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AgriTech Today

An English e-Magazine dedicated to Agriculture and Allied Sciences

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From the Editors Desk

I am pleased to announce the first issue of AgriTech Today, an English e-Magazine dedicated to publish popular articles of Agriculture and allied Sciences. The purpose of the magazine is to provide a platform for the academicians, researchers, Post Graduate students, research scholars etc to express their view on their specialization.

The agricultural industry is a vital sector that provides food for the growing population, and it is constantly evolving. The advent of technology in agriculture has brought about a significant transformation in the way we farm, process, and distribute food. The agricultural technology industry, also known as AgriTech, is developing rapidly, with innovative solutions that address the challenges faced by farmers, such as climate change, food security, and sustainability.

The new AgriTech Today Agricultural Magazine is a welcomed addition to the industry, providing valuable insights and information about the latest developments in Agriculture sector. In this issue, eight articles are reviewed and selected for publication which includes topics on 3D printing, Food waste to fuel, Aloe vera, Ohmic heating technology for berries, Biochar, Automation in livestock farming, Biochar production and Functional foods. The magazine is a must-read for anyone interested in the future of agriculture and the role that technology will play in shaping it.

I whole heartedly thank the editorial team and authors for their contribution in bringing up this issue.

Editor

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Biochar Production: A Sustainable and Profitable Business Model for Farmers

Prajakta Phadtare, Surendra Kalbande and Rinju Lukose

India is the second-largest agro-based economy wherein crop cultivation is taken all around the year, producing a large amount of agricultural waste, including the crop residue otherwise the stubbles. The prime means of disposing of the stubbles, in North India, is being the stubble burning that has popped out as a major issue of environment issue, severely affecting the air quality of the Delhi NCR, since 2015. This steers to serious health threats and ultimately global warming. The principal adverse effect of stubble burning on the environment is the emission of greenhouse gases (GHG's) and raised levels of particulate matter (PM) that engender global warming and loss of biodiversity of agricultural lands. Burning of crop residues releases increased quantity of air pollutants viz., CO_2, CO, NH_3, NOx, SOx, Non-methane hydrocarbon (NMHC), volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs) and particulate matter compounds (SVOCs) and particulate matter. Biochar can serve as a potential ingredient to remediate the problem caused by the stubble burning. There are many reports available presenting the scope of biochar in improving soil nutrient status, plant productivity and mitigation of greenhouse gases and are discussed in this section.

Biochar is defined as a carbon-rich material produced during pyrolysis process that is a thermochemical decomposition of biomass with a temperature about ≤700°C in the absence or limited supply of oxygen. The global biochar market reached a valuation of US$ 8 Million in 2020, which amounts to around 0.23% share of the overall charcoal market. Sales of biochar are slated to rise at a CAGR of 11% to top US$ 23 Million by 2031. Demand for pyrolysis technology in biochar is set to increase at a CAGR of 10% across the assessment period of 2021 to 2031. As per Fact.MR, a market research and competitive intelligence provider, the global biochar market was valued at US$ 8 Million in 2020. Biochar sales are primarily driven by its growing use as a charcoal alternative and widening applicability in electricity and power generation. Non-energy applications also remain a major booster to biochar sales. Carbon sequestration and water retention properties of biochar and driving demand for biochar in agriculture. Though the use of biochar in building materials, plastics recycling, and as a carbon black alternative is currently at its nascent stage, its industrial applications are likely to grow as government agencies continue to research in this area. Growing demand for biochar in electricity production, rising adoption of gasification biochar systems, and increasing sales of biochar in agriculture are driving the market growth. All of these factors are expected to drive the biochar products market at 11% CAGR over the 2021 to 2031 forecast period.

Problem

After the harvest of agricultural product, tons of agriculture waste are generated. Example - cotton stock, paddy straw, ground nut shells, etc. Farmers burn this waste product or they use this products as cattle feed. Burning of the agriculture waste causes tremendous pollution by releasing harmful greenhouse gases in atmosphere.

Reasons

Absence of proper agricultural waste management technologies. If the technologies are present that are expensive and not feasible to use by individual farmers. No incentive to farmers to use agriculture waste management practices.

Solutions

The proper solution for this problem is, to utilize the agriculture waste generated for production of the biochar by continuous biochar

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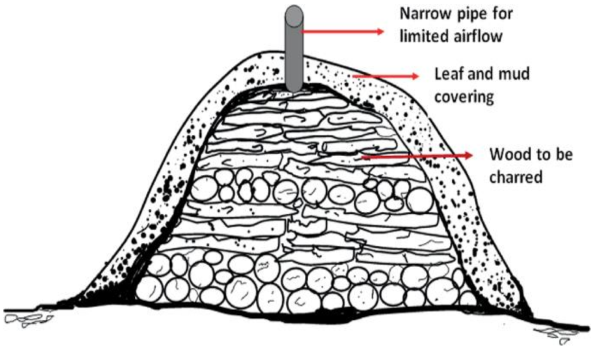
reactor. The produced biochar is further used for application in the soil as a soil health improving agent or biochar can also be used as burning fuel for heat generation.

Biochar

Biochar is a carbon rich charcoal that is formed by the pyrolysis (thermal decomposition) of organic biomass or agricultural residues which is used as soil amendment. It is composed of carbon (C), hydrogen (H), oxygen (O), nitrogen (N), sulphur (S) and ash in different proportions. It is mainly used to improve soil nutrient content and to sequester carbon from the environment. It's highly porous structure makes it attractive option for soil amendment as it improves water holding capacity of the soil by increasing the total surface area of the soil. Due to large availability of biomass resources, India has great potential towards production of biochar. The properties of biochar can change extensively, depending on what the biochar is prepare from and how it is complete. Some biochar can have characteristics which make them an excellent amendment in one soil but not another.



Pyrolysis Technology

Biomass that is heated between temperatures of 300-600°C typically is referred as a slow pyrolysis product, as the process time can take many hours. The benefit of the slow pyrolysis process is that up to 40% of the biomass input can be converted to biochar. The fast pyrolysis process occurs at temperatures above 600°C and can be completed in minutes, this process produces higher ratios of oil and syngas and less biochar. Use of pyrolysis technology for biochar production will continue to grow, as it produces rich in carbon content and highly stable yield. Pyrolysis technology is widely used by several market players for high and stable yield production of biochar market. Various feedstocks and a large device (reactors) are utilized to make biochar through pyrolysis. Usually employed reactors contain: bench scale fixed bed, well swept fixed bed, fluidized bed and auger vertical tubular kinds.

