivatives; honey; and maple syrup (Xu et al. 2019). Sweeteners are polysaccharides characterized for their sweet taste, are absolutely necessary components of baked goods and are added to products leavened either by yeasts or by chemicals like in the case of cake batter and cookies. The handed-down sweetening substance used is sucrose. Sucrose is notoriously known for its deleterious effects on human health like diabetes.

Alternatives of sucrose

Given its universality, sucrose has become easily contingent and is increasingly being replaced by sweeteners, natural and synthetic in nature (Struck et al. 2014). Along with sucrose, there are several other sweeteners that are taken liberty with such as crystal form of glucose, unrefined or partially refined sugar, cane or sugar beet molasses, liquid sugar, Invert sugar syrup, Honey, sugar derived from maple, Glucose or corn syrup, High fructose corn syrup, High-intensity sweeteners, Sugar alcohols or polyols. They can be categorized (Fig.1) conforming to their content of calories as follows.

- Nutritive or caloric sweeteners that can be either mono or disaccharides, or a mixture of both.
- Non-nutritive or high-intensity sweeteners are zero or low-calorie sweeteners.

They can also be divided according to their origin, either as natural or artificial sweeteners. Their functions are sweetening, tenderizing, fermentation control through osmotic pressure, batter aeration (crystallized sugars), yeast food or nutrient, bulking agents (body), crust colouring or browning agents, flavouring agents (molasses, honey, malt, maple sugar), hygroscopic moisturizing agents, texture givers and shelf-life extending by minimizing water activity.

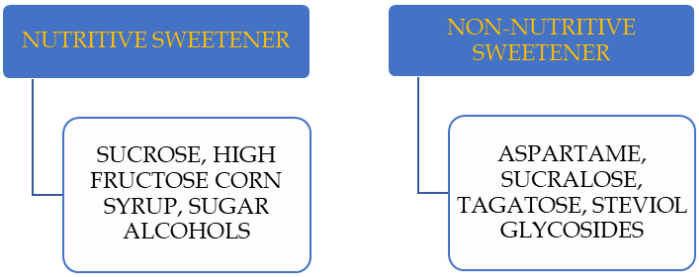


Fig. 1: Classification of sweeteners used in bakery

According to how much a particular sweetener contributes to doughs, batters, or finished products, they are selected on the following basis namely sweetness level or relative sweetness. Fermentability is also an essential variable that can be studied along with the total solids and moisture content of the liquid sweeteners (maple syrup or honey) or dry sweeteners. All these factors are hypercritical for batter-based products like cakes.

The food industry is becoming more interested in sucrose alternatives to use in low-sugar products. One of the key ingredients in sweet baked goods is sucrose, which greatly increases their energy content. A reduction in the consumption of sugars in the human diet has been advised due to the association between dental caries and excessive consumption of low molecular mass carbohydrates and other diet-related health problems (WHO, 2004).

Impact of using alternative sweeteners

Altering the sugar content may have a deleterious impact on the rheology and texture of food. When making low-sugar baked goods, reducing the amount of sucrose can result in noticeable changes to the final product's rheological and textural properties, as well as appearance, texture, flavour, and mouthfeel. Although frequently overlooked and consequently understudied, these aspects are rudimentary since a novel cuisine that is properly prepared from a nutritional and healthy point of view should also be enjoyable and satisfying to consume. Aspects like texture, volume, colour, taste, and shelf

life of the product all significantly vary when the sucrose concentration decreases, though. Both the acceptability of the product and the processing characteristics of batters or doughs may be negatively impacted by these alterations. The thermal stability of sweeteners is one of the key criteria for their usage in bread goods for example Aspartame begins to thermally decompose at temperatures reached during baking. Additionally, sweeteners vary in terms of sweetness intensity, sweetness profile, sweetness persistence, aftertaste, mouthfeel, solubility, and stability (Ding and Yang 2021).

Future prospects

Finding a substitute for sucrose that matches its sensory and bulk qualities is therefore the key issue in replacing it, leading to the production of products that are comparable to their full sugar counterparts. Replacing sucrose with a combination of a heat-stable high-intensity sweetener and a bulking component can preserve the viscous nature of the batter and the finished product's texture. Finding a replacer or replacer combination that offers outstanding product features, is simple and beneficial to the fundamental structure consequently the intrinsic value of cereal-based foods is a crucial problem for large-scale commercial applications. In order to produce bakery items with decreased sugar that consumers will accept, it is crucial to make sure that the alternative sweeteners have an impact on the product quality that is equivalent to that of sucrose and that they have similar machinability. The natural and high-intensity artificial sweeteners both have the benefit of imitating a flavour and sweetness similar to that of sucrose, but they do not contribute as much to the viscosity and body of batter or dough, which may have a negative impact on a number of characteristics that are derived from the microstructure of the product, e.g., inulin and polydextrose have been particularly utilized again and again in those circumstances, even though an amalgamation of a bulking agent with a high-intensity sweetener or an appropriate dietary fibres may be applied to address these issues. Tagatose is a prospective natural sweetener considering it has attributes that are comparable to those of sucrose in terms of volume and sweetness, but only about half as much caloric value. Given that polyols make available good bulking traits for utilization in baking products, they can occasionally possess or exhibit a low relative sweetness, which confines their potential for use from a sensory perspective. Utilizing one or a combination of specific sweetening agents depends largely on the food type and its role played in the matrix and as of now, not surprisingly, there is currently a lack of a perfecting sweetener for replacing sucrose.

Conclusion

So, to conclude, exploring a total replacement to sucrose for use in bakery products is yet to be achieved. Considering the negative impact it bestows on human well-being, consumption in moderation can be an answer to the problem.

References

Ding, Shiyong, and Jun Yang. 2021. "The effects of sugar alcohols on rheological properties, functionalities, and texture in baked products–A review." *Trends in Food Science & Technology* 111:670-679.

Struck, Susanne, Doris Jaros, Charles S Brennan, and Harald Rohm. 2014. "Sugar replacement in sweetened bakery goods." *International Journal of Food Science & Technology* 49 (9):1963-1976.

Xu, Shaohe, Guanyu Wang, Ruili Guo, Zhong Wei, and Jinli Zhang. 2019. "Extraction of steviol glycosides from Stevia rebaudiana (Bertoni) leaves by high-speed shear homogenization extraction." *Journal of Food Processing and Preservation* 43 (12):e14250.

* * * * * * * *

Avocado: A Storehouse of Phytochemicals and Nutraceuticals

T. Yatung[1*], L. Monish[2], M. N. Singh[2] and P. K. Nimbolkar[2]
[1]Dept. of Horticulture, MTTC & VTC, CAU (I), Pasighat, Arunachal Pradesh
[2] Dept. of Fruit Science, College of Horticulture and Forestry, CAU (I), Pasighat, Arunachal Pradesh
*Corresponding Author: tassoyatung@gmail.com

Avocado (*Persea americana* Mill) also known as Butter fruit, fruit of the new world or the 21st century fruit. It is a tropical evergreen climacteric fruit crop, originally from Mexico and Central America belonging to the family Lauraceae. The genus *Persea* comprises of two subgenres *Persea* and *Eriodaphne*. *Persea americana* grown for commercial production are divided into three botanical varieties: *Persea americana* var. *drymifolia* (Mexican species); *Persea americana* var. *american* (West Indian species); and *Persea nubigena* var. *guatemalensis* (Guatemalan species).

Avocado has a wide distribution and is gaining popularity worldwide, it is extensively marketed owing to its nutritional benefits for human health, especially due to the compounds present in the lipidic fraction, such as omega fatty acids, phytosterols, tocopherols and squalene.

Consumption of avocado helps in maintaining the balanced diet, especially in reducing cholesterol and preventing cardiovascular diseases. It is a million-dollar fruit that fetches high price from the fresh produce costing about Rs. 150-400/kg in the metro cities of India to Rs. 700/kg fruit in towns like Pasighat, Itanagar etc., of Nort East India. Besides being used as fresh, the fruit and the biowaste also find its way in food, cosmetics, nutraceutical, textile industries etc., thus making this fruit a high valued crop and hence the name "Green Gold of Africa" been rightly given to it.

Distribution

Avocado is grown in tropical or semi-tropical areas experiencing little rainfall in summer. In India, it is grown in small localized pockets of Tamil Nadu, Kerala, Maharashtra, Karnataka in the south-central part and in the eastern Himalayan state of Sikkim, Darjeeling and Kalingpong hills of North Bengal, and few pockets of Arunachal Pradesh.

Area and production

Mexico is the largest producer of Avocado in the world followed by Colombia, Dominican Republic, Peru, Indonesia, Kenya, Brazil, Ethiopia etc. The global production of avocado in 2020 was 8.06 million tonnes of which Mexico accounted for 45 percent of total avocado production in international market. Avocado production in Asia is limited to Indonesia, China, Israel, Vietnam, Philippines, Korea. The USA is the number one importer of avocado in the world, followed by the Netherlands, which plays an important role as transit country in the international trade. The top-ranking avocado exporting countries in world are Mexico, Peru, Colombia and Chile.

In India, the production is very limited. The cultivation is confined to states of Tamil Nadu, Kerala, Karnataka and Maharashtra and few patches of North East India that accounts for 5000 tonnes of avocado production. The wide agroclimatic conditions prevailing within the country and availability of high yielding improved varieties are highly favorable for area expansion and bringing avocado under cultivation.

Nutritional Values

Avocado have remarkedly higher fat content than most other fruits, ranging from 14% to 32%, for which it is called butter fruit, it is low in carbohydrates but high in calorie. As per USDA report in 2004, each 100g of avocado pulp gives 670KJ energy thus suitable for person on diet, total sugar content ranges from 3-8mg/g, dietary fiber 3.7- 4.7% and protein from 2.9-3.6mg/g. The fruit is predominantly rich in fatty acids such as oleic acid, palmitoleic acid, linoleic acid, linolenic acids and palmitic acid that are good fats and is free of cholesterol. Avocado is also highly rich in minerals such as calcium, copper, iron, magnesium, phosphorous, potassium, silicon that helps in maintaining good bone health, muscle contraction,

nervous and immune system, regulating body temperature, oxygen transport, electron transport, combating hypertension etc. The avocado fruit is also rich in vit. B complex; thiamine, riboflavin, niacin, pantothenic acid, pyridoxine, and folate, vitamins C, E and K. The fruit is highly nutritious and fiber rich, it is considered to have nutrients four times more than any other fruits, three times proteins more than apple, 35% potassium (358mg/100 g) higher than banana thus making it a superfood. The nutrient and mineral composition of avocado fruit is given below in Table.

Table 1: Proximate and mineral analysis of avocado fruit (per 100 g edible part)

Nutrients	Qty	Minerals	Qty
Protein (g)	1.7 0	Calcium (mg)	10.00
Fat (g)	26.40	Chlorine (mg)	11.00
Total carbohydrates (g)	5.10	Copper (mg)	0.45
Crude fiber (g)	1.80	Iron (mg)	0.60
Vitamin A (mg)	0.17	Magnesium (mg)	35.00
Ascorbic acid (mg)	16.00	Manganese (mg)	4.21
Niacin (mg)	1.10	Phosphorous (mg)	38.00
Riboflavin (mg)	0.13	Sodium (mg)	368.00
Thiamine (mg)	0.06	Sulphur (mg)	28.50

(Source: Madhav Rao and Abdul Khader, 1977)

Bioactive compounds:

Polyphenols- Apigenin, Catechin, Cinnamic acid, Chlorogenic acid, Coumaric acid, Epicatechin, Ellagic acid, Ferulic acid, Gallic acid, Gentisic acid, Homovanillic acid, Hydroxybenzoic acid, Luteolin, Naringenin, Protocatechuic acid, Procyanidins, Resorcylic acid, Sinapic acid, Quercetin, Rutin, Tyrosol glucoside, Vanillic acid, Vanillin.

Carotenoids- Lutein, Zeaxanthin, α-carotene, β-carotene, β-criptoxanthin, Neoxantin, Neochrome, lutein, chrysanthemaxanthin

Tocopherols-α-tocopherol, γ-tocopherol, δ-tocopherol

Sterols- β-sitosterol Pulp, Campesterol, Stigmasterol

Pharmacological properties

The fruit has high level of High-Density Lipoproteins (HDL) that helps in lowering the blood cholesterol levels there by acting as anti-hyperlipidemic, it also has anti-inflammatory, anti-microbial, anti-hypertensive, anti-oxidant, anti-proliferative, anti-dyslipidemia, anti-diabetic, anti-bacterial, anti-cholinesterase, hepatoprotective and neuroprotective properties owing to the presence of polyphenols, carotenoids, tocopherols and sterols. The β-sitosterol in avocados has a special effect on immunity, contributing to the treatment of diseases such as cancer, HIV and other infections. The presence of Chrysanthemaxanthin, a major carotenoid in avocado along with other carotenoids helps in conversion of vitamin A that is facilitated with the help of the rich fat available in the fruit and is considered to be good for eyes. With all these health benefiting properties of the fruit, avocado becomes a great boon for a healthy body.

Industrial application of avocado:

In the recent years avocado have become widely popular not only due to its immense health benefits but also because of its wide spectrum of application in the cosmetic industry. The fruit is highly rich in fat; thus, oil is extracted out of it which is employed in preparation of cooking oil for baking, roasting, sauteing, and frying due to high smoke point, in cosmetics industries for preparation of body oil, lotions and creams, face and hair mask due to high vit E content which has moisturizing and antioxidant properties. Avocado, being a seasonal fruit, to take the advantage of year-round availability value addition is done to the fruit, which is available in the market in the form of avocado oil, guacamoles, dry avocado powder, dehydrated products and avocado blended ice creams, juice, sauce, dried and shredded avocado pieces, chutneys etc. Tonnes of waste is released from the processing industries in the form of seed, skin, rotten avocado fruits etc., that create environmental pollution thus to avoid such situation and earn extra income, valorization of these waste is done by extraction of vital parts like starch, protein and phytochemicals, which have different industrial

applications such as in textile industries, the starch obtained from seed is used as a sizing, stiffening agent and as thickener. The avocado seed is used in preparation of biopolymer that has industrial application in textile, plastic, medical, electronics, constriction, packing and agricultural sectors, the seeds can be used in production of bioenergy such as biogas, biodiesel, ethanol production, paper and pulp production, seeds also find its application in brewery industry, food industry as food colorant and preparation of food formulation etc.

Conclusion

Avocado being a highly nutritious fruits, area under its cultivation in India can be expanded and the fruits may be sold at affordable price so that it is available to all section of the Indian population helping them to meet good health and also to combat the environmental pollution, valorization of biowaste from processing industries may be carried out both in cottage and large-scale industries which would help in facelifting of the country's economy.

Reference

Duarte, P. F., Chaves, M. A., Borges, C. D., & Mendonça, C. R. B. (2016). Avocado: characteristics, health benefits and uses. Ciência rural, 46, 747-754.

Ghosh, S. P. (2000). Avocado production in India. Avocado production in Asia and the Pacific, 24-30.

Jimenez, P., Garcia, P., Quitral, V., Vasquez, K., Parra-Ruiz, C., Reyes-Farias, M., ... & Soto-Covasich, J. (2021). Pulp, leaf, peel and seed of avocado fruit: A review of bioactive compounds and healthy benefits. Food Reviews International, 37(6), 619-655.

Maitera, O. N., Osemeahon, S. A., & Barnabas, H. L. (2014). Proximate and elemental analysis of avocado fruit obtained from Taraba state, Nigeria. Indian Journal of Science and Technology, 2(2), 67-73.

Tesfaye, T., Ayele, M., Gibril, M., Ferede, E., Limeneh, D. Y., & Kong, F. (2022). Beneficiation of avocado processing industry by-product: A review on future prospect. Current Research in Green and Sustainable Chemistry, 5, 100253.

Tripathi, P. C., Karunakaran, G., Sakthivel, T., Sankar, V., Senthilkumar, R., Muralidhara, S. R. & Begane, N. (2014). Avocado cultivation in India. Bulletin, Central Horticultural Experiment Station Indian Institute of Horticultural Research Chettalli, Kodagu, Karnataka, 14.

* * * * * * * *

Heavy Metals as Possible Contaminant

Deepali Sharma
Assistant Professor, Department of Nutrition & Dietetics Faculty of Allied Health Sciences, Shree Guru Gobind Singh Tricentenary University, Gurgaon-Badli Road, Budhera, Gurugram Haryana- 122505
*Corresponding Author: deepali_fahs@sgtuniversity.org

The introduction of harmful substances to humans and other living organisms by different means into the environments is termed as pollution. It is caused by several means that are produced in higher concentrations than usual and they can be some harmful solids, liquids, or gases and are called as pollutants.

Among the pollutants responsible for health hazards, these 'heavy metals' are measured as one of the most important environmental pollutants. Heavy metals are the term used for those metals which have density five times higher of water and have toxicity. They are essential to environment but becomes toxic when are available in excess amount. They are posed a great concern because they have a chain of transfer of from contaminated soil to ground water, crops, food chain, animals and ultimately to humans.

Heavy metals are non-biodegradable contaminant hence they have a large spectrum to effects seen especially among children who are more sensitive than adults. Their dissolved forms exaggerate through circulators in the biosystem, majorly the food chain, and results into elevated concentration in humans (Duruibe *et* al., 2007).

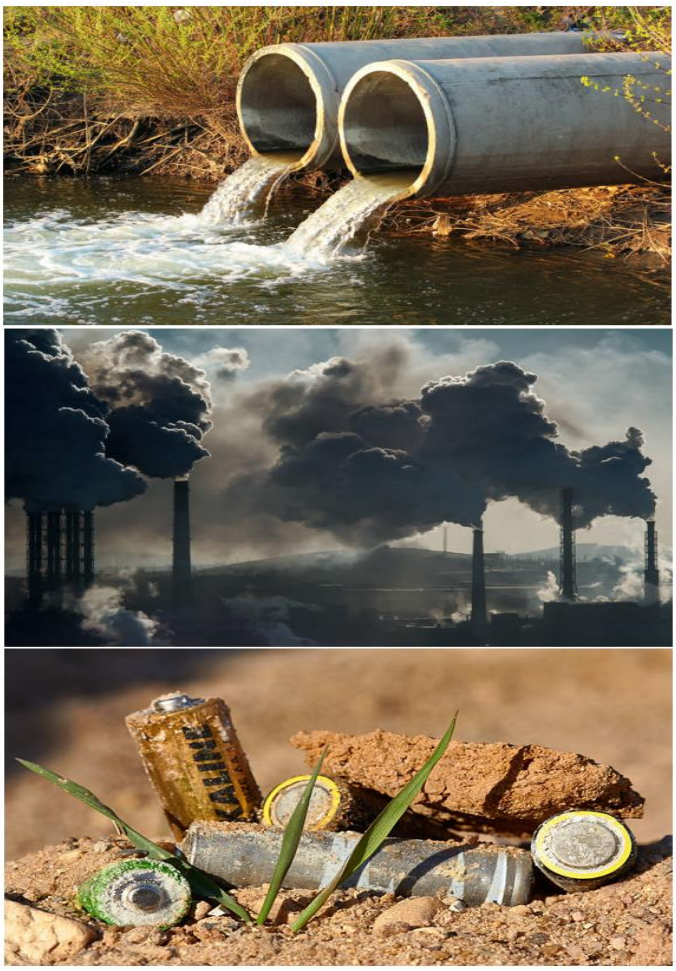
Generally, some of these heavy metals are toxic like mercury, cadmium, lead, arsenic and other compounds. They are important types of contaminants found in fresh crops tissues and in foods. They are classified in groups of basic metals, metalloids and transition metals. Among them, transition metals are found majorly. Toxicity of metalloids varies according to the oxidation state and concentration status. At a specific oxidation state they are termed as trace metals and in another oxidation state they are highly toxic. Not all metals are toxic to organisms. Some are essential even at a low concentration and reveal toxic state with increased concentration. (Al-Musharafi SA, 2016)."

Heavy metal-sources

These metals are emitted both by natural and anthropogenic activities into the environment. They increase metal concentrations to a level which is harmful to the environment.

They are also found in rocks in different chemical forms, and recovered as minerals sulphides, such as iron, arsenic, lead, zinc, cobalt, gold, selenium and antimony. Some metals are found during the mining processes, or in open and partially covered pits and are transported through wind and flood. Most of the water bodies and environmental air are polluted through the mining activities."

The use of fertilizers and pesticides in agriculture is the second most important source of heavy metal pollution. Theses metals are found in fertilizers and also in some pesticides as micronutritional or bicidal components either a naturally occurring contaminant or introduced when waste materials are used to formulate fertilizers product (ISHS, 2001).



The partially treated or mostly the untreated disposals are directly dumped in to the water bodies and these wastages majorly are accumulated with variety of chemicals including heavy metals. Due to scarcity of water bodies in many areas, the water from these contaminated water bodies is used in the agricultural practices by farmers. Manure may contain harmful chemicals that cause harm to fauna, despite their easy availability and rich nutrients content. Their accumulation also depends upon the species of plant, as well as other factors including temperature, moisture, organic matter, pH; nutrient availability and others. Their concentration in crops may vary among local, regional and country level (Zurera and Morena, 1984; Hu *et al*., 2014).

They can also be introduced into environment during erosion by rain as well as groundwater stream flow to soil. As a result of increased industrialization and urbanization in every part of the country, there are cases of growing environmental pollution and more heavy metal levels in soil, vegetation, water, food, milk and human body. Crops become more contaminated with heavy metals if they are grown on contaminated soil polluted by mining, industrial or domestic sewage sludge, pesticides and fertilizers, transportation or marketing nearby polluted areas where food items are easily exposed to air pollution (Kumar *et al*., 2018).

Metals contamination through such crops of vegetables, tubers, fruits and milk attributed to sources human activities such as melting of metals or metalloids, other mineral works and also other industry and factory, or as a result of impact of fertilizers and pesticides containing these metals, which would contaminate the nearby environmental as well as extension of cities and their development. Food items can also be contaminated by the soil, water or air pollution and other then irrigation land, food items get polluted by mining, vehicular of industrial exhaust or during their transit and transportation, marketing and local food processing methods (Salhotra and Verma, 2017).

Heavy metals contamination in food

Heavy metals enter human body through ingestion of contaminated food, inhalation from the atmosphere, drinking contaminated water, and due to skin contact with agriculture, pharmaceutical, manufacturing, residential and industrial areas. Air pollution contaminates vegetables during transportation and marketing and elevates levels of heavy metals in vegetables (Walker *et al*., 2012).

More than half of the world's population depends on ground water for survival. The ground water being in direct contact with soil, rock and plateaus, those constituents of this source might contaminate the ground water. Water is able to dissolve, absorb and adsorb with many compounds. Because of wide diversity of contaminate affecting the water resources, surface (Nardi *et al*., 2009)."

Industrial effluents pollute freshwater with heavy metals and may precipitate and get absorbed on solid surface thus remaining suspended in water and then these metals are taken up by fauna Farm animals feed on these contaminated grass and water then becomes susceptible to environmental pollution from heavy metals (Javed *et al*., 2013)."

Variance of heavy metals concentration among vegetable to vegetable may be attributed for the type of heavy metal (Jassir *et al*., 2005). The consumption of milk and milk products as cheese, yogurt and milk powder is always important and has increased however they play an important role in human nutrition (Khalil and Soliem, 2013).

Heavy metals health effects

They can have negative effect on the metabolism process of living organisms when ingested through food or drinking water and gets absorbed and found exceeding the maximum limits. Some metals show more side effects on human health as they can be easily accessed through food intake even though they are not important for biological functions. In comparison to adults, children seem to be more sensitive for the accumulation of such metals (Ojedokun and Bello, 2016).

Excessive accumulation of toxic metals can lead to numeral serious health issues as well as deplete essential nutrients in human. Long term exposure to theses environmental toxicants can negatively affect human preliminarily from their early embryogenic

stage and throughout the postnatal life (Cao *et al*., 2016). Moreover their delayed consumption can cause damage in mental and central nervous system functions and lead to chronic accumulation in vital organs thus causing disruption of numerous biochemical processes, such as cardiovascular, bone diseases, nervous, lungs, kidney, liver and others (Raikawar *et al*., 2008). Symptoms help to identify the contaminant as they are the first indicators of contamination. And as a result of metal poisoning, symptoms include intellectual disability in children, dementia in adults, and other issues like central nervous system disorders, kidney diseases, liver disease, insomnia, depression, emotional instability and vision disturbances (Flora *et al*., 2008)."

If this toxicity of toxic metals exposure remained unrecognized or improperly treated; it may increase significant medical problems by showing a greater impact on increasing the morbidity and mortality rate. Their application in domestic, industrial and agriculture influences wider distribution in the environment raising serious concerns over their latent health effects on humans. Toxicity that arises from sudden contact to significant quantities of metals usually leads to multiple organ systems defects. Health outcomes of toxic metals depend upon the type of element, route and duration of exposure and to a greater level on individual's vulnerability (Jan *et al*., 2011)."

Conclusion

Heavy metals have become a chronic concern globally. They are a major environmental pollutant and have drawn attention due to their serious health implications. A drastic increase of urbanization and industrialization has increased soil pollution. Accumulation of these toxic metals in plants through polluted soil and water is the chief source of crops and vegetation contamination and their consumption by human and animals in food chain becomes risky. Crops which are grown in suburban and urban areas of developing and developed countries are the main source of heavy metals accumulation.

In developing countries, heavy metals investigation is gaining attention. And analyses of toxic metals in food and their permissible levels in food items have been carried out by different public and governmental organizations, along with their occurrence in soil, water and food, and long term exposure at local, regional and global scales has been investigated in various researches.

References

Al-Musharafi, S. K. (2016). Heavy metals in sewage treated effluents: Pollution and microbial bioremediation from arid regions. The Open Biotechnology Journal, 10(1).

Cao, J., Xu X., Hylkema, M. N., Eddy, Zeng, E. Y., Sly, P. D., Suk, W. A., Bergman, A., & Huo, X. (2016). Early-life exposure to widespread environmen-tal toxicants and health risk: A focus on the immune and respiratory systems. Annals of Global Health, 82(1):119-131.

Duruibe, J. O., Ogwuegbu, M. O. C., & Egwurugwu, J. N. (2007). Heavy metal pollution and human biotoxic effects. International Journal of physical sciences, 2(5), 112-118.

Flora, S. J., Mittal, M., Mehta, A. (2008). Heavy metal induced oxidative stress & its possible reversible by chelation therapy. The Indian Journal of Medical Research, 128(4), 501-523.

Hu, W., Chen, Y., Huang, B., & Niedermann, S. (2014). Health risk assessment of heavy metals in soils and vegetables from a typical greenhouse vegetable production system in China. Human and Ecological Risk Assessment: An International Journal, 20(5), 1264-1280.

ISHS. (2001). Heavy metal contamination in deciduous tree fruit orchards: Implication for mineral nutrient management. Acta Horticulture 564: IV International symposium on mineral nutrition of deciduous fruit crop.

Jan, A. T., Ali, A., & Haq, Q. M. R. (2011). Glutathione as an antioxidant in inorganic mercury induced nephrotoxicity. Journal of Postgraduate Medicine, 57(1), 72.

Jassir, M. S., Shaker, A. & Khaliq, M. A. (2005). Deposition of heavy metals on green leafy vegetables sold on roadsides of Riyadh city, Saudi Arabia. Bulletin of Environmental Contamination & Toxicology, 75(5), 1020-1027.

Javed, F., Ahmed, H. B., Crespi, R., & Romanos, G. E. (2013). Role of primary stability for successful osseointegration of dental implants: Factors of influence and evaluation. Interventional Medicine and Applied Science, 5(4), 162-167.

Kar, I., Mukhopadhayay, S. K., Patra, A. K., & Pradhan, S. (2015). Metal concentrations and histopathological changes in goats (Capra hircus) reared near an industrial area of West Bengal, India. Archives of environmental contamination and toxicology, 69(1), 32-43.

Khalil, H. M., & Seliem, A. F. (2013). Determination of heavy metals (Pb, Cd) and some trace elements in milk and milk products collected from Najran Region in K.S.A. Life Science Journal, 10, 1-5.

Kumar, V., Chauhan, R. K., Srivastava, S., Singh, J., & Kumar, P. (2018). Contamination, enrichment and translocation of heavy metals in certain leafy vegetables grown in composite effluent irrigated soil. Archives of Agriculture and Environmental Science, 3(3), 252-260.

Nardi, E. P., Evangelista, F. S., Tormen, L., Saint, T. D., Curtius, A. J., de Souza, S. S., & Barbosa Jr, F. (2009). The use of inductively coupled plasma mass spectrometry (ICP-MS) for the determination of toxic and essential elements in different types of food samples. Food Chemistry, 112(3), 727-732.

Ojedokun, A. T., & Bello, O. S. (2016). Sequestering heavy metals from wastewater using cow dung. Water Resources and Industry, 13, 7–13.

Salhotra, M. P., & Verma M. R. (2017). Determination of Heavy Metals Contamination in Some Vegetables and Fruits Samples from the Market of Jagdalpur, Chhattisgarh State. IOSR Journal of Applied Chemistry, 10(5), 110-113.

Walker, C. H., Sibly, R. M., & Peakall, D. B. (2005). Principles of ecotoxicology. CRC press.

Zurera-Cosano, G., Moreno-Rojas, R., Salmeron-Egea, J., & Lora, R. P. (1989). Heavy metal uptake from greenhouse border soils for edible vegetables. Journal of the Science of Food and Agriculture, 49(3), 307-314.