A higher biochar yield was found with a slow pyrolysis process than with others. Based on the mode of operation, pyrolysis reactors can be classified as batch, semi-batch and continuous. The batch type pyrolysis plant doesn't need pre-treatment devices and the raw materials can be put into the reactor directly. In the batch-type biochar reactors, biomass materials are fed in different batches, and biochar is prepared by firing agro residues in air tight drum. Biochar yield in batch type process varies from 12.5 – 30%. In continuous type pyrolysis as the name indicted the reactor, the biochar produced in the continuous uninterrupted way in the continuous biochar reactor. It consists of the feed hopper, screw conveyor, heating mechanism etc. These types of reactors are suitable for uninterrupted commercial production of biochar. Biochar yield in continuous type varies from 25 – 40%.

In Heaping and charring method biomass is piled up to a height of about three to four feet and is covered with mud paste. Vents are opened starting from the top and working downwards on drying of mud paste. The heap is set fire from one end and let to smoke for a considerable time period usually few days to week. In biochar kiln method bricks and clay are used in the construction. The biomass is added continuously as the fire continues. Air is allowed to enter from bottom as long as biomass is added continuously while burning. As the biomass reaches the level just below the secondary air vents, further addition of biomass is stopped and then the bottom vent is also closed. After some time, water is sprinkled to extinguish the fire and biochar is collected after some time. In drum method various forms of drum have been developed. Some have in horizontal and others are in vertical. Also, some require external heating, the other may need initial sparking for burning. There is hardly any control over the temperature and air supply. Also, the pyrolyzed biomass may not be uniform. The ash content in biochar is also high. Above developed technologies having minimal control over temperature, air supply and time parameters. Biochar is formed under oxygen stress conditions but there is no perfect control over temperature.

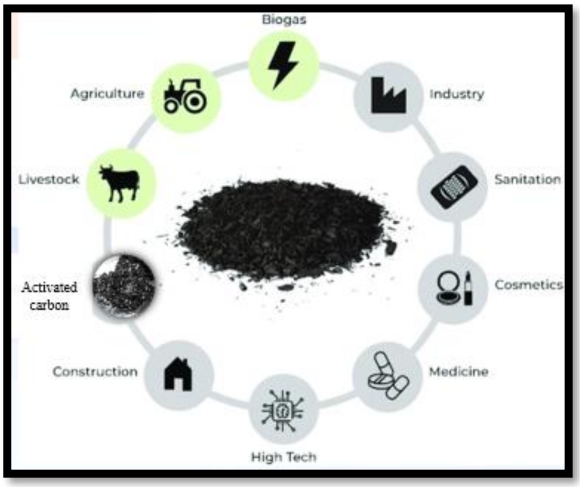
Table 1. Biochar production technologies, time required and biochar yield

Sl. No.	Type	Time	Char yield (%)
1.	Pit	Few days - week	12.50 – 30.00
2.	Heap	Few days - week	15.00 - 20.00
3.	Kiln, brick walled	1.00 – 5.00 h	12.50 - 33.00
4.	Kiln, steel walled	1.00 – 5.00 h	18.90 – 31.40
5.	Drum method	1.00 – 5.00 h	15.00 – 20.00
6.	Auger method	3 – 30 min	20.00 – 45.00

Auger or screw reactors operate continuously, which can be seen as an advantage to other reactor systems commonly used for slow pyrolysis, such as batch kilns, drum method and twin-retorts. Advantages of auger reactors include: flexible and reliable control of residence time by varying the screw speed and temperature by temperature controller.

Biochar Application

1. Biochar for soil health
2. Activated Carbone production from biochar
3. Biochar for water purification
4. Biochar as fuel
5. Biochar as a catalyst
6. Carbone Sequestration
7. Pharmaceutical industry
8. Construction sector uses
9. Sewage water treatment
10. Textile industry uses