* * * * * * * *

Entrepreneurship development through Value addition of Millets

Khogare D.T. and R. Anitha
Sr. Scientist and Head, KVK, Madanapuram, Wanaparthy District. Telangana state
SMS (Home Science), KVK, Madanapuram, Wanaparthy District. Telangana state
*Corresponding Author: khogare_2006@rediffmail.com

Demand for a healthy diet has brought the Millets back as value added RTE products on to the table. Mrs Uma Devi, Wanaparthy Mandal, Wanaparthy District 35 years old women entrepreneur realized this when she is in a idea to start a Food based enterprise in the Wanaparthy. She had a small business, selling ayurvedic products in Wanaparthy mandal. When is learned about the skill trainings offered by KVK Madanapuram she grabbed the opportunity and enrolled herself into Skill training of value addition of millets.

KVK Interventions/ initiatives

In the year 2019, Mrs Uma Devi got training at KVK, Madanapuram under "Skill training on Millet Processing and Value addition" for 5 days and took assistance from KVK Scientists for establishing Small Scale Millet Unit that Includes Bakery Equipment's. She also gained knowledge on Organic Millet Cultivation, Post-Harvest and hygiene packing techniques.

Impact of intervention

- She is now able to provide employment for 3 Rural Women on daily basis.
- All the products are packed with brand name of "Arogyamasthu" with FASSI registration.
- At present she could realize a net income of Rs.2,75,000.00 per year.

The achievements in value addition brought her few awards notables among them include:

- Women Entrepreneur award by DRDA of Wanaparthy district. Telangana.
- Best women farmer under Value Addition by KVK, Madanapuram, Telangana

Contact details of the farmer

Name of the farmer	Address	Phone no
Mrs Uma Devi (W/O) of Eshwar Reddy	Wanaparthy Mandal, Wanaparthy District	7286086918

Table 1: Economics

Sr.No	Particulars	Production per month (kg)	Gross income (Rs.)	Net Returns (Rs.)
1	Millet Cookies	100 kgs	25000/-	7000/-
2	Millet ladoo	100 kgs	25000/-	5000/-
3	Millet cake	1000 no.	20000/-	19000/-
Total				31,000/-

* * * * * * * *

Success Story on Value Addition and Marketing of Millet Products

Khogare D.T. and R. Anitha
Sr. Scientist and Head, KVK, Madanapuram, Wanaparthy District. Telangana state
SMS (Home Science), KVK, Madanapuram, Wanaparthy District. Telangana state
*Corresponding Author: khogare_2006@rediffmail.com

Millets are tasty grains that have a mildly sweet, nut-like flavour. Millets are rich sources of protein, dietary fiber, energy and minerals when compared to rice. These millets have diversified high food value but the consumption of these millets has declined for want of standardized processing techniques to compete with fine cereals. Hence an effort was made to increase the utilization of small millets in popular foods which would find ready acceptability with the tag of 'HEALTH FOODS'.

Small millet-based value-added products including traditional recipes, bakery products, pasta products, flaked and popped products instant food mixes are developed and standardized by various institutes. The products which are commonly prepared by the farmers using cereals are replaced with small millets to increase their utilization.

Training and motivation

Mrs Nirmala old from Amarachintha of Wanaparthy dist. got training on "Skill training on Millet Processing and Value addition" at KVK, Madanapuram under UNATTI programme for 5 days and took assistance from KVK Scientists for establishing Small Scale Millet Unit that Includes Bakery Equipment's. She also gained knowledge on Millet Cultivation, Post-Harvest and hygiene packing techniques.

Adoption of technology and innovative practice

Processing and value addition started as home scale production with one product (Ragi Cookies) and slowly expanded to other 3 types or Millet Cookies (Sorghum, Pearl Millet and Fox tail millet). She branded and registered her product and obtained FSSAI certificate. She marketed her products by establishing store in Amarachintha village of Wanaparthy District Telangana State. She brought several innovations in to practice. Sugar was substituted with Jaggery and Dates to improve the taste and nutrition.

Achievements

She with the support of family established a small store at Amarachintha village of Wanaparthy District of Telangana wherein she put the Millet cookies for sale along with millet cake and Laddu. All the products are packed with brand name of "Arogyamasthu" with FASSI registration. At present she could realize a net income of Rs.31,000/- per month.

Contact details of farmer

Name of the farmer	**Address**	**Phone no**
Mrs Nirmala	Amarachintha of Wanaparthy dist	9553356769

Table 1: Economics

Sr.No	Particulars	Production per month (kg)	Gross income (Rs.)	Net Returns (Rs.)
1	Millet Cookies	100 kgs	25000/-	7000/-
2	Millet ladoo	100 kgs	25000/-	5000/-
3	Millet cake	1000 no.	20000/-	19000/-
Total				**31,000/-**

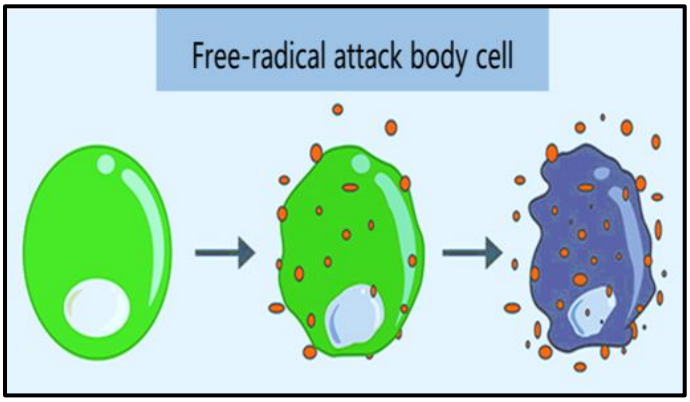
* * * * * * * *

Vitamin C's Battle Against Radicals

N. Sandhya Rani[1], A. Lalitha[2] and V. Usha Rani[3]
[1]Ph. D Scholar, Dept. of Human Development and Family Studies
[2]Ph. D Scholar, Dept. of Extension Education and Communication Management
[3]Ph. D Scholar, Dept. of Resource Management and Consumer Science
College of Community Science, PJTSAU, Hyderabad
*Corresponding Author: sandhyadolly111@gmail.com

Free radicals are highly reactive and unstable molecules that are made by the body naturally as a byproduct of normal metabolism. Free radicles are unstable atoms that can damage cells, causing illness and aging. Free radicals are missing an electron from their outer shell. That makes them unstable, so they go and steal an electron from the molecules in our skin cells, or from our blood cells or from wherever they can. Free radicals have a lifespan of only a fraction of a second, but during that time can damage DNA, sometimes causing mutations that can increase your risk of getting health conditions like heart disease and cancer.

Once free radicals are made, they're free to do damage to the body-whether they came from exposure to a carcinogen or the normal processes of the body. The availability of free radicals creates something called oxidative stress in the body. It's called "stress" because the chemical reactions that let free radicals get an electron occur in the presence of oxygen. There are several parts to this process. When one free radical "steals" an electron from a molecule, that molecule becomes a free radical because it's missing an electron. That cycle continues and makes more free radicals. Free radicals can damage the body's DNA. Our DNA contains our genes, proteins, lipids, cell membranes, and other important substances. Damaged DNA can lead to disease.

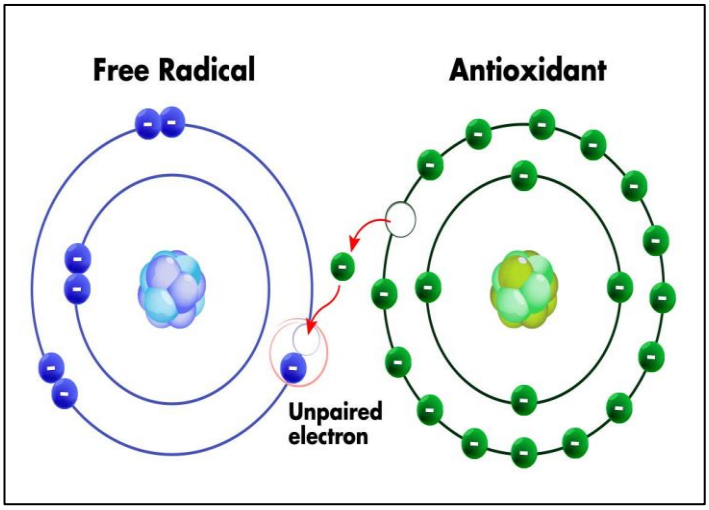


Sources of free radicles: Free radicals can also be made by the body after exposure to toxins in the environment such as

* Tobacco smoke and ultraviolet (UV) light,
* Exposure to toxic chemicals, such as pesticides and air pollution,
* Smoking,
* Alcohol and fried foods
* Stress
* Medical radiation

How to reduce free radicals:

Many of the plant chemicals (phytochemicals) in our foods are antioxidants. These nutrients stop the formation of free radicals and may reduce the damage they would cause in the body. Antioxidants are also unstable and looking for a partner. Like free radicals, antioxidants have an uneven number of electrons. Unlike free radicals, though, antioxidants don't typically steal from otherwise stable molecules to keep themselves in check. The power of antioxidants to fight free radicals is one reason why a diet rich in vegetables and fruits has been linked with a lower risk of many diseases.



Vitamin C: An Essential Defender Against Free Radical Damage

Foods and substances that have antioxidant properties that come from outside the body (exogenous) include: Vitamins such as Vitamin A, C, E, Q, N (alpha-lipoic acid), P (bioflavonoids), B1, B3, B6, B9. In particular, our focus revolves around the provenance of Vitamin C present in fruits and vegetables that can be grown in home gardens amidst the Indian climate.

Vitamin C (l-ascorbic acid) is a water-soluble micronutrient required for multiple biological functions. It is necessary for normal growth and development, Vitamin C is one of the potent reducing agents and scavenger of free radicals in biological systems, working as a scavenger of oxidizing free radicals and harmful oxygen-derived species. To harness the antioxidant properties of vitamin C and help reduce the impact of free radicals, it's important to include an adequate amount of vitamin C-rich foods in your diet. The Recommended Dietary Allowance (RDA) for vitamin C varies based on factors such as age, sex, and life stage. the RDAs are as follows:

- Adult Men (aged 19 years and older): 90 mg per day
- Adult Women (aged 19 years and older): 75 mg per day

However, during certain conditions such as pregnancy and lactation, the recommended intake may be higher.

Many vitamins C-rich fruits and vegetables can be grown in a home garden/farm in the Indian climate. Here are some options given in Table 1.

In conclusion, the understanding of free radicals and their potential harm to the body underscores the importance of incorporating antioxidants into our diets. It is essential to recognize the role of other antioxidants, such as Vitamins A, E, and various bioflavonoids, which complement the antioxidant spectrum. The sources of these exogenous antioxidants extend beyond vitamin C, providing a comprehensive approach to fortifying the body against free radical damage.

Vitamin C, a potent defender against free radical damage, plays a crucial role in neutralizing these unstable molecules. The discussion has shed light on the sources of vitamin C, emphasizing fruits and vegetables that can be cultivated in home gardens within the Indian climate. By exploring a variety of vitamin C-rich options, ranging from amla and guava to bell peppers and tomatoes, individuals can make informed choices to enhance their antioxidant intake. These homegrown solutions offer not only a sustainable approach to nutrition but also a practical means of combating oxidative stress. The versatility of vitamin C, found in both fruits and vegetables, allows for a diverse and enjoyable array of choices in promoting overall health

In implementing a diet rich in antioxidants, individuals can potentially reduce the impact of free radicals on their health, minimizing the risk of conditions like heart disease and cancer associated with oxidative stress. As we consider the interconnectedness of diet, health, and the environment, cultivating vitamin C-rich foods in home gardens not only contributes to personal well-being but also promotes a sustainable and resilient approach to nutrition. Ultimately, the pursuit of antioxidant-rich nutrition serves as a proactive step toward a healthier and more vibrant life.

Table 1: List of Fruits and vegetables rich in Vitamin C

Here are some vitamin C-rich fruits that you can grow in a home garden in the Indian climate	
Amla (Indian Gooseberry)	Amla is an excellent source of vitamin C and is well-suited to Indian climates. It is a small, green fruit that can be grown in pots or directly in the ground.
Guava	Guava trees thrive in the Indian climate, and they produce fruits with a high vitamin C content.
Lemon	Citrus trees, including lemon and lime, are excellent sources of vitamin C. They can be grown in pots or directly in the ground in various regions of India.
Papaya	Papaya plants are well-suited to tropical climates and can be grown in Indian gardens. They produce large, orange fruits rich in vitamin C.
Strawberries	While strawberries prefer a cooler climate, they can be grown in some parts of India, especially in the hills or during the winter season.
Mango	Mangoes not only taste delicious but also contain vitamin C. There are many varieties of mango trees that can be grown in different parts of India.
Kiwi	Kiwi plants can be grown in certain regions of India. They require a subtropical climate and well-drained soil.
Here are some vitamin C-rich vegetables that you can grow in a home garden in the Indian climate	
Bell Peppers	These colorful peppers, especially red and green varieties, are rich in vitamin C. They can be grown in pots or garden beds.
Tomatoes	Tomatoes are versatile and can be grown in various regions of India. There are numerous varieties to choose from, including cherry tomatoes.
Broccoli	Broccoli is a cool-season vegetable, and certain varieties can be cultivated in the winter season in parts of India with cooler temperatures.
Cauliflower	Similar to broccoli, cauliflower is another cruciferous vegetable that can be grown during the winter season in many regions of India
Spinach	Spinach is a leafy green that contains a good amount of vitamin C. It can be grown in pots or directly in the ground, especially during the cooler months.
Cabbage	Cabbage is a cool-season crop that can be grown in the winter months in regions with milder temperatures
Radishes	Radishes are quick-growing root vegetables that can be cultivated in the winter season in various parts of India
Green Peas	Peas are legumes that can be grown in cooler temperatures, making them suitable for the winter season in certain regions.
Cucumber	Cucumbers are refreshing vegetables with a moderate vitamin C content. They can be grown in pots with proper support or in garden beds.

* * * * * * * *

Tulsi: A Miraculous Plant

Muske Deepa Navanath[1] and Snehal S. Deshmukh
[1]Assistant professor (GPB), College of Horticulture, Bidar, University of Horticultural sciences, Bagalkote
*Corresponding Author: muskedeepa@gmail.com

Tulsi is a symbol of the Hindu religious tradition. Although the word 'Tulsi' gives the connotation of the incomparable one, its other name, Vishnupriya means the one that pleases Lord Vishnu. Found in most of the Indian homes and worshipped, its legend has permeated Indian ethos down the ages. Known in English as Holy Basil and botanically called *Ocimum sanctum*, Tulsi belongs to plant family Lamiaceae.*Ocimum sanctum L.* (Tulsi), *Ocimum gratissium* (Ram Tulsi), *Ocimum canum* (Dulal Tulsi), *Ocimum basilicum* (BanTulsi), *Ocimum kilimandscharicum, Ocimum ammericanum, Ocimum camphora* and *Ocimum micranthum* are examples of known important species of genus Ocimum which grow in different parts of the world and are known to have medicinal properties [1,2,3]

It recently has been shown to hold scientific worth in the areas of medical, Agricultural and pharmacy. Medicinal plants have been identified and used throughout human history. Plants have the ability to synthesize a wide variety of chemical compounds that are used to perform important biological functions [4, 5]. A traditional *anti*-fertility agent and libido enhancer in Ayurveda, Holy Basil is currently being investigated for these two claims and its health properties. A good source of dietary Ursolic acid, which may cause the anti-fertility aspects [6]. Traditionally, the active ingredient is an oil extract of the leaves, which although traditionally used for a myriad of reasons is most commonly regonized for anti-stress and pro-vitality propertiesand to defend against attack from predators such as insects, fungi and herbivorous mammals [7,8].

Tulsi is a popular home remedy for many ailments such as wound, bronchitis, liver diseases, hiccough, ophthalmia, gastric disorders, genitourinary disorders, skin diseases, various forms of poisoning and psychosomatic stress disorders1-2. It has also aromatic, stomachic, carminative, demulcent, diaphoretic, diuretic, expectorant, alexiteric, vermifuge and febrifuge properties [9,10,11,12].

Morphology

Tulsi is an erect, tall subshrub with hairy stems having leaves of greenand purple in color, strongly scented and have a decussate phyllotaxy. The purplish flowers are placed in close whorls on elongate racemes.

Active compounds in tulsi

Tulsi leaves contain bright, yellow coloured and pleasant volatile oil (0.1 to 0.9%). The oil content of the drug varies depending upon the type, the place of cultivation and season of its collection. The oil is collected by steam distillation method from the leaves and flowering tops. It contains approximately 7.0% eugenol, carvacrol (3%) and eugenol-methyl ether (20%). It also contains caryophyllin, ursolic acid, rosmaric acid, thymol, methyl chavicol, citral,carvacrol, β-caryophyllene. Seeds contain fixed oil with good drying properties. The plant is also reported to contain alkaloids, glycosides, saponins, tannins, an appreciable amount of vitamin C, and traces of maleic acid, citric and tartaric acid [13,14,15].

Active Ingredient

- Ursolic acid
- Eugenol,
- Bioflavonols such as Apigenin and lutein
- Ocimumosides A and B
- Ocimarin
- Rosmarinic Acid

Traditional uses

Different parts of plant are used in Ayurveda and Siddha Systems of Medicine for prevention and cure of many illnesses and everyday ailments like common cold, headache, cough, flu, earache, fever, colic pain, sore throat, bronchitis, asthma, hepatic diseases, malaria fever, as an antidote for snake bite and scorpion sting, flatulence, migraine headaches, fatigue, skin diseases, wound, insomnia, arthritis, digestive disorders, night blindness, diarrhea and influenza. The leaves are good for nerves and to sharpen memory. Chewing of Tulsi leaves also cures ulcers and infections of mouth [15,16].

Therapeutic Applications

Tulsi is mainly used in the treatment of following disorders like Antidiabetic, Cardiac activity,

Wound healing activity, Radio-protective effect, Genotoxicity, Antioxidant, Hypolipidemic, Antimicrobial, Gastro protective, Antinociceptive (Analgesic), Anti-fertility, Anthelmintic activity, Anti-inflammatory, Anticancer, Thyroid activity. Many research articles have given the proofs of its miraculous activity on dying diseases [17,18,19,20].

Neurological Impact

Stress and Anxiety

Some components of *ocimum sanctum*, namely ocimarin and the ocimumosides A and B, appear to exert antistress activity when given to rats at the dose of 40mg/kg [5].In otherwise healthy subjects given *ocimum sanctum* twice daily (500mg each time after meals) over the course of two months, supplementation appeared to reduce symptoms of generalized anxiety disorders as assessed by the BPRS[7, 8].

Interactions with Hormones

Testosterone

The only noted effects of Holy Basil on testosterone levels are from a rabbit study ingesting 2g of Holy Basil per day. This study and previous onesnoted reductions in sperm count and reproductive potential, which parallels studies with the component of Holy Basil Ursolic Acid.A possible explanation being a possible androgenic analogue in Holy Basil which increases testosterone sufficiently enough to repress luteinizing and follicle-stimulating hormones significantly.

Safety and Toxicity

Toxicity has been reported for the oil extract of Holy Basil (which contains 70+/-3% eugenol content) and has been found to be 42.5ml/kg bodyweight. Whereas the dry plant extract with a normal eugenol content has an LD_{50} of between 4600-6400mg/kg bodyweight in research animals [10,11].

Genomics

The genome of Tulsi plant has been sequenced and the draft genome has been published independently by research teams from CSIR-Central Institute of Medicinal and Aromatic Plants at Lucknow and National Centre for Biological Sciences at Bengaluru. The genome size was estimated to be 612 mega bases. The metabolite-biosynthesis genesfor Ursolic acid and Eugenol have been identified. These metabolites were shown to have anti-cancerous properties as well. It was further commented that these metabolites could be utilized as anti-cancerous drugs

Conclusion

Tulsi is "the elixirof life" useful against stress; it enhances stamina and increases efficient use of oxygen by body; strengthens immune system; reduces inflammation; protects from radiation; reduces aging; supports the lungs, liver and heart; it exhibits antibiotic, antiviral and antifungal, antioxidant properties. Different parts of plant have been used in Ayurvedic ancient Medicine to cure an array of ailments including common cold, cough, headache, flu, asthma, fever, colic pain, sore throat, bronchitis, hepatic diseases, malaria fever, as an antidote for snake bite, flatulence headaches, fatigue, skin diseases, wound, insomnia, arthritis, influenza, digestive disorders, night blindness, diarrhea. Tulsi acts as an adaptogen that helps the body and mind to encounter different physical, chemical emotional and infectious stresses, and restore physiological and psychological functions. Its having ability to release ozone in minor quantity. In future it may be used in bioremediation technology to get rid from heavy metal pollution.

Its having importance's in activities such as antibacterial, antiviral, antifungal, antiprotozoal, antimalarial, anthelmentic, antidiarrhoeal, analgesic, antipyretic, antiinflammatory, antiallergic, antihypertensive, cardioprotective, central nervous system (CNS) depressant, memory enhancer, antihypercholesterolaemic, hepatoprotective, antidiabetic, antiasthmatic, antithyroidic, antioxidant, anticancer, chemopreventive, radioprotective, immunomodulatory, antifertility, antiulcer, antiarthritic, adaptogenic / antistress, anticataract, antileucodermal and anticoagulant activities.

Such significant and health promising potential, in addition to its highly specific therapeutic actions, paved way for the broad range of Tulsi traditional medical uses, and also contributes for its mythological importance and religious sanctity. This review will definitely help for the researchers as well as clinicians dealing with *O. sanctum* to know its

proper usage as this herb is seemed to be highly valuable, possessing many pharmacological / medicinal properties.

References

[1]. Prakash P, Gupta N. Therapeutic uses of Ocimum sanctum Linn (Tulsi) with a note on eugenol and its pharmacological actions: a short review. Indian J PhysiolPharmacol. (2005)

[2]. Seth SD, Johri N, Sundaram KR. Antispermatogenic effect of Ocimum sanctum. Indian J Exp Biol. (1981)

[3]. Singh S, Taneja M, Majumdar DK. Biological activities of Ocimum sanctum L. fixed oil--an overview. Indian J Exp Biol. (2007)

[4]. Fabricant DS, Farnsworth NR (March2001). "The value of plants used in traditionalmedicine for drug discovery". Environ.Health Perspect. 109 Suppl 1 (Suppl 1): 69–75.

[5]. Tapsell LC, Hemphill I, Cobiac L et al.(August 2006). "Health benefits of herbs andspices: the past, the present, the future". Med.J. Aust. 185 (4 Suppl): S4–24.

[6]. Chattopadhyay D, et al. A potent sperm motility-inhibiting activity of bioflavonoids from an ethnomedicine of Onge, Alstoniamacrophylla Wall ex A. DC, leaf extract. Contraception. (2005)

[7]. Bhargava KP, Singh N. Anti-stress activity of Ocimum sanctum Linn. Indian J Med Res. (1981)

[8]. Gupta P, et al. Constituents of Ocimum sanctum with antistress activity. J Nat Prod. (2007)

[9]. Singh S, Majumdar DK. Evaluation of antiinflammatory activity of fatty acids of Ocimum sanctum fixed oil. Indian J Exp Biol. (1997)

[10]. Mukherjee R, Dash PK, Ram GC. Immunotherapeutic potential of Ocimum sanctum (L) in bovine subclinical mastitis. Res Vet Sci. (2005)

[11]. Khanna S, Gupta SR, Grover JK. Effect of long term feeding of tulsi(Ocimum sanctum Linn) on reproductive performance of adult albino rats. Indian J Exp Biol. (1986)

[12]. Padalia RC, Verma RS. Comparative volatile oil composition of four Ocimum species from northern India. Nat Prod Res. (2011)

[13]. Kumar A, et al. Chemical composition, antifungal and antiaflatoxigenic activities of Ocimum sanctum L. essential oil and its safety assessment as plant based antimicrobial. Food ChemToxicol. (2010)

[14]. Hakkim FL, Shankar CG, Girija S. Chemical composition and antioxidant property of holy basil (Ocimum sanctum L.) leaves, stems, and inflorescence and their in vitro callus cultures. J Agric Food Chem. (2007)

[15]. Singh S, Taneja M, Majumdar DK. Biologicalactivities of Ocimum sanctum L. fixed oil- Anoverview. Indian J ExpBiol 2007, 45:403-412.

[16]. Reghunandana R, Sood S, Reghunandana V,Mehta RM, Singh GP. Effect of Ocimumsanctum Linn (Tulsi) extract on testicularfunction. Indian J Medical Research, 1995,49(4): 83–87.

[17]. Bhattacharyya D1, et al. Controlled programmed trial of Ocimum sanctum leaf on generalized anxiety disorders. Nepal Med Coll J. (2008)

[18]. Mondal S, et al. Double-blinded randomized controlled trial for immunomodulatory effects of Tulsi (Ocimum sanctum Linn.) leaf extract on healthy volunteers. J Ethnopharmacol. (2011)

[19]. Gupta S, Mediratta PK, Singh S, Sharma KK,Shukla R. Antidiabetic,antihypercholesterolaemic and antioxidanteffect of Ocimum sanctum (Linn) seed oil.Indian J ExpBiol, 2006, 44(4): 300-4.

[20]. Agrawal P, Rai V, Singh RB. Randomized placebo-controlled, single blind trial of holy basil leaves in patients with noninsulin-dependent diabetes mellitus. Int J ClinPharmacolTher. (1996).

* * * * * * * *

Application of Thermosonication for the Processing of Fruit Juices

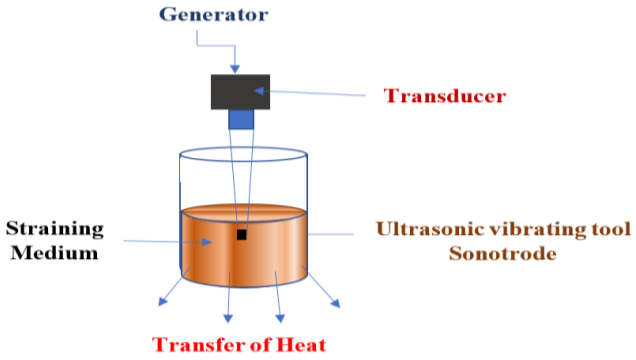
Puja Das*, Prakash Kumar Nayak, and Radhakrishnan Kesavan
Department of Food Engineering& Technology, Central Institute of Technology Kokrajhar, Kokrajhar, Assam, India
*Corresponding Author: pdas12994@gmail.com

Abstract

The increasing demand for superior quality and freshness in fruit juices, free from additives and preservatives, has led to the adoption of ultrasound technology in juice processing. Thermosonication emerges as an innovative and viable alternative to traditional heat treatment processes. This technique shows promise in elevating the quality and safety standards of fruit juices, offering enhanced energy efficiency compared to conventional thermal methods. Moreover, it surpasses the effectiveness, safety, and reliability of using ultrasound technology alone in achieving the desired destruction of food-borne pathogens. This article delves into the impact of combined ultrasound-heat application on the quality and safety aspects of fruit juices.

Introduction

Fruits, being highly perishable, necessitate processing into juices for a consistent year-round supply. Ensuring the utmost quality of juice is essential to meet consumer preferences, and considerations for juice safety play a crucial role in extending shelf life. Fruit juices, being thermally sensitive, are susceptible to chemical, physical, and microbiological alterations. The chosen processing methods can significantly influence both the quality and safety of fruit juices. In the present scenario, non-thermal food processing technologies offer a viable solution to cater to the demand for natural and healthful fruit juice beverages, minimizing any adverse impact on their inherent nutritional and organoleptic properties. The traditional method of processing fruit juices relies heavily on thermal procedures, leading to the loss of certain nutritional compounds like flavonoids and carotenoids. The efficiency of this conventional process typically ranges between 60 to 80% of fruit juice yield, with a noticeable decline when using older fruits. The adoption of ultrasound as an alternative technology for processing fruit juices has garnered considerable attention. This approach offers advantages such as reduced processing time, lower energy consumption, increased efficiency, and enhancements in the shelf life and quality of fruit juices. These improvements stem from the unique property of the instantaneous transfer of acoustic energy into the fruit juices. The application of ultrasonic treatment enables the penetration of fruit cell walls, facilitating the release of cell contents trapped in the fruit tissues. While thermal preservation methods like pasteurization and sterilization are commonly employed to eliminate microorganisms and deactivate enzymes in fruit juices, the high temperatures exceeding 80 °C during these treatments may lead to undesired alterations in various properties of the juices, encompassing physical, chemical, biological, and organoleptic aspects such as nutrients, color, and flavor. In contrast, thermosonication technology, which combines moderate heat within the range of 37 to 75°C with ultrasound treatment, emerges as a potential alternative processing technique capable of enhancing the inactivation of enzymes and microbial activity. The integration of low-frequency ultrasound with mild heat is anticipated to decrease both processing temperature and time by 16% and 55%, respectively. This reduction aims to mitigate adverse impacts on the quality of fruit juices, rendering the overall processing more economically viable. In comparison to conventional thermal processing, thermosonication achieves equivalent lethality values at a lower processing temperature. The inactivation of enzymes and microbes during thermosonication treatment results from the combined effects of heat and cavitation— the phenomenon involving the formation, growth, and explosion of bubbles in a liquid. Cavitation disrupts cell membranes and induces the production of free radicals through temperature and pressure changes. This article provides a comprehensive overview of current knowledge and applications of ultrasound, both independently and in thermosonication treatment, for the processing of fruit juices. It includes a detailed discussion on the effects of thermosonication