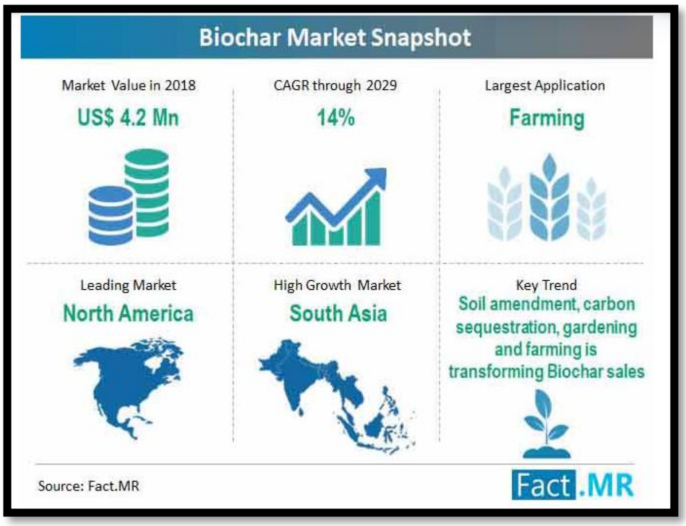


Biochar for soil health

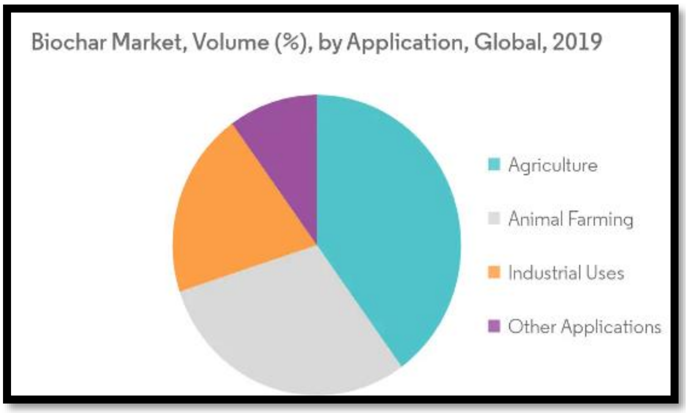
Biochar has potential to sequester carbon in soils and simultaneously improve soil quality and plant growth. Agriculture is likely to be the largest biochar application over the coming years, and it is expected to maintain its dominance. Biochar increases water and fertilizer holding capacity of the soil, providing important nutrients to crops and promoting plant growth. In a lot of pot and field studies, biochar has been shown to get better crop yields when compared to suitable controls where biochar was not applied. The use of Biochar has been gradually increasing in developing countries because it can improve the physical and chemical properties of soil and increases soil fertility and productivity to increase crop strength and growth with fewer emissions. The special ability of Biochar is to retain nutrients and water in the surface soil horizons. In developing countries, governments are encouraging people to use biochar for farming as it can minimize greenhouse gases like nitrous oxide and methane emissions and maximize the crop production. It boosts soil fertility and gives crops the nutrients they require. Yield improvements with biochar have been qualified to the following effects: 1) Increase in pH, the pH of biochar is often high (e.g. >9). This is beneficial in soil where the pH is lesser than optimal for the intended use, but not if the pH is higher than best; 2) Immediate or direct addition of nutrients. Ash in biochar contributes some nutrients to soil, but this is a short-term effect; 3) Retention of nutrients substances. With the passing of time, biochar surfaces advance an ability to retain nutrients in soil. This is a lengthy - period advantage of biochar and sets it apart from other forms of biological materials in soil, which also help retain nutrients but decompose relatively quickly; 4) Potential improvement of soil physical properties. Biochar has an extremely low density & highly porous; 5) Biochar may provide suitable situations for advantageous microbes soil, for example N-fixing Rhizobia and Mycorrhizal fungi.

Biochar application in soil acts as a conditioner and plays a much more important role in improving crop growth than as a fertilizer itself. Biochar can be used as a soil amendment to improve soil quality, to increase soil pH and CEC, improve water quality, increase soil moisture retention, reduce emission of greenhouse gases from soil, leaching of nutrients, soil acidity, irrigation and fertilizer requirements and also to reclaim degraded and spoiled land. The application of biochar to soil has been shown to improve crop yields which could be due to direct or indirect effect. The direct effect explained by fact that biochar being concentrated during pyrolysis contains higher amount of nutrients than the biomass from which they are prepared. The indirect effect is due to improvement in soil physical, chemical and biological properties due to biochar application. Organic manures improve soil properties and nutrients use efficiency but in tropical condition they mineralize quickly resulting lesser benefits, while a fraction of biochar remains in soil in a very stable form for a long time. Biochar application boost up the available water content of the soil up to 97 percent and saturated water contents 56 percent. Biochar amended soil retained 15 % more moisture contents as compared controlled treatment. Biochar application increased the water retention capacity of the soil because it increases soil porosity and also due to adsorptive nature of biochar.

Biochar Market



The growing need for quality food and with the most population getting attracted to various organic crop foods India, the demand for biochar is augmenting in various farming processes. The demand for growing high-quality crops for organic food and continuous development in farming are the key driving factors for the market growth. According to a new report by EMR titled, 'Global Biochar Market Report and Forecast 2021-2026, the global biochar market size was valued at USD 1.67 billion in 2020. The market is further expected to reach USD 3.24 billion by 2026, with a CAGR of 11.8% during 2021-2027. Biochar is a developing industry that is expected to play a significant role in increasing crop production and productivity in the agricultural sector. International biochar experts Albert Bates and Kathleen Draper estimate that biochar as a soil amendment will only ultimately represent 5% of the global market for biochar in the future.



Major Factors Driving the Growth of Biochar Market

Biochar can increase soil fertility, water holding capacity and crop productivity. The increase in soil fertility leads to increased crop production. This feature is expected to drive the biochar market. A large number of market players are improving their R&D capabilities to explore the potential application of biochar in the generation of electricity, and nutrition retention of soil. This in turn is expected to provide a lucrative biochar market growth opportunity.

Market Strategy and Marketing Plan

By producing biochar from this machine farmers can sell this biochar to other farmers in term they can earn money, also can be sold to bio-fertilizers manufactures as raw materials. Farmers can sell their agriculture waste to biochar production unit in this way farmers can earn money. Industrialists can also setup commercial biochar production unit and that way they can earn money. Also blended biochar product sell to market.

Marketing

Products and Price

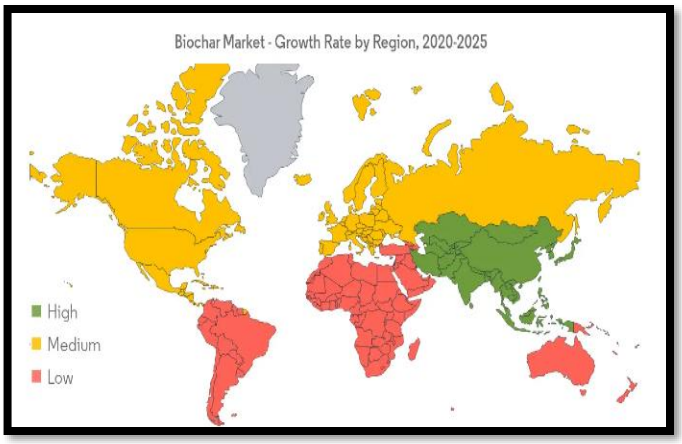
100% pure biochar and mixed with other fertilizers by the consumer and biochar compost/fertilizer mixes, which are formulated to meet specific soil amendment needs.

Distribution

Distribution of biochar is a large expense for any biochar business. Both models face similar concerns when it comes to the packaging and shipping of biochar.

Promotion

To large-small farmers, home gardeners,



managers of city parks, golf courses and university campuses and wineries etc.

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Functional Food Revolution

Kumari Sunita

Belief in healing power of foods is not a new concept having been a widely held view of generation. This widespread belief in the merit of so called "functional food (functional foods which are a class of foods that have strong putative metabolic role & above that is seen in a wide variety of common foods) has captured the interest of not only scientists but also of consumers. Consumers of today view food as a miracle medicine and therefore for them this may be a revolution. Other possible reasons for viewing this concept as a revolution is the increased health care cost and technological advancement in food industry. Now it is possible to take out bad stuff (fat, cholesterol, sodium and calories) to putting back or enhancing the good stuff. It is possible for example to produce anti-cancer broccoli that could be sold to health-conscious consumers at premium cost. Epidemiological data has suggested that six of the ten leading causes of death in world are believed to be related to diet and other environmental factor over which we have significant control. Theses disease are cancer, chronic heart disease, stroke, diabetes, atherosclerosis and liver disease.