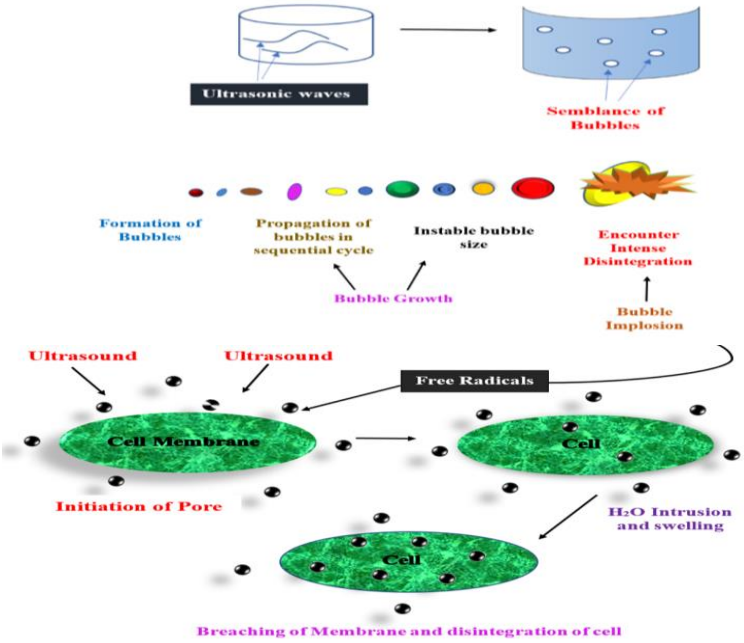


Fig. 1 Schematic view of thermosonication process. (Adapted from Das et al., 2023)

treatment on preserving juice quality, encompassing parameters such as juice yield, ascorbic acid content, color, and the destruction of enzymes and contaminants in fruit juices

Basic principles of ultrasound

Ultrasound is sound wave transmitted with frequency higher than audible frequency of 20 kHz. The ultrasound equipment usually has frequencies from 20 kHz to 10 MHz. The application of ultrasound in food industry consists of low and high energy ultrasound. The low energy ultrasound has intensities of less than 1 Wcm^{-2} and frequencies of more than 100 kHz. It can be used in non-destructive analytical measurements and monitoring of composition and physicochemical properties of food during processing and storage for quality control purposes. High energy ultrasound, which is also known as power ultrasound has intensities higher than 1 Wcm^{-2} and frequency range of 20 to 100 kHz. The power ultrasound is useful in invasive applications, which gives impact to physical, chemical, and biological properties of foods in processing, preservation, and safety such as milk homogenisation, juice yield enhancement and microbial inactivation. There are two different ultrasonication techniques, which are submergence in an ultrasonic bath or direct application to the fruit juices using a probe sonicator.

Gas bubbles are produced in liquid media by ultrasonic waves prior to acoustic cavitation phenomenon, which is the interaction between ultrasonic waves, liquid and dissolved gas when ultrasound passes through a liquid medium. Pressure changes around the dissolved gas nuclei leads to oscillations, where the dissolved gas and solvent vapour disperse in and out of the oscillating bubbles. The quantity of gas and vapour that enters the bubbles during this expansion period is beyond the quantity that diffuses out of the bubbles during the compression stage of bubbles oscillations. The bubbles then grow in successive cycles to an unstable size, burst in the compression phase and release very high heat and pressure around the collapsing bubbles to break the compounds in the liquid and give localised sterilisation effect. At this point, particle dispersion and cell disruption occur.

Thermosonication treatment in fruit juice production

The quality of fruit juice is frequently compromised by enzymatic reactions and microbial actions, leading to issues like enzymatic browning and microbial growth in apple juice. Utilizing ultrasound processing for juice treatment has been documented to have minimal adverse effects on crucial quality attributes such as vitamin C content, color, cloud

stability, and viscosity. The application of thermosonication treatment offers a method to deactivate enzymes and eliminate microorganisms at lower temperatures and shorter durations, resulting in reduced losses of ascorbic acid, total phenolics, flavonoids, and flavonols. Here are some of the effects of thermosonication treatment on fruit juice quality:

Microbial Inactivation: Thermosonication helps in the reduction of microorganisms (bacteria, yeast, and molds) in fruit juices. The combination of heat and ultrasound disrupts cell membranes and structures, leading to the inactivation of microorganisms. This can extend the shelf life of the juice by reducing the risk of spoilage and improving safety.

Enzyme Inactivation: Enzymes responsible for the deterioration of fruit juices can be inactivated by thermosonication. This helps to preserve the color, flavor, and nutritional content of the juice by preventing enzymatic browning and other undesirable reactions.

Improved Extraction of Bioactive Compounds: Thermosonication can enhance the extraction of bioactive compounds, such as antioxidants, from fruits. The mechanical effects of ultrasound can break down cell walls, releasing more compounds into the juice. This can contribute to the health benefits of the juice.

Reduced Processing Time: Compared to traditional heat treatments, thermosonication often requires shorter processing times. This can help in preserving the sensory attributes of the juice, such as color and flavor, as well as minimizing the impact on heat-sensitive nutrients.

Texture and Viscosity: The application of ultrasound in thermosonication may affect the texture and viscosity of fruit juices. It can break down cell structures and improve the homogeneity of the juice, leading to a smoother texture.

Improved Heat Transfer: Ultrasound facilitates heat transfer within the product, ensuring more uniform heating. This can result in more consistent product quality and reduce the risk of localized overcooking or undercooking.

Energy Efficiency: Thermosonication can be more energy-efficient compared to conventional heat treatments, as it often allows for lower temperatures and shorter processing times.

Minimal Impact on Nutrient Content: In some cases, thermosonication has been shown to have a lesser impact on the nutrient content of fruit juices compared to traditional thermal processing methods. It's important to note that the specific effects of thermosonication can vary depending on factors such as the type of fruit, initial juice quality, process parameters (temperature, ultrasound frequency, intensity), and treatment duration. Research in this field is ongoing, and advancements in technology and processing techniques may continue to refine the understanding of the effects of thermosonication on fruit juice quality.

Thermosonication treatment has been investigated for its potential to enhance the safety of fruit juices by reducing microbial contamination. The combination of heat and ultrasound in thermosonication can lead to several safety-related effects:

Pathogen Reduction: Thermosonication can be effective in reducing pathogenic microorganisms in fruit juices. The treatment targets a broad spectrum of microorganisms, including potential pathogens, which contributes to the overall safety of the product.

Spoilage Microorganisms: The inactivation of spoilage microorganisms by thermosonication helps prevent deterioration of the juice quality and ensures that consumers are not exposed to potentially harmful or undesirable microbial metabolites.

Reduced Reliance on Chemical Preservatives: The microbial inactivation achieved through thermosonication may reduce the reliance on chemical preservatives in fruit juices. This is beneficial for consumers who may prefer products with fewer additives.

Improved Homogeneity: Thermosonication can contribute to improved homogeneity of the juice by breaking down cell structures and ensuring more uniform heat distribution. This helps in achieving consistent microbial inactivation throughout the

product, reducing the risk of localized areas with insufficient treatment. The combination of heat and ultrasound ensures that all portions of the liquid volume receive similar treatment. This consistency is crucial for achieving a homogeneous product, as it reduces the likelihood of localized overprocessing or underprocessing, which could affect the overall quality of the juice.

Minimized Risk of Cross-Contamination: The uniform application of thermosonication treatment helps minimize the risk of cross-contamination by ensuring that all parts of the juice receive adequate microbial inactivation. This is particularly relevant in large-scale processing where ensuring uniform treatment can be challenging. Thermosonication minimizes the risk of cross-contamination in food processing, including the treatment of fruit juices, through several mechanisms that ensure uniform and thorough microbial inactivation such as uniform treatment, enhanced penetration, reduced temperature variability, prevention of cold spots, consistent microbial inactivation, and improved homogeneity.

Conclusions

The concurrent use of ultrasound and mild heat in the fruit juice processing industry holds significant promise, offering multiple advantages in preserving juice quality and ensuring safe processing. Ultrasound-induced cavitation plays a crucial role in reducing juice yield, ascorbic acid content, and color loss, while simultaneously enhancing enzyme inactivation and microbial destruction. This approach allows for shorter processing times, categorizing it as a form of minimal processing, aiming to retain freshness and promote health benefits.

References

Das, P., Nayak, P. K., & krishnan Kesavan, R. (2022). Ultrasound assisted extraction of food colorants: Principle, mechanism, extraction technique and applications: A review on recent progress. Food Chemistry Advances, 100144.

Jabbar, S., Abid, M., Hu, B., Hashim, M. M., Lei, S., Wu, T., & Zeng, X. (2015). Exploring the potential of thermosonication in carrot juice processing. Journal of Food Science and Technology, 52, 7002-7013.

Wu, W., Xiao, G., Yu, Y., Xu, Y., Wu, J., Peng, J., & Li, L. (2021). Effects of high pressure and thermal processing on quality properties and volatile compounds of pineapple fruit juice. Food Control, 130, 108293.

Pradhan, D., Abdullah, S., & Pradhan, R. C. (2020). Optimization of pectinase assisted extraction of Chironji (Buchanania lanzan) fruit juice using response surface methodology and artificial neural network. International Journal of Fruit Science, 20(sup2), S318-S336.

Liao, H., Jiang, L., Cheng, Y., Liao, X., & Zhang, R. (2018). Application of nisin-assisted thermosonication processing for preservation and quality retention of fresh apple juice. Ultrasonics sonochemistry, 42, 244-249.

Sasikumar, R., Chutia, H., & Deka, S. C. (2019). Thermosonication assisted extraction of blood fruit (Haematocarpus validus) juice and process optimization through response surface methodology. The Journal of Microbiology, Biotechnology and Food Sciences, 9(2), 228.

Table 1: Effect of thermosonication on quality attributes of fruit juices

Sl No.	Quality attributes	Effect of thermosonication treatment	Findings
1	Colour of juice	Promotes juice lightness	Highest retention of carotenoid from carrot juice 97.33% (Jabbar et al., 2015) Significant retention of anthocyanin from blueberry juice 94.12% (Wu et al., 2021)
2	Vitamin C content	Removes dissolved oxygen during cavitation to produce less degradation of ascorbic acid	Significant amount of vitamin C was retained in blood fruit and apple juice (about 96%) (Sashikumar al., 2019; Abid et al., 2014).
3	Juice yield	Increases juice production capacity	Juice yield of Blueberry and Mango was found to be higher of 82.3% (Wu et al., 2021). (Holtung et al., 2017).
4	Inactivation of enzymes	Improves juice rheological properties by inactivation of pectin methylesterase (PME) and polygalacturonase (PG).	PPO and POD inactivation in apple juice were 93.85% and 91%, respectively (Abid et al., 2014). PME inactivation in tomato juice were more than 98.5% (Liao et al., 2018). PME and PG in Chironji juice was almost inactivated and 90% inactivated, respectively (Pradhan et al., 2020).
5		Preserves juice colour by inactivation of polyphenoloxidase (PPO) and peroxidase (POD).	

* * * * * * * *

Soya-Based Textured Food Products: Pioneering a Sustainable Culinary Revolution

Kirtigha R
M. Tech Scholar, Department of Food Technology, Faculty of Engineering and Technology,
JAIN (Deemed- to-be University), Bengaluru, Karnataka, India
*Corresponding Author: rkirtigha@gmail.com

In a world grappling with the challenges of climate change, resource scarcity, and a growing global population, the quest for sustainable food sources has become imperative. Soya-based textured food products have emerged as a beacon of hope in this context. The soybean, often referred as soya, scientifically known as *Glycine max* is a multipurpose agricultural marvel and a powerhouse of nutrients. This humble legume, which has its roots in East Asia, has crossed national boundaries to become an essential part of world industry. They have already made their mark in the food industry, and their future appears exceedingly promising. This article delves into the world of soya-based textured food products, exploring their development, current applications, and the promising trajectory they follow in reshaping the future of our culinary landscape.

Genesis of Soya-Based Textured Food Products

Soya-based textured food products owe their existence to the versatile soybean. First introduced as a meat extender during World War II, soy has since evolved into a cornerstone of plant-based diets worldwide. Textured soy protein (TSP), soy protein isolate (SPI), and soy protein concentrate (SPC) are the primary raw materials used in crafting these products. Through a process called extrusion, these soy proteins are transformed into various shapes and textures, closely resembling meat. This transformation not only replicates the taste and texture of animal products but also packs them with essential nutrients, including high-quality protein, fiber, vitamins, and minerals.

Nutritious Powerhouse

Soya has a tremendous nutritional value, which is one of its most notable qualities. the fact that it contains all essential amino acids necessary for maintaining human health, it is a complete protein supply. In addition, soy is a nutritionally dense food since it is high in vitamins, minerals, and antioxidants. Its reputation as a dietary superstar is mostly due to its heart-healthy fat content and lack of cholesterol.

Current Applications

Plant-Based Meat Alternatives: Soya-based textured food products have carved a significant niche in the ever-expanding market for plant-based meat alternatives. Brands like Beyond Meat and Impossible Foods have made headlines with their innovative soy-based products, providing consumers with cruelty-free, sustainable, and nutritionally rich options.

Dairy Substitutes: Beyond meat, soy-based textured foods have also found a footing in the dairy industry. Soy milk, yogurt, and cheese are now common alternatives for individuals seeking lactose-free, low-cholesterol, and plant-based options.

Snack Foods: The versatility of soya-based textures extends to snack foods. Soy protein crisps are increasingly being used as a base for healthy snacks, catering to the growing demand for protein-packed, on-the-go options.

Asian Cuisine: Traditional Asian cuisines, particularly in countries like Japan and China, have long embraced soy-based products like tofu and tempeh. These traditional foods are now gaining popularity worldwide due to their flavor, nutritional value, and versatility.

The Future of Soya-Based Textured Food Products

The future of soya-based textured food products seems to be brighter than ever, driven by several key factors:

Environmental Sustainability: As concerns about the environmental impact of meat production grow, soya-based products offer a sustainable alternative. They require significantly fewer resources, produce fewer greenhouse gases, and are less land-intensive than traditional livestock farming.

Health and Nutrition: Soya-based textured food products align with the growing consumer interest in health and wellness. Rich in plant-based proteins, these products cater to those seeking a balanced diet, reduced cholesterol intake, and a lower risk of chronic diseases.

Technological Advancements: Ongoing research and innovation in food technology continue to refine the taste, texture, and versatility of soya-based products. This ensures they can compete with animal-based counterparts in terms of sensory experience.

Global Adoption: With globalization and increased awareness of sustainability, soya-based textured food products are transcending borders. As more cultures embrace them, new culinary possibilities and fusion dishes are emerging.