How they act in the body?

Functional components may trigger enzyme system that block or surpass DNA damage, reduce tumour size and decrease the effect of oestrogen like hormone. These components also help to inactivate and eliminate carcinogens other toxicants and thus offers protection against cancer. Other target of functional component in the body is lipid homeostasis, strengthening of immune functions and restoration of balance of colonic micro flora. For the last target is achieved with the help of prebiotics and probiotics the functional components of which is non-pathogenic bacteria. These bacteria which are taken as yoghurt & reaches colon of gastro-intestinal system. They produce lactic acid (which lowers pH of the medium which exerts antibacterial effect on pathogenic bacteria.

Today when a larger number of world populations are deficient in lactase enzyme which is responsible for digestion of milk the intake of yogurt in place of milk which contain same nutrient as milk except the lactose which is in the form of glucose and galactose (partially broken product) in yogurt help prevent symptoms of bloating, flatulence and diarrhoea. Besides this certain epidemiological survey has supported that consumption of yogurt and fermented milk may reduce the evidence of colon and breast cancer, diarrhoea and immune system stimulation. Green tea, garlic, cabbage, cauliflowers, onion, gingers soya beans, grapes, nuts turmeric, citrus fruits and antioxidant rich fruits and vegetables are such foods where functional component help prevent the chronic diseases. However, it should be always be taken as diet not as a drug.

Functional properties of mushrooms

Commonly consumed mushrooms that are both edible and have functional properties include Auricularia, Grefolia, Hericium, Lentinus and Pleurotus. Most edible mushrooms like Agaricus bisporus commonly known as button mushroom however do not show medicinal value and some

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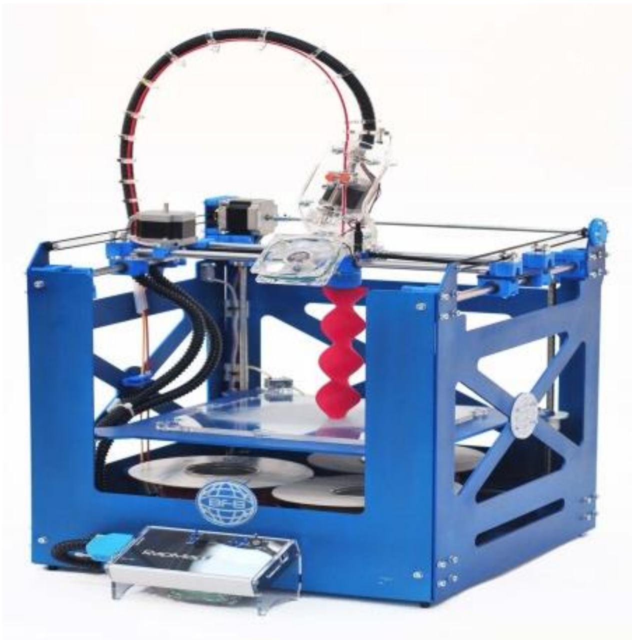
medicinal mushroom like Ganoderma and Coriolus are not edible. Many cultures have used mushroom as food as well as medicine however the use of mushroom as functional food is notable in the East. Mushroom has been incorporated in health tonics, soup, tea and health foods. It has been used to lubricate the lungs, tonify kidneys and reduce excessive dampness. More recently mushroom have been shown to modulate the immune system, lower blood pressure and blood li[id concentrations, and inhibit tumours ,inflammation and microbial action. Shiitake mushroom is a model of the functional mushroom with demonstrated bioactivity has led to isolation of pure compounds that have reached pharmaceutical status.

An overview on 3D printing of foods

Saurabh Shankar Patel, Adarsh M Kalla, Jitendra Chandra Chandola and Ratul Moni Ram



The 3D printing is a process of taking a digital 3D model and turning that digital file into a physical object. 3D printer was invented by a man named Chuck Hull back in 1986 he came up with the idea in 1983 when he was using UV light to harden tabletop coatings. He coined the term “stereolithography” in his Patent entitled “Apparatus for Production of Three-Dimensional Objects by Stereolithography”. He defined stereolithography as a method and apparatus for making solid objects by successively “printing” thin layers of the ultraviolet curable material one on top of the other. His invention concentrated solely on a fabrication process called Stereolithography (SLA). later on numerous other 3D printing technologies have been developed, such as Fused Deposition Modeling (FDM)/Fused Filament Fabrication (FFF), Selective Laser Sintering (SLS), PolyJetting and others, all of which rely on layer-by-layer fabrication and are based on a computer code fed to the printer.

How 3D printer works

The 3D design of food which meets the unique demand of special consumer categories,

such as, elderly, children and athletes are once designed in computer or simply downloaded, must be converted into some computer language/codes so that 3D printer can read it. The 3D design model is converted into G-code, which is a numerical control programming language used mainly for computer aided manufacturing. It is a language which tells a machine how to move. Without G-code there would be no way for the computer to communicate where to deposit, cure or sinter a material during the fabrication process. There are some programs which convert the 3D model files into G-code. Once the G-code is created it can be sent to the 3D printer, providing a blueprint as to what its next several thousand moves will consist of. These steps all add up to the complete fabrication of a physical object.

Application of 3D printing

Once the 3D printing was commercialized, many manufacturers started producing their end use components or their entire product via additive manufacturing as a way to reduce costs, save time, and produce better products. It is used in aerospace industry, medicine, food industry and art. Many aircraft manufacturers and aeronautic agencies such as NASA and the ESA, are relying upon 3D printing in order to produce complex geometries and reduce the overall weight of their aircraft and

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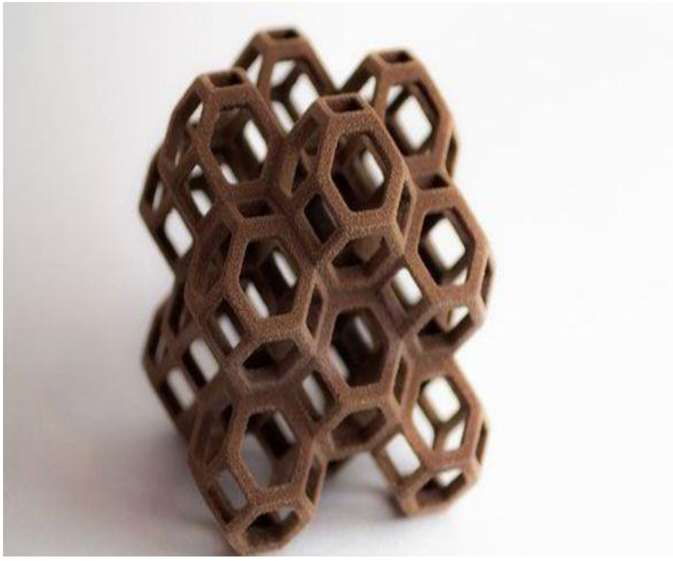
hence save the fuel. Companies like Boeing and Airbus are using 3D printing to reduce the weight of their aircraft, allowing them to cut fuel costs for each flight. At Organovo, they design and create functional human tissues using 3D bio-printing technology. They do so by using a process similar to



an FDM desktop 3D printer where they use hydrogels infused with living cells. 3D printing has a great potential to fabricate complex geometries, elaborated textures and tailored nutritional contents. For this reason, 3D technology is driving major innovations in food industry. The printing of 3D food relies on three key factors: (1) printability, (2) applicability and (3) post-processing.

3D printing of food

Additive manufacturing was used to develop 3D objects based on the materials such as ceramics, metals and polymers. For printing 3D objects layer by layer, ultra violet curable polymers (photosensitive) were used. However Additive Manufacturing (AM) technology using photo-sensitive materials is not suitable to design food. In the food sector, the application of 3D printing techniques was firstly reported by researchers from Cornell University who introduced the Fab@Home Model 1 which operates on extrusion process and is capable of producing forms using liquid food materials. In subsequent years many studies were carried out in an effort to adapt AM technology to the design 3Dimensional foods. However, this technology also represents some challenges as it is not easily applied to the complex food materials with a wide variation in physico-chemical properties.

The 3D food printing techniques can be classified based on the material supply: liquid, powder and culture of cells. The deposition of liquid-based materials can be performed via extrusion and inkjet processes. Powder-based structures are printed by deposition followed by application of a heat source (laser or hot air) or particle binder. The cell culture deposition (bioprinting), as this technique is applied to print meat analogue.

Conclusion

Although AM technologies have received a lot of attention in the field of food engineering, there are still many barriers to overcome for AM technology to be incorporated in place of traditional manufacturing fabrication processes. Ideally, the end-properties related to the mechanical stability of 3D printed food should match with those in conventional manufacturing processes. And, in terms of texture design and nutritional optimization, AM technology would potentially defeat traditional fabrication methods. If any challenges are to be faced by AM technology, in the field of food engineering is attributed to process productivity and product innovation and functionality.

Role of Automation in the Livestock Farming

Sharanabasava[1*], Akshay Kumar[2], Shivanand[1], Nagaratna[1] and Abhinash P[1]

Livestock farming is an essential component of the global food industry, supplying a massive portion of the world's meat, dairy, and other animal products. However, with the world population projected to reach 10 billion by 2050, there is a growing need for increased food production to meet the demand. Automation has emerged as a solution to this challenge, with many livestock farmers adopting various automated systems to enhance efficiency, reduce labour costs, and increase productivity. In this article, we will discuss the role of automation in the livestock farming industry.

Types of Automation Systems Used in Livestock Farming

The livestock farming industry is leveraging various automation systems to enhance efficiency and productivity. These systems include:

Feeding Systems

Feeding systems are automated systems used to feed livestock, such as cows, pigs, and chickens. These systems are designed to provide precise quantities of feed to each animal, ensuring they get the required nutrients for growth and development. Some of the feeding systems used in livestock farming include automatic feeding systems, batch feeding systems, and computer-controlled feeding systems.

Milking Systems

Milking systems are automated systems used to milk dairy cows. These systems use sensors to detect when a cow needs to be milked, and then automatically attach and detach the milking machines. This reduces the need for manual labour and ensures consistent milk production.

Climate Control Systems

Climate control systems are used to regulate the temperature, humidity, and ventilation in livestock buildings. These systems help keep optimal conditions for the health and well-being of the animals, which can improve productivity and reduce the risk of diseases.

Breeding Programs

Breeding programs are automated systems used to select the best animals for breeding. These systems use data such as genetic traits, performance records, and pedigree information to select the best animals for breeding. This can lead to improved genetics in the herd, resulting in better growth rates, disease resistance, and productivity.

Benefits of Automation in Livestock Farming

Increased Efficiency

Automation systems in livestock farming can enhance efficiency by reducing the need for manual labour, improving the accuracy of processes, and optimizing feed and water consumption.

Reduced Labour Costs

Livestock farmers can save significant labour costs by adopting automated systems. These systems require minimal human intervention, reducing the need for farm laborers and associated labour costs.

Improved Productivity

Automation systems can improve productivity by optimising feeding, milking, and breeding programs. This can lead to increased milk yield, meat production, and better-quality animal products.

Enhanced Animal Welfare

Automation systems can help enhance animal welfare by maintaining optimal conditions in livestock buildings, providing precise feeding and

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watering, and reducing stress during milking and other procedures.

Challenges in Implementing Automation in Livestock Farming

Although automation has numerous benefits in livestock farming, its implementation is not without challenges. Some of the challenges include:

High Initial Investment Costs

The initial investment costs of automation systems in livestock farming can be significant, which can deter some farmers from adopting these systems.

Technical Complexity

Some automation systems in livestock farming can be complex to operate and maintain, requiring specialized skills and expertise.

Dependence on Technology

Farmers may become too dependent on automation systems, leading to a lack of skills and expertise in traditional farming practices, which could be problematic if the systems fail.

Data Security and Privacy

The use of automation systems in livestock farming generates significant amounts of data, which must be securely stored and protected to prevent misuse or theft.