Investment and Market Growth: The soaring popularity of plant-based diets has attracted significant investment. This infusion of capital is accelerating research, development, and market expansion, making soya-based textured food products more accessible than ever.

Conclusion

Hence, Soya-based textured food products are not just a trend but a culinary revolution driven by sustainability, health consciousness, and innovation. Their trajectory into the future is marked by a growing presence in our diets, supported by a global movement towards healthier, more sustainable eating habits. As we look ahead, these products are poised to play a pivotal role in reshaping our food systems, contributing to a more environmentally friendly and nutritionally balanced world.

References

Ali, N. (2010). Soybean processing and utilization. In The soybean: botany, production and uses (pp. 345-374). Wallingford UK: Cabi.

Colletti, A., Attrovio, A., Boffa, L., Mantegna, S., & Cravotto, G. (2020). Valorisation of by-products from soybean (Glycine max (L.) Merr.) processing. Molecules, 25(9), 2129.

Erickson, D. R. (Ed.). (2015). Practical handbook of soybean processing and utilization. Elsevier.

Shea, Z., Singer, W. M., & Zhang, B. (2020). Soybean production, versatility, and improvement. Legume crops-prospects, production and uses.

* * * * * * * *

Success Story of Fish Food Kiosk for Promoting Fish Food Varieties and Value-Added Products

Bhukya Bhaskar
M.F.Sc, ICAR- CIFE, Mumbai, Maharashtra, India
*Corresponding Author: bhaskarkalyan2@gmail.com

Name of the Fishermen Beneficiary: Pilli Nagaraju
Name of the Fishermen Cooperative Society: Fcs Gurthur
Location of The Fish Food Kiosk: Thorrur Municipality
Mandal Name: Thorrur
District: -Mahabubabad

Situation before initiating the Activity

Fishermen youth due to weak financial background and poor employment opportunities, left studies and working home as a fishermen & Agriculture allied activities, followed by as a temporary worker in private school, due to COVID-19, he lost the work in Private school, he faced difficulties, usually he was interested in fisheries awareness and training programmes conducted by the Fisheries department, himself understood and realized after the training programme, took loan from others, for applying the fish food kiosk.

Economic/ Social status

Middle class, as one of the fishermen Community members participating with responsibility and help uneducated fishermen and working on seasonal basis based on availability of fish harvesting work and substantially working as daily wage-earning Agriculture and allied works.

What are the problems/issues/challenges were faced by the fishermen:

In majority of the time, he faced difficulties due to lack of financial support for starting fish value added products business and lack of technical assistance.

Initiation of the Activity: 2020

Benefit received: Fish food kiosk

Scheme under which received benefit

NCDC &State funded Integrated Fisheries Development Scheme- Fisheries Department, TSCOF, Telangana State.

Through the SLSC, scrutiny by the Department of Fisheries and District Fisheries office, Mahabubabad.

Financial assistance under Scheme

90% Subsidy for the Initial Unit cost of 4Lakhs, while revised unit cost was increased in latter which is Rs. 435000/- the additional 35000/- were added in addition to the above 90% subsidy amount which is raised amount of Rs. 75000/- in the form of beneficiary contribution and 360000/- as a Subsidy.

Fig 1: Beneficiary with varieties of value-added fish products

Technical assistance from fisheries department & other institutions

During IFDS applications distribution the awareness meeting on individual components under IFDS and followed by the technical training and exposure visits were conducted on Value added fisheries products as Fish Cutlets, fish rolls, fish nuggets, fish Samosa, Fish Sandwich, fish Pakoda, Fish pickles, Prawn Pickles, Fish Curry, Fish fry varieties, fish balls, fish biryani.

Investment/Expenditure

Initially paid as beneficiary contribution Rs. 75000 in prior to the Grounding and received food kiosk, due to lack of financial support, insufficient materials for running food kiosk he kept for pending for few months and took loan from others started after received motivation in another training programme conducted by fisheries department and the barrowed amount of Rs. 50000/- for purchasing of cooking utensils & accessory materials, Fridge, etc, and

running cost of for purchase of raw fresh fish from various localities varies based on the distance of availability fishes, on an average daily expenditure range about Rs.3000- 5000/-day.

Monitoring mechanisms

Fig: 2. Food kiosk

As per time-to-time guidelines issued by the Hon'ble Commissioner of Fisheries, State Fisheries Department of Telangana, and instructions of the District Fisheries officer, Mahabubabad, the Monitoring activities were randomly carried out by through visiting programme by the Fisheries Field officer, Mahabubabad/ field staff, for the purpose of updating current status and inspecting the quality and quantity of work carried out at the working place of Food kiosk.

Outcome of the activity in terms of quantitative & Qualitative:

Beneficiary regularly bringing the fishes and preparing fish value added fish products on his own successfully running due to the financial support in the form of Higher Subsidy, and good training programme on various technical aspects of value-added fishery products to the beneficiary (the fishermen) started the activity, now successfully running fish products and fetching high demand in the Thorrur Municipality.

Outcomes

Significantly receiving attention of the fish food consumers in the area, as in the Beneficiary with self-interest, due to preparation of different varieties of value-added fish products and supply on prior demand as per consumers request to supply. On average beneficiary earning income of Rs. 1000-1500/day. In excluding of all the daily expenditure. Monthly income of about Rs. 25000-50000/month.

* * * * * * * *

Mulberries Fruit: Nutritional values and their Products

Dhanashree Jadhav[1], Anisha Mahaparale[1], Chetana Bhamare[1] and Sagar M. Chavan[2]
[1]M. Tech students, [2]Assistant Professor
D. Y. Patil Agriculture and Technical University, Talsande
*Corresponding Author: dhanashreejadhav259@gmail.com

Mulberries are the fruit from mulberry trees, which are in the Moraceae family. Mulberry fruit shown in Fig.1. The three most common commercial mulberry species include white mulberry (Morus alba), black mulberry (Morus nigra), and red mulberry (Morus rubra) all having multiple cultivars ("Mulberry" – CRFG, 1997).

Fig.1. Mulberry

White mulberry is native to eastern and central China; red mulberry is native to areas of the central and eastern United States; and black mulberry is native to western Asia ("Mulberry" – CRFG, 1997).

Mulberry fruits range in size and length, but most resemble the size of a blackberry. Depending on the variety and ripeness, mulberries can exhibit an extremely sweet flavour to a tangy sweet flavour (McNatt, 2019). Fruits from black mulberry are said to have the best flavour with an equal blend of sweet and tart. The name of the mulberry species does not necessarily reflect the colour of the fruit: for example, fruit from white mulberry can be white, lavender or black, while fruit from red mulberry can be a deep red colour to almost black ("Mulberry" – CRFG, 1997)

Description

Mulberries are deciduous and have toothed, sometimes lobed leaves that are alternately arranged along the stems. Individuals can be monoecious (bearing both male and female flowers) or dioecious (bearing only male or female flowers). The minute flowers are borne in tight catkin clusters. Each fruit develops from an entire flower cluster and is formally known as a multiple. The fruits somewhat resemble blackberries and ripen to white, pink, red, or purple (Melissa Petruzzello, 2019)

Nutritional values

Fresh mulberries consist of 88% water and only have 60 calories per cup (140 grams).By fresh weight, they provide 9.8% carbs, 1.7% fiber, 1.4% protein, and 0.4% fat. Mulberries are often consumed dried, similar to raisins. In this form, they contain 70% carbs, 14% fiber, 12% protein, and 3% fat — making them fairly high in protein compared to most berries.Here are the main nutrients in a 3.5-ounce (100-gram) serving of fresh mulberries (USDA food composition databases).

- **Calories:** 43
- **Water:** 88%
- **Protein:** 1.4 grams
- **Carbs:** 9.8 grams
- **Sugar:** 8.1. grams
- **Fiber:** 1.7 grams
- **Fat:** 0.4 grams

Carbs

Fresh mulberries consist of 9.8% carbs, or 14 grams per cup (140 grams). These carbs are mostly simple sugars, such as glucose and fructose, but also contain some starch and fibre.

Fiber

Mulberries have a decent amount of fibre, corresponding to 1.7% of their fresh weight.

The fibers are both soluble (25%) in the form of pectin and insoluble (75%) in the form of lignin.

Fibres help you maintain a healthy digestive system, decrease cholesterol levels, and reduce your risk of many diseases (Pubmed Central highly respected database from the National institute of the health).

Vitamins and Minerals

Mulberries are rich in many vitamins and minerals, particularly vitamin C and iron (Pubmed

Central highly respected database from the National institute of the health).

Vitamin C

An essential vitamin that is important for skin health and various bodily functions

Iron

An important mineral that has various functions, such as transporting oxygen throughout your body.

Vitamin K1

Also known as phylloquinone, vitamin K is important for blood clotting and bone health.

Potassium

An essential mineral that may lower blood pressure and reduce your risk of heart disease.

Vitamin E

An antioxidant that protects against oxidative damage.

Other Plant Compounds

Mulberries are rich in plant compounds, such as anthocyanins, that contribute to their color and beneficial health effect (Pubmed Central highly respected database from the National institute of the health), (Masood Sodiq Butt, 2008)

The most abundant ones include:

- **Anthocyanins:** A family of antioxidants that may inhibit oxidation of LDL (bad) cholesterol and provide beneficial effects.
- **Cyanidin:** The main anthocyanin in mulberries is responsible for their black, red, or purple color.
- **Chlorogenic acid:** An antioxidant abundant in many fruits and vegetables.
- **Rutin:** A powerful antioxidant that may help protect against chronic conditions like cancer, diabetes, and heart disease.
- **Myricetin:** A compound that may have a protective effect against some cancers.
- Deep-coloured and mature mulberries are richer in plant compounds and have a higher antioxidant capacity than colourless and immature berries.

Mulberry fruits products

- Mulberry is consumed in several ways such as fruit wines, berries, jams, jelly or muesli.
- Product made from Mulberry leaves are shown in Fig. 2 and Fig. 3
- Product made from Mulberry fruit shown in Fig.4.
- Mulberry can also be consumed in the form of juices and syrups for the effective management of various diseases (Parida S *et al*.,2020).
- Fruit jam Mixed fruit jam prepared based on ratios of 70:30 rosella and mulberry fruit extract (Wongchalat and Chatthongpisut., 2016)
- Cupcake The concentrated amount of M. alba paste used to prepare cupcakes. (Jan et al., 2021)
- Alcoholic beverage Fruit of M. alba used to produce alcoholic beverage and also used as a raw material to brew fruit wine (Daris-Martin et al., 2003)
- M. alba fruits can also be used to prepare spiced squash and appetizers Hamid H *et al*.,2017)

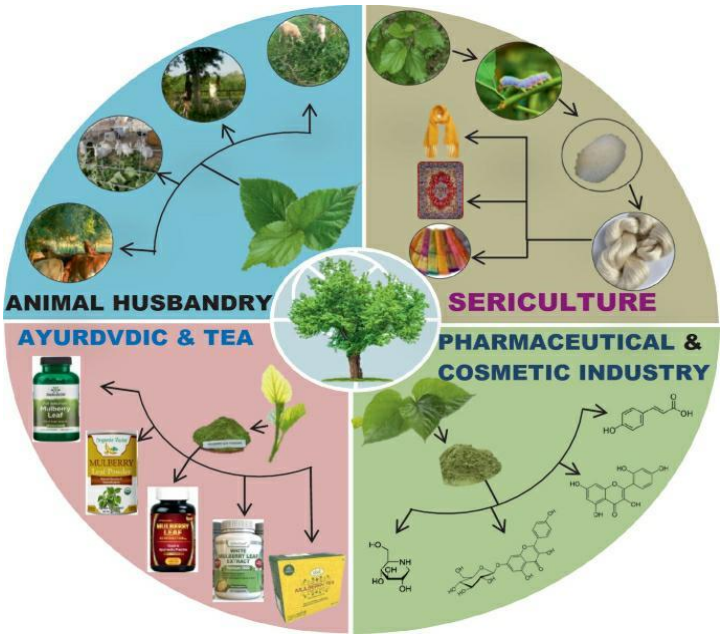


Fig.2. Mulberry leaves uses in different ways

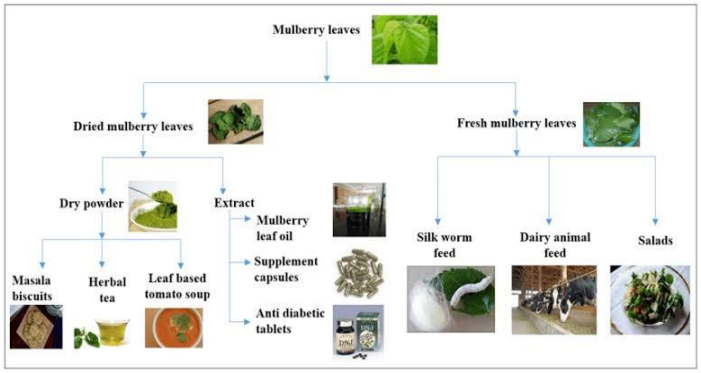


Fig.3. Mulberry leaves products and uses

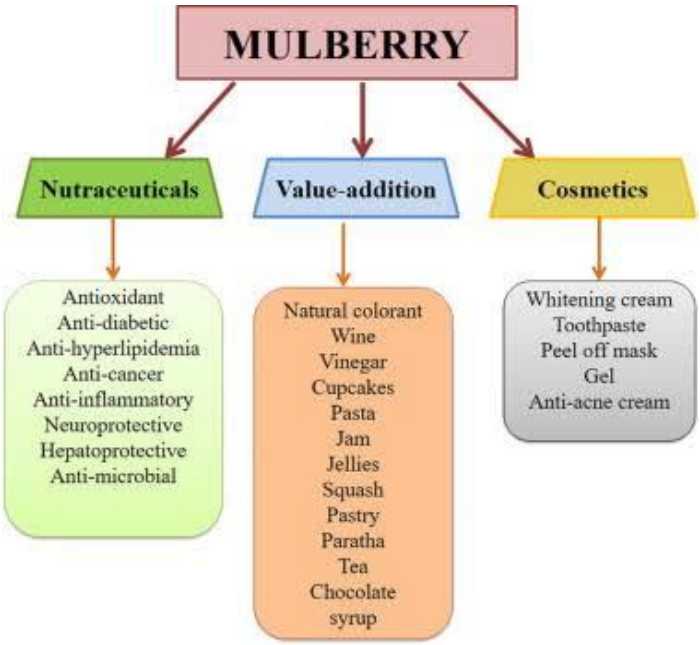


Fig 4. Mulberry fruit products

Conclusion

- Mulberry is known in India as "Kalpa Vruksha" as all the parts of the plant have many uses. It is essential to sericulture as the foliage constitutes the sole feed of the mulberry silkworm
- They're a good source of iron, vitamin C, and several plant compounds and have been linked to lower cholesterol, blood sugar, and cancer risk
- We need to grow mulberry because of its unique nutrition values and also, it's leaves have an important medicinal value.