Conclusion

In conclusion, automation has transformed the livestock farming industry, enabling farmers to improve efficiency, reduce labour costs, increase productivity, and enhance animal welfare. By leveraging various automation systems such as feeding, milking, climate control, and breeding programs, farmers can optimize their operations and produce more animal products to meet the growing global demand. However, the implementation of automation in livestock farming is not without challenges, and farmers must address these challenges to fully benefit from this technology. Despite the challenges, the adoption of automation in livestock farming is expected to continue growing, and we can expect more innovations in the future that will revolutionize the industry even further.

Converting Food Waste into Fuel: An Innovative Solution to Reduce Waste and Greenhouse Gas Emissions

Sharanabasava[1*], Akshay Kumar[2], Shivanand[1], Nagaratna[1] and Abhinash P[1]

Food waste is a global problem, with an estimated one-third of all food produced in the world going to waste. This not only results in economic losses but also contributes to environmental problems, such as greenhouse gas emissions and the depletion of natural resources. One innovative solution to address this issue is the conversion of food waste into fuel. In this article, we will explore the science and technology behind this process and the potential benefits it can bring to society and the environment.

What is Food Waste?

Food waste is defined as any edible or inedible part of food that is discarded or lost, regardless of its source or stage in the food supply chain. This includes food that is not harvested, spoiled, expired, or simply thrown away by consumers or food establishments. Food waste can occur at every stage of the food supply chain, from production to consumption, and can result from various factors, such as overproduction, inefficient storage and transportation, and consumer behavior.

The Impact of Food Waste on the Environment

Food waste has significant environmental impacts, including the release of greenhouse gases (GHGs) into the atmosphere. When food waste is sent to landfills, it decomposes and produces methane, a potent GHG that is 28 times more powerful than carbon dioxide (CO2) in terms of its global warming potential. Landfills are the third-largest source of methane emissions in the United States, accounting for 16 percent of total emissions, according to the Environmental Protection Agency (EPA). Methane emissions contribute to climate change and air pollution, which can have negative effects on human health and the environment.

Moreover, food waste also has an impact on the depletion of natural resources, such as water and energy. For example, producing one pound of beef requires approximately 1,800 gallons of water, while producing one pound of vegetables requires about 39 gallons of water, according to the Water Footprint Network. When food is wasted, all the resources that went into producing it, including water, energy, and land, are also wasted.

Converting Food Waste into Fuel

Converting food waste into fuel is a promising solution to mitigate the negative impacts of food waste on the environment and to reduce our dependence on fossil fuels. There are several methods to convert food waste into fuel, including anaerobic digestion, composting, and pyrolysis.

Anaerobic digestion is a biological process in which microorganisms break down organic matter in the absence of oxygen, producing biogas, a mixture of methane and carbon dioxide. The biogas can be used as a fuel for electricity generation, heating, or transportation. Anaerobic digestion is suitable for wet organic waste, such as food scraps, manure, and wastewater.

Composting is a natural process in which organic matter is decomposed by microorganisms under aerobic conditions, producing compost, a nutrient-rich soil amendment. Composting can be used to divert organic waste from landfills and to produce a valuable product for agriculture and landscaping. However, composting does not produce energy and requires large amounts of space and time.

Pyrolysis is a thermal process in which organic matter is heated in the absence of oxygen, producing biochar, a solid carbon-rich material, and syngas, a mixture of hydrogen and carbon monoxide. The syngas can be used as a fuel for

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electricity generation, heating, or transportation. Pyrolysis is suitable for dry organic waste, such as wood chips, sawdust, and paper.

Benefits of Converting Food Waste into Fuel

Converting food waste into fuel has several potential benefits for society and the environment. In this section, we will explore some of these benefits in more detail.

Reducing Greenhouse Gas Emissions

One of the most significant benefits of converting food waste into fuel is the reduction of greenhouse gas emissions. As mentioned earlier, when food waste is sent to landfills, it decomposes and produces methane, a potent greenhouse gas. However, by converting food waste into biogas or syngas through anaerobic digestion or pyrolysis, respectively, methane emissions can be significantly reduced. Biogas and syngas can be used as a renewable energy source, replacing fossil fuels and reducing carbon emissions.

Reducing Dependence on Fossil Fuels

Converting food waste into fuel can also reduce our dependence on fossil fuels. Fossil fuels are a finite resource, and their extraction and use have negative environmental impacts, such as air and water pollution, land degradation, and climate change. By using biogas or syngas produced from food waste, we can reduce our reliance on fossil fuels and move towards a more sustainable energy system.

Generating Renewable Energy

Another benefit of converting food waste into fuel is the generation of renewable energy. Biogas and syngas can be used to generate electricity, heat buildings, or fuel vehicles, providing a reliable and clean source of energy. This can help reduce our carbon footprint and promote energy independence and security.

Diverting Waste from Landfills

Converting food waste into fuel can also help divert waste from landfills, reducing the amount of waste that is sent to these facilities. This, in turn, can extend the lifespan of landfills, reduce the need for new landfill sites, and reduce the associated environmental and social impacts, such as air and water pollution, habitat destruction, and public health risks.

Producing Nutrient-Rich Soil Amendments

Composting, a method of converting food waste into nutrient-rich soil amendments, can also have several benefits. Compost can improve soil health, increase crop yields, reduce the need for synthetic fertilizers, and sequester carbon in the soil. Additionally, composting can help divert organic waste from landfills and reduce methane emissions.

Challenges and Limitations

While converting food waste into fuel has several potential benefits, there are also challenges and limitations associated with this process. In this section, we will discuss some of these challenges.

Collection and Sorting of Food Waste

One of the main challenges of converting food waste into fuel is the collection and sorting of food waste. Unlike other waste streams, such as plastics and paper, food waste is highly variable and requires specialized equipment and infrastructure for collection, transportation, and sorting. In addition, food waste can be contaminated with non-biodegradable materials, such as plastics and metals, which can interfere with the conversion process and reduce the quality of the end product.

Technological Maturity and Scalability

Another challenge of converting food waste into fuel is the technological maturity and scalability of the process. While anaerobic digestion and composting have been widely adopted, pyrolysis is still in its early stages of development and has not yet been widely implemented. Additionally, the scalability of these processes can be limited by factors such as feedstock availability, infrastructure, and economic viability.