References

Butt Sadiq Masood, Nazir Akmal, Sultan Tauseef M, Schroen Karin. Morus Alba L.nature's functional tonic. Trends in Food Science & Technology. 2008; 19(10):505-512

Darias-Martín J, Lobo-Rodrigo G, Hernández-Cordero J, Díaz-Díaz E, Díaz-Romero C. Alcoholic beverages obtained from black mulberry. Food Technology and Biotechnology. 2003;41(2):173-176

Hamid H, Thakur NS. Development of appetizer (spiced squash) from mulberry (Morus alba L.) and its quality evaluation during storage. Journal of Applied and Natural Science. 2017;9(4):2235-2241

Jan B, Parveen R, Zahiruddin S, Khan MU, Mohapatra S, Ahmad S. Nutritional constituents of mulberry and their potential applications in food and pharmaceuticals: A review. Saudi Journal of Biological Sciences. 2021;28(7):3909-3921

Melissa Petruzzello, 2019 physical description about mulberry

Mulberry, California Rare Fruit Growers (CRFG), 1997

Parida S, Rayaguru K, Panigrahi J. Mulberry cultivation and its phytochemical benefits: A review. J Nat Remed. 2020 Sep 10;21(5):33-48

Wongchalat R, Chatthongpisut R. Nutritional value and anthocyanins of mulberry and Roselle mixed fruits jam. Applied Mechanics and Materials. 2016; 855:65-69.

* * * * * * * *

Nutritional Importance and Health benefits of Kainth (*Pyrus Pashia*) Fruit

Anchal Sharma, Rajat Singh*, Kalpna Thakur, Jyoti Chaudhary and Rimpika
Dr YSP College of Horticulture and Forestry, Thunag, Mandi-175048, (HP) India
*Corresponding Author: rajatsingh340@gmail.com

Abstract

Kainth (*Pyrus Pashia*) is important wild Himalayan fruit belongs to the family Rosaceae. The fruit is commonly found in the forests, around the roadside and the waste land of the villages. All parts of the kainth tree such as fruit, leaves, flowers, and bark are highly nutritious and have medicinal benefits due presence of functional components. The fruit possess anti-diabetic, anti-microbial and anti-inflammatory activities that help in reducing the risk of chronic diseases. This fruit has the potential for development of value-added products like jam, juice and pulp, but till date not much work has been reported on value addition of kainth fruit, which may be due to shorter shelf life of the fruit. The fruits having shorter shelf-life can be preserved better using food processing techniques. Therefore, the conversion of kainth fruit into different value-added products could help in the prevention of wastage, increase its consumption and shelf-life and make it valuable in fighting against various human ailments.

Keywords: Kainth, Chronic diseases, Phytochemical, Functional components, Value-added products

Introduction

Kainth (*Pyrus pashia*) fruits belongs to the Rosaceae family, commonly known as Indian/Asian wild pear, Himalayan pear, shegal, melu and mehal (Prakash et al., 2021). In India, the plant is commonly found in the northern states such as Himachal Pradesh, Uttarakhand and Punjab. Kainth is generally used as a rootstock for pear (Pandey and Pant, 2018). The fruit is best grown in the height range of 750 to 2600 m. The immature fruits are usually willow green in colour with a light brown spot on the outer surface and the fruits turn black and soft when they become mature (Figure 1). The fruit is high in nutrition and is a rich source of various phytochemicals, antioxidants, and bioactive compounds with promised health benefits (Wang et al., 2021; Vidakovic et al., 2022). Edible flowers of this fruit are used for treatment of cancer and cardiovascular diseases, the fruits are used against diarrhoea, GI disorders and other various diseases (Riya et al., 2023). Decoction of the fruit with other plants is used to cure spleen and stomach-related ailments. The plant is also used as cattle fodder to improve milk production. The fruit has a shorter shelf-life due to high perishability during full maturity, therefore the fruits fall under the under-utilized fruit category. The fruits having short shelf-life can be preserved better using food processing techniques. Therefore, the conversion of kainth fruits to different value-added products by using food processing techniques could help in the prevention of wastage, increase its consumption, and shelf-life and make it valuable in fighting against various diseases and promoting good health.

Fig. 1: Kainth (*Pyrus pashia*) fruit

Chemical composition of kainth fruit

The chemical composition of kainth fruit varies with the variety and location where it grows. The ripened fruits were reported to be edible and highly nutritious. The fruit contains a moisture content (60.36%), total soluble solids (6-11^{0}Brix), titratable acidity (6-11%), total carbohydrate (28.38%), reducing sugar (6.79%), crude fibre (16.18%), crude fat (1.62%), crude protein (3.29%), ash (1.10%), ascorbic acid (63.82 mg/100g), total phenols (173 µg GAE/ml), and total carotenoid (1847 mg/100 g) (Mawlein et al., 2023; Rymbai et al. 2023; Prakash et al., 2021; Sharma, 2022). The fruits contain various minerals, such as nitrogen (0.68 mg), magnesium (0.12 mg), potassium (3.21 mg), calcium (0.75 mg), and phosphorus (0.86 mg) (Prakash

et al., 2021). The ripened fruits of P. pashia have been reported to be nutritious and edible. Proximate analysis has demonstrated that the fruits contain ~60.36±0.25 moisture, 28.38±0.12% total carbohydrates, 6.79% reducing sugars, 16.18% crude fiber, 1.62±0.20% crude fat, 3.29±0.21% protein and 1.10±0.05 of total ash content. These nutritional values of P. pashia indicate that it is a nutritionally rich fruit. The fruits contain various minerals, such as nitrogen (0.68 mg), calcium (0.75 mg), magnesium (0.12 mg), potassium (3.21 mg), phosphorus (0.86 mg) and iron (traces) per 100 g dwb. The fruit is also rich in phytochemicals, such as gallic acid, chlorogenic acid and catechin (32,33). To date, there are no published reports available regarding its vitamin contents, at least to the best of our knowledge. The fruit is still an underutilized source of nutrition due to its short shelf life and limited awareness. Tag et al (34) studied the leaves of the P. pashia tree to determine its nutritional profile. The proximate analysis revealed that the leaves contained a low moisture content (26.33±0.39%, dwb), ash (4.40±0.19%, dwb), crude protein (1.79±0.07%, dwb), crude fat (0.89±0.07%, dwb), crude Fibre (21.22±1.18%, dwb) and a total carbohydrate content of 66.61±0.42%, dwb. The mineral content analysis revealed that the leaves contain low amount of sodium (0.09%), phosphorus (0.13%) and an ample amount of potassium (0.80%) and calcium (0.65%). The leaves were also found to contain a-tocopherol (55.02±0.35 mg/100 g) and carotenoids

Health benefits

Kainth fruit is used for the treatment of diarrhoea, eye-related problems, GI disorders and other various diseases. The flowers of this fruit are used for the treatment of cancer and cardiovascular diseases. The leaves and bark are used for the treatment of hair loss, gastric ulcers, and typhoid fever. Decoction of the fruit with other plants is used to cure spleen and stomach-related ailments. The fruit also possess anti-diabetic, anti-microbial and anti-inflammatory activities that help in reducing the risk of chronic diseases. The fruit is a good source of essential nutrients including vitamin A and vitamin C, minerals such as potassium, calcium and antioxidants which are beneficial for the overall health of the body.

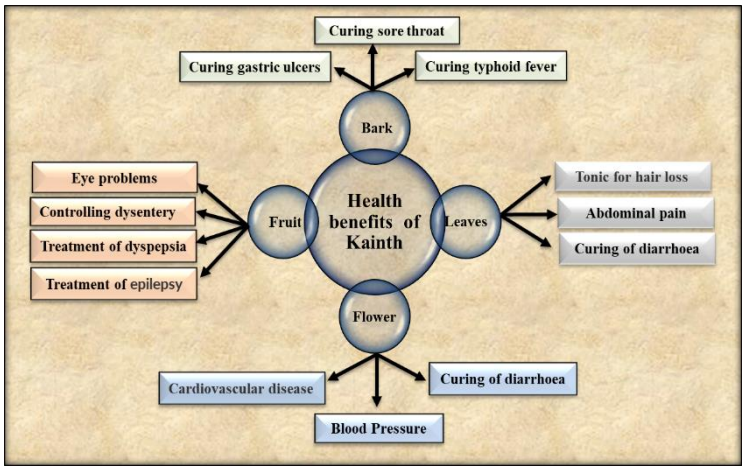


Fig. 2: Health benefits of Kainth fruit

Value added products

Kainth is one of the important wild Himalayan fruits which contains good amounts of antioxidant and bioactive compounds. Kainth fruit has a good potential to be processed into value-added products such as jam, juice, chutney, candy, powder and bakery products. These value-added products not only make kainth fruit more accessible but also extend the shelf-life and increase the consumption of the fruit.

Conclusion

Kainth is well known for its health benefits due to its antimicrobial, anti-fungal and anti-inflammatory properties. There has been extensive research in the field of medicinal and pharmaceutical properties of kainth fruit, but only a few researches have been reported on the application and use of kainth fruit in the food industry for the preparation of value-added products. The conversion of kainth fruit to different value-added products such as jam, juice, candy etc. can useful for addressing nutritional security and creating new income generation opportunities for local people.

References

Mawlein J, Verma V and Haz S. (2023). Standardization of vegetative propagation technique of wild edible Himalayas pear (Pyrus pashia) on newly identified local rootstock, RC Sohjhur-3. Journal of Crop and Weed, 19(1), pp.244-251.

Pandey N and Pant J. (2020). Determination of physicochemical and pharmacological

screening of leaves and flowers part of Pyrus pashia. Intl. J. Herb. Med, 8, pp.28-32.

Prakash O.M, Chauhan A.S and Kudachikar V.B. (2021). Traditional uses, nutrition, phytochemistry and various pharmacological properties of Indian wild pear. International Journal of Functional Nutrition, 2(4), pp.1-13.

Riya S.K. Kumar A. Prakash S. Kumar A and Dubey A. (2023). The standardization of method and time of propagation in pear (Pyrus communis L.). Interaction (Method× Time), 12(6.245), pp.4-416.

Rymbai H. Verma V.K. Talang H. Assumi S.R, Devi M.B, Sangma R.H.C, Biam K.P, Chanu L.J, Makdoh B, Singh A.R and Mawleiñ J. (2023). Biochemical and antioxidant activity of wild edible fruits of the eastern Himalaya, India. Frontiers in Nutrition, 10, p.1039965.

Sharma S. (2022). Value addition to underutilized wild Himalayan Pear (Pyrus Pashia): Development, Composition, and sensory characteristics of jam. ScienceOpen Preprints.

Vidaković A, Šatović Z, Tumpa K, Idžojtić M, Liber Z, Pintar V, Radunić M., Runjić T.N, Runjić M, Rošin J and Gaunt D (2022). Phenotypic variation in European wild pear (Pyrus pyraster (L.) Burgsd.) populations in the North-Western Part of the Balkan Peninsula. Plants, 11(3), p.335.

Wang L, Shi Y, Wang R.Su. D, Tang M, Liu Y and Li. Z (2021). Antioxidant Activity and Healthy Benefits of Natural Pigments in Fruits: A Review. International Journal of Molecular Sciences, 22(9), p.4945.

* * * * * * * *

Exploring the Anti-Inflammatory Properties of Fruits

Pooja M. E.[1] and Madhusudhan Nayak C.[2]
Ramaiah University of Applied Science, Bangalore
[1]Ph.D Scholar, Dept. of Food Technology, Faculty of Life and Allied Health Sciences
[2]Assistant Professor, Dept. of Food technology, Faculty of Life and Allied Health Sciences
*Corresponding Author: poojaeranna27@gmail.com

Are you exhausted after years of dieting? You've tried everything to lose weight: low- calorie, sugar, low-fat, low-carb- and, to be honest, low-satisfaction-regimens that have left you worse off and worn out.

If the description is accurate, you may be pulled to a completely different strategy. The decades-old notion of intuitive eating is intended to assist those who are locked in the cycle of dieting create a healthier connection with food. The fundamental idea is that our bodies instinctively know what, when, and how much to consume in order to be fed. However, a lifetime of constant messaging- from "clean your plate" demands to parades of stick-thin models- has prevented many of us from listening to that inner voice.

Intuitive eating opposes the rules and limits ingrained in diet thinking, which frequently backfires, resulting in yo-yo weight loss and gain. Indeed, research indicates that around 80% of people who lose considerable amounts of weight recover part or all of it within a year. Instead, intuitive eating encourages us to eat when we are hungry and quit when we are full. It also considers your pleasure- how much you love the meals you consume- which, strangely, may contribute to weight reduction.

Intuitive eating is a framework that integrates mind and body and encourages you to trust in your own ability to feed yourself for years and years." Says Emily Blake, a dietitian at Harvard affiliated Brigham and Women's Hospital.

They are nature's first treats. And naturally sweet fruits are crucial in keeping our bodies healthy. Consuming at least one and a half to two cups of a variety of fruits each day can increase antioxidant activity. Fruits are high in anti-inflammatory substances, which help protect our systems against heart disease, diabetes, and some types of cancer and intestinal illness.

How can you include more healthy fruits in your diet? Consuming grapes and stone fruits in the summer, apples and pears in the fall, persimmons and pomegranates in the winter, and citrus and cherries in the spring is one technique.

While all fruits are high in disease-fighting nutrients, several have earned special attention in the nutrition industry for their anti-inflammatory properties.

Berries

These gemlike fruits, which range from strawberries and blackberries to cranberries and blueberries, are particularly high in antioxidant and anti-inflammatory activity. Berries include plant pigment phytochemicals, such as anthocyanins and ellagic acid, in addition to fiber and vitamin C, which may be responsible for their health benefits. Increased berry consumption has been related to decreased chances of heart disease, Alzheimer's disease, and diabetes in studies.

Apples

Maybe what they say about an apple a day is true. A Research of over 35,000 women discovered that eating this fruit, along with its related, pears, was associated with a decreased risk of dying from heart disease. The main components of apples, fiber, vitamin C, pectin, and polyphenols, have been linked to anti-inflammatory effects and an increase in beneficial microorganisms in the gut, especially in animal studies.

Stone fruit

Stone fruits include cherries, peaches, apricots, and plums. These fruits are high in fiber, vitamin C, potassium, and compounds related to their hues. Cherries, for example, have received the lion's share of study among stone fruits. Some research suggests eating cherries can help minimize post-exercise discomfort and soreness, as well as the likelihood of gout episodes. Cherry's high quantities of phenolic chemicals, which have been related to lower inflammation, may be responsible for these benefits.

Citrus

Vitamin C is abundant in citrus fruits such as oranges, grapefruit, lemons, and limes. Fiber, potassium, calcium, B vitamins, copper, and anti-inflammatory phytochemicals such as flavonoids and carotenoids are also present. Despite the fact that there has been limited human study on citrus, the nutrients present in citrus fruits have been linked to heart-protective properties.