Economic Viability

The economic viability of converting food waste into fuel is also a challenge. While the production of biogas and syngas can generate revenue from the sale of electricity or heat, the cost of producing these fuels can be high, and the revenue generated may not be sufficient to cover the costs. Additionally, the market for these fuels may be limited, and competition from other renewable energy sources can reduce demand.

Conclusion

In conclusion, converting food waste into fuel has the potential to provide several benefits for society fossil fuels, generating renewable energy, diverting waste from landfills, and producing nutrient-rich and the environment, including reducing greenhouse gas emissions, reducing dependence on soil amendments. However, there are also challenges and limitations associated with this process, such as the collection and sorting of food waste, technological maturity and scalability, and economic viability. Despite these challenges, it is clear that converting food waste into fuel is a promising solution to the global waste management and energy challenges we face today. By investing in research and development and supporting the implementation of these technologies, we can move towards a more sustainable and circular economy that prioritizes waste reduction, resource conservation, and renewable energy generation.

Kumari: Plant of immortality

Chethan T, Ravi Pujari and Vikramsimha H. V.

The term for aloevera in Sanskrit is '*kumari*', which means beautiful young girl.' Ayurveda considers aloevera to be the herb that maintains a woman looking young at all times. It's a revitalizing herb that belongs to the Rasayana class of Ayurvedic herbs. Rasayana herbs are anti-aging, immune-system-building, and healing agents that protect your body from the normal wear and tear of daily life and stress.

Aloe plants, which go by a few common names such as "burn plant," "lily of the desert," and "elephant's gall" — have been used traditionally to treat wounds, hair loss, hemorrhoids, and digestive issues. Aloe is a genus of plants belonging to the larger lily family. Aloe is the most common of the 420 species of aloe and also the most noted for its benefits. The plant is native to southern and eastern Africa and is now grown worldwide.

These days, aloe has an entire industry behind it. Its juice and leaf gel is used in cosmetics and personal-care products such as moisturizer, soap, shaving cream, and suntan lotion. The aloe products that probably come readily to mind are the bright green gels that are stocked on drugstore shelves. Probably it is used to soothe nasty sunburn.

Aloe plants like it warm, so their ideal temperature is between 25 degree Celsius and 38 degree Celsius. If it gets too cold, the leaves will turn yellow or pucker. These plants also don't like drafts, so ensure they're not in a spot where a door or window is constantly opening and closing.

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It is propagated through suckers. The suckers are dipped in 0.1 % Carbendazim for five minutes and planted in the field. For planting one hectare of land, 10,000 suckers are required. Roots of Aloe do not penetrate below 20-30 cm. so depending upon soil type plough the land thoroughly and bring soil to fine tilth. At time of last ploughing add 6 ton per acre of well decomposed cow dung in soil. Forms ridge and furrow for planting of suckers at 45 or 60 cm apart. If necessary irrigate the field. Plant suckers at 40 or 30 cm apart

Plant suckers in July-August for better growth. Under irrigated conditions, sowing can be done around the year except in winter month. Normally spacing of 45 cm x 40 cm or 60 cm x 30 cm is followed. Plant three- to four-month-old suckers in a pit having depth of 15 cm. 22000 suckers required per acre of land.

At time of land preparation, apply 60-80 quintal per acre of well decomposed cow dung. Apply basal dose of N:P:K @ 20:20:20 kg/acre in form of Urea @ 44 kg, Super Phosphate @ 125 kg and MOP @ 34 kg per acre. Do earthing up and keep field weed free. Weeding is to be done at proper intervals. Weeding is mainly done twice in a year. In summer or dry conditions, apply irrigation with interval of 2 weeks. In rainy season, it does not require any irrigation and in winter season, less irrigation should be given as the plant not take up much water. Before irrigation drenching should be done so that extra water will runs out.

Aloe crop take 18-24 months to fully mature. In year time, it bears yellow colour flower. It can be harvested 4 times a year. 3-4 leaves cut from each plant. Carry out picking in morning or in evening. The leaves are regenerated and thus crop can be harvested up to 5 years. Allow freshly harvested plant to wilt and loose moisture in the field before transporting. Wilting is noticed normally within 24 to 72 hours. But the plant should be kept dry and cool to prevent fermentation or mould growth.

Ohmic Heating: A Novel Technique for processing Berries

Mansee Rana, Baldev Singh Kalsi, Preeti Birwal

Berries consist of an extensive amount of bioactive chemicals like flavonoids, anthocyanins and phenolic acids. These compounds are proven to offer a number of health advantages, including anti-inflammatory, anticancer, antioxidant characteristics. Because berries are very delicate and in short supply owing to the season, they are typically processed into a puree, juice beverage, and jam using different techniques of processing, which may affect the bioactive compounds and bioactivities (Li et al., 2017).Traditional thermal processing is one of the most essential methods used in food processing to inactivate microbes and enzymes, but it has been proven to have a negative impact on heat-sensitive polyphenols and nutritional properties (Salari & Jafari, 2020). One of the most difficult difficulties in the food processing business is minimising the degradation of bioactive chemicals undergoing traditional heat treatments. Ohmic heating (OH) is gaining popularity among researchers as an alternative to traditional thermal approaches.

Ohmic Heating: Principle

Ohmic heating (also known as electrical conduction or electrical resistance heating) works on the principle that an alternating or changing electric current travels through particles of food, causing ions to migrate in the direction of electrodes with opposite charges. Then, ions collide with each other as they move, causing resistance to ion movement along with a rise in kinetic energy. The heating of product is done by converting the food into electrical resistance which generates instantaneous and volumetric heat in it because of the ions in motion. The quantity of heat produced is estimated by various factors like electric field, current, voltage along with electrical conductivity of the food particles (Alkanan et al., 2021).

Benefits of Ohmic Heating

The time it takes to raise the temperature at this cold point with traditional heating may overprocess the residual particles and the surrounding liquid. This much processing destroys nutrients and reduces flavour(Varghese et al., 2014). While in case of ohmic heating, heat is generated within the food particles, and the inside-out heating pattern allows for uniform and quick heating (Tian et al., 2018). Due to this ohmic heating preserves the colour and nutritional characteristics of food while also allowing for faster processing times and larger yields in contrast to traditional heating methods. Moreover, Ohmic heating has low investment costs, high energetic efficiency and is considered technically simple (Kaur et al., 2016)

Factors Affecting Ohmic Heating

Factors like time and temperature of treatment, electric field strength and frequency have a significant impact on Ohmic heating (Sakr & Liu, 2014).The larger the strength of the electric field, quicker is the heating rate. Ohmic heating is commonly done with alternating current (AC) because the fast variations in the direction of the electric field cause ions to vibrate. The longer the heating period and higher the temperature of ohmic heating, the greater the microbial inactivation is achieved (Tian et al., 2018). But increasing the heating time and temperature will degrade the bioactive compounds. So, all the parameters must be considered according to the requirement in the process design.