Pomegranates

Pomegranate seeds are high in vitamins C and K, potassium, fibre and powerful phytochemicals including anthocyanin and resveratrol. These nutrients may be responsible for the possible health advantages of eating pomegranates.

Grapes

These juicy fruits are packed with fibre, vitamins C and K, and potent phytonutrients.

* * * * * * * *

Role of Nutrigenomics in Human Health and Diseases

Pooja
Research Scholar, Department of Food & Nutrition, PAU, Ludhiana
*Corresponding Author: poojaluhach025@gmail.com

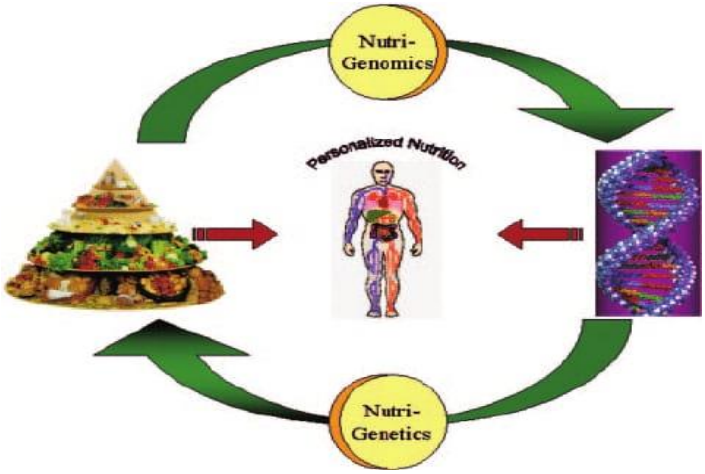
With the completion of human genome sequencing and incoming the-Omics area, the new term "Nutritional Genomics" tends to replace the former "nutrient-gene interactions". Nutritional genomics is the study of the interactions between our genetic makeup and the foods we consume and the health outcomes that may occur. Nutritional genomics is a relatively new field of study that involves two distinct fields: nutrigenomics and nutrigenetics. The influence of nutrients on genes expression is called Nutrigenomics. It is the science that examines the response of individuals to food compounds using post-genomic and related technologies which includes genomics, transcriptomics, proteomics, metabolomics etc. It will also determine the individual nutritional requirements based on the genetic makeup of the person as well as the association between diet and chronic diseases which will help to understand the etiologic aspects of chronic diseases such as obesity, cardiovascular disease (CVD), type-2 diabetes and cancer. In contrast, the heterogeneous response of gene variants to nutrients, dietary components and developing nutraceuticals is called Nutrigenetics. It also reveals why and how people respond differently to the same nutrient. In this way, considering different aspects of gene–nutrient interaction and designing appropriate diet for every specific genotype that optimize individual health, diagnosis and nutritional treatment of genome instability, we could prevent and control conversion of healthy phenotype to diseases.

Principles of nutrigenomics

These are 5 basic principles of nutrigenomics:

i. Substances contained in the food (micro- and macro-nutrients) can directly or indirectly affect the human genome through changes in its structure and gene expression.

ii. Some genes regulated by active substances in the diet probably play a crucial role in the onset, incidence, progression and severity of the disease.



iii. The degree to which diet influences the balance between health and disease may depend on individual's genetic makeup.

iv. Under certain circumstances and in some individuals the diet can be an important risk factor for the development of the number of diseases.

v. Nutritional intervention is based on the knowledge of individual's nutritional status and needs as well as genotype (individualized nutrition) and can be used for prevention, mitigation or healing the chronic diseases.

Strategies related to nutrigenomics

The use of genomic techniques in molecular nutrition research can be divided into **two different strategies** which are complementary to each other.

Strategy I: It uses the conventional hypothesis-driven strategy, i.e., specific genes and proteins. Nutrients have an impact on the expression of these specific genes and proteins. These are discovered utilizing genetic technologies including transcriptomics, proteomics, and metabolomics, which subsequently enables the identification of the regulatory pathways by which food affects homeostasis.

Strategy II: It is the system biology approach, which includes gene, protein and metabolite signatures. They are linked to particular nutrients or dietary patterns and may serve as "early warning" molecular indicators for nutrient-induced changes to homeostasis. The first strategy will provide us with

detailed molecular data on the interaction between nutrition and the genome, whereas the second strategy might be more important for human nutrition, given the difficulty of collecting tissue samples from 'healthy' individuals.

Nutrient-gene interaction can occur in three ways:

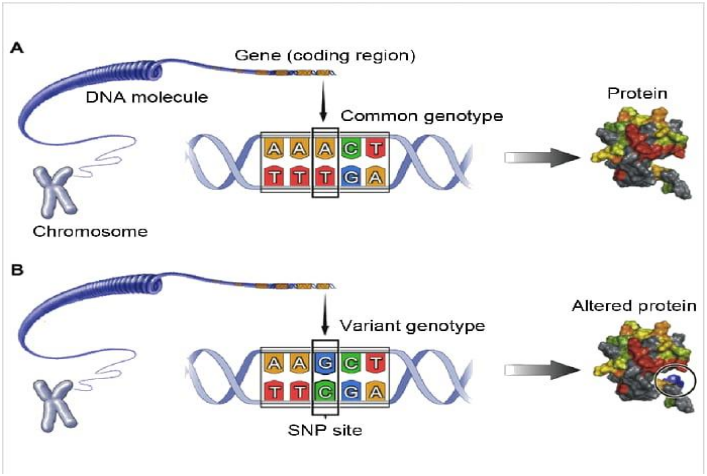
(i) **Direct interactions:** When nutrients interact with a receptor, they may behave as transcription factors that bind to DNA and abruptly activate the expression of certain genes

(ii) **Epigenetic interactions:** Nutrients can alter the structure of DNA (or of histone proteins in chromatin) so that gene expression is chronically altered. The sustained effects of epigenetic mechanisms are mediated by methylation of DNA or by methylation, biotinylation of histones or acetylation, or by both functions. The resulted epigenetic modifications can result in changes in gene expression that can last throughout a person's life and can even persist across generations.

(iii) **Genetic variations**: Common genetic variations (single-nucleotide polymorphisms (SNPs)) can alter the expression or functionality of genes. All the three mechanisms can result in altered mechanism of and altered dietary requirements for nutrients.

Gene-nutrient interaction (i.e., Nutrigenetics)

Nutrigenetics term was used first time by Dr R.O Brennan in 1975 in his book Nutrigenetics. Nutrigenetics is defined as the science that studies the effect of genetic variation on dietary response. Its main goal is to investigate the impact of genetic variation, particularly as a single-nucleotide polymorphism (SNP), on an individual's response to dietary intake, especially in terms of how genetic variation influences an individual's metabolic state. SNPs are the most common genetic variation, occur at about 500-2000 bp throughout the human genome, and normally found in at least 1per cent of the population. When the genetic sequences of two individuals are aligned and compared, only about 1 of every 1000 base pairs of nucleotide sequence of human DNA, which is about 0.1%, exhibits variance and many of these variations



are found in just a single base pair/letter in the DNA code, for example, a cytosine (C) in place of guanine (G). This variation involving a single base pair is called SNP.

In this sense, several SNPs have been associated with common chronic diseases through interactions with the intakes of macro and micronutrients, or with the consumption of particular foods and dietary patterns. Examples include polymorphisms in taste-related genes such as the sweet taste receptor (TAS1R2) and cluster of differentiation (CD36), which have been linked to dyslipidaemia in Mexican patients who consume high levels of carbohydrates and fats, respectively. Low intakes of folate, vitamin B6 and vitamin B12 have been related to an increased risk for breast cancer in people with common variations in the genes regulating homocysteine metabolism, such as methylenetetrahydrofolate reductase (MTHFR) and methionine synthase (MTR). Additionally, it has been noted that a number of polymorphisms in the genes that make up the vitamin D pathway can also affect vitamin D status, by altering the biological activities of the vitamin D in the body. It's interesting to note that postmenopausal women with low calcium intakes have an increased risk of osteoporosis due to SNPs in the vitamin D receptor (VDR) gene, which impact vitamin D availability. Moreover, SNPs in genes encoding lipid proteins such as apolipoprotein C3,(APOC3) and apolipoprotein A 1(APOA1) conferred a higher risk of metabolic syndrome in subjects with a Western dietary pattern. Likewise, a genetic variant in the cytochrome P450 family 1 subfamily A member (CYP1A2) gene was associated

with an increased risk of hypertension and CVD in moderate and heavy coffee drinkers.

Role of nutrigenomics in human health and diseases

Nutrigenomics aims to identify the effects of several nutrients, including macronutrients and micronutrients on the genome and explores the interaction between genes and nutrients or food bioactive and their effects on human health. It investigates the impact of diet and nutrition on gene expression, especially through epigenomic (e.g., histone methylation), transcriptomic (e.g., RNA transcription), proteomic (e.g., protein synthesis) and metabolomic (e.g., metabolite synthesis) high-throughput assays. Transcriptomics, proteomics, and metabolomics are technologies that apply in Nutrigenomics research. According to numerous studies, nutrients can alter the expression of genes at the level of gene regulation, signal transduction, chromatin structure and protein function.

Nutrigenomics effect on human health and diseases

According to estimates based on body mass index (BMI), more than 35% of the world's population (2100 million people) is either overweight or obese. Obesity is linked to a wide range of health problems, including dyslipidaemias, cardiovascular diseases (CVD), type 2 diabetes mellitus (T2DM), non-alcoholic fatty liver disease (NAFLD) and various types of cancer. These issues come with significant financial and societal implications.

High-fat diets, particularly those high in saturated fatty acids, have increased the expression of neuropeptides involved in the development of obesity and gene expression profiles related to inflammation, glucose intolerance, and liver lipid accumulation. However, low-protein diets increased the expression of the gluconeogenic genes in the liver, which led to the development of glucose intolerance. Additionally, diets low in choline and folate were linked to the deregulation of genes involved in lipid metabolism, which affected the susceptibility and severity of NAFLD. While selenium, vitamin B12, and vitamin A deficiency could raise CVD vulnerability by upregulating proinflammatory and lipogenic genes, chromium insufficiency downregulated insulin signalling genes, showing a role in T2DM pathogenesis.

Experimental studies have shown the beneficial effects of nutrients and bioactive food compounds as a result of the regulation of critical gene expressions. In this regard, it has been shown that eating a Mediterranean diet lowers the postprandial expression of genes that encode proteins linked to inflammation, endoplasmic reticulum stress, atherogenesis and oxidative stress. A low expression of genes associated to inflammation and inappropriate lipid accumulation has also been linked to large intakes of monounsaturated fatty acids from the consumption of olive oil. Diets with a high content of polyunsaturated fatty acids favourably regulate the expression of neuropeptide genes involved in energy homeostasis. Moreover, energy-restricted diets supplemented with eicosapentaenoic acid, and Ł-lipoic acid have been associated with upregulation of fatty acid-oxidizing genes, as well as downregulation of lipogenic and proinflammatory genes. In contrast, high-protein diets prevent and reverse NAFLD by modulating the expression of genes involved in liver lipid metabolism.

Effects of bioactive food compounds on gene expression

Effects of bioactive food chemicals on gene expression have been extensively investigated, and some of the most well-known examples are green tea, theaflavin in black tea, sulforaphane in cruciferous vegetables, resveratrol in grapes and red wine, curcumin in turmeric, genistein in soy beans, and various polyphenols in apples. As a result, substances including genistein, theaflavin, curcumin, epigallocatechin-gallate, and sulforaphane may have anticancer effects by upregulating tumor suppressor genes and downregulating tumor-promoting genes. Additionally, curcumin and resveratrol have demonstrated antiatherogenic benefits by reducing the expression of matrix metalloproteinases, which are crucial for plaque formation and progression. The modulation of genes involved in adipogenesis, lipolysis, and fatty acid oxidation by apple polyphenols is noteworthy because it appears to prevent diet-induced obesity.

Conclusion

Nutrigenomics is a rapidly developing new body of knowledge that will change future research and practice in human nutrition. Nutrigenomics is anticipated to produce biomarkers for health, early biomarkers for disease propensity, dietary responders and non-responders and bioactive food components. In the long run, nutrigenomics will enable efficient dietary-intervention strategies to restore normal homeostasis and prevent diet-related disorders. Undoubtedly, nutrigenomics research is still in its infancy, and much more work needs to be done to properly understand the mechanism and get over any obstacles or limits.

References

Amin T, Ahapatra H M, Bhat S V and Gulleria S P S (2012). Application of Nutrigenomics in Food Industry: A Review. Indian Horticulture Journal 2(3-4): 54-59.

Ramos-Lopez O, Milagro F I, Allayee H, Chmurzynska A, Choi M S, Curi R, De Caterina R, Ferguson L R, Goni L, Kang J X, Kohlmeier M, Marti A, Moreno LA, Pérusse L, Prasad C, Qi L, Reifen R, Riezu-Boj JI, San-Cristobal R, Santos J L, Martínez J A (2017). Guide for current nutrigenetic, nutrigenomic, and nutriepigenetic approaches for precision nutrition involving the prevention and management of chronic diseases associated with obesity. J Nutrigenetic Nutrigenomics 10(1-2): 43-62. Doi: 10.1159/000.

Constantin N and Wahli W (2013). Nutrigenomic foods: What will we be eating tomorrow? Nutrafoods, 12: 3-12. doi: 10.1007/s13749-013-0014-x

Farhud D D, Yeganeh M Z and Yeganeh M Z (2010). Nutrigenomics and nutrigenetics. Iran J Public Health 39(4):1-14.

Reen K J, Yadav K and Singh J (2013). Nutrigenomics: concept, advances and applications. Asian J. Dairy & Food Res 34(3): 205 -12. doi: 10.5958/0976-0563.2015.00041.X.

Neeha V S and Kinth P (2013). Nutrigenomics research: a review. J Food Sci Technol 50(3):415-28. doi: 10.1007/s13197-012-0775-z.

James A M (2020). Nutrigenetics/nutrigenomics, personalized nutrition, and precision healthcare. Curr Nutri Rep https://doi.org/10.1007/s13668-020-00327-z

Müller M and Kersten S (2003). Nutrigenomics: goals and strategies. nature reviews 4: 315-22.

Michael F, Ahmed S, Leah C, Lynnette R F, Tapaeru-Ariki C F, Shyong TE,John M, Woon-Puay K, Lin X, Michelle Z, Michael B, Leah C, Trevor L, Kim Y C F ,Richard Head (2011).Nutrigenetics and Nutrigenomics: Viewpoints on the Current Status and Applications in Nutrition Research and Practice. J Nutrigenetic Nutrigenomics 4: 69–89.

* * * * * * * *

AgriTech Today Magazine
Valmiki Sahitya Sampada
#3, Harthikote Post, Hiriyur
Dist. Chitradurga, Karnataka, India
Pin Code: 577545