Application of Ohmic Heating for Processing Berries

Recently, the novel and emerging technology of ohmic heating has been applied for processing

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berries. In an investigation by Sarkis et al., (2013), the pasteurization of pulp of blueberry using ohmic heating showed 5.7-14.7% degradation of anthocyanin, while traditional thermal heating showed a degradation of 7.2%. The results of the study showed that deterioration enhanced with both raising voltage from 160 to 240 V and increasing solids content from 4 to 16 g/100g.These findings might be explained by electrochemical processes catalysed by high voltages. For the blueberry pulp with a solid content of 10 g/100 g, the anthocyanin degradation was observed lower for lower voltage (160V) than the reported for conventional heating. During the osmo-dehydration (OD) of blueberries, the mass transfer was intensified by combination it with ohmic heating and pulsed vacuum (PV) treatments. PVOD/OH method of treatment at 50 °C, reaching a loss of nearly 50% of the over-all polyphenol content equated with the fresh sample and a loss of 70–80% of the flavonoids and non-flavonoids. The polyphenol retention was more at less temperatures; hence, the application of an intermediate process temperature (40 °C) was selected as a pre-treatment for 240 min prior to further drying at 60°C. The OH application shortens the drying time, thus favouring bioactive component retention and producing higher-quality products than conventional heating (Moreno et al., 2016). Another study by Hardinasinta et al., (2021)evaluated the applicability or use of ohmic technology for sterilizing purees and juices from three types of berry-like fruits grown in Indonesia, namely, jambolana, bignay, and mulberry. The results of the study showed that ohmic heating is a appropriate technology to sterilize juices of these fruits. The electrical conductivities of the juices ranged from 0.128 to 0.430 $S.m^{-1}$ and rose linearly with temperature rise. Heating rates ranged from 0.57 to 0.66 °C/s, with system performance coefficients (SPC) ranging from 0.64 to 0.81. According to the findings of this research, ohmic heating is appropriate for the sterilization of juices of these fruits thus it has a quick heating time and a high coefficient of performance.

Conclusion

The preservation of bioactive substances under heat treatment is a difficult problem for the food business. Ohmic heating, a new thermal technology, has the potential to lessen the degradation or loss of bioactive chemicals. Ohmic heating is an advancing method to process berries due to its rapid, efficient, and scalable nature. However, optimizing the time, temperature, and voltage of the extraction process is crucial to achieving the highest retention of bioactive compounds. Higher temperatures, longer extraction times and higher voltages generally result in higher yields, but only up to a certain point, beyond which degradation becomes more significant. Overall, because Ohmic heating has a much shorter processing time than conventional procedures, bioactive compounds happen to be better retained.

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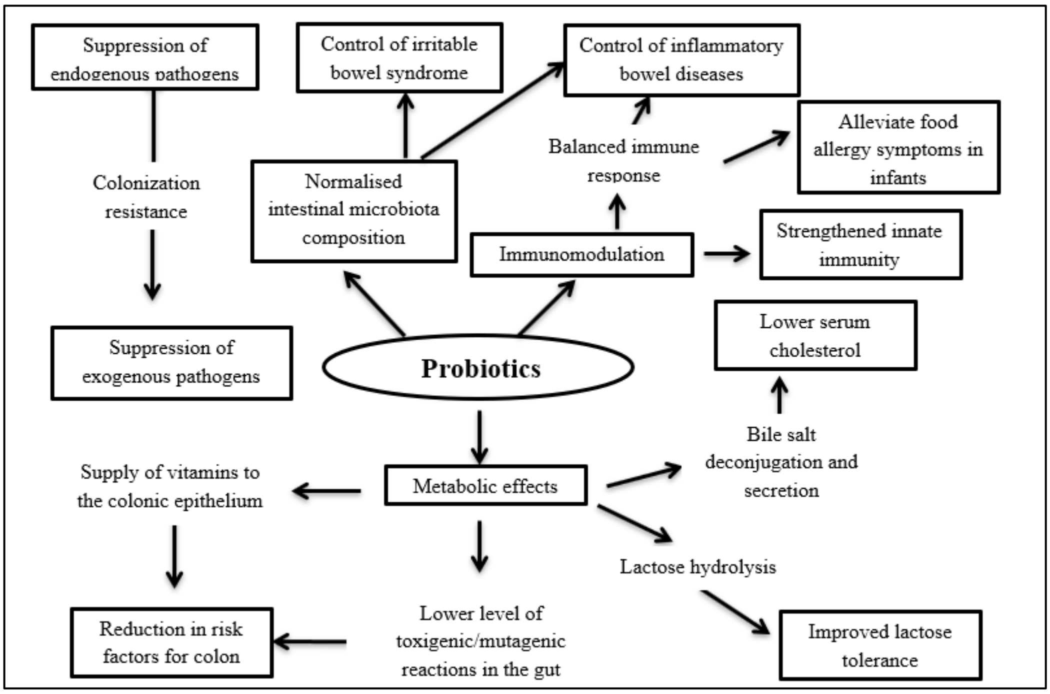
Probiotics and Their Health Benefits

Devikrishna P[1], Patel S. S[2], Vijay Kumar[2], Abhay Kumar Singh[2], Kanhaiya Lal Regar[2]

Humans are intrinsically born with the common inhabitants to preserve the great health, but the changes within the food habits enormously influenced the normal differences of the intestinal organisms. However, the present world is more sensible around the well-being and has information on the food items that they take. "Probiotics" have dragged the consideration to re-establish intestine microbial homeostasis. Therefore, the improvement of probiotic food formulations is a key investigative region of the functional food market. The probiotics concept was presented by Elie Metchnikoff in the 20th century, and the market for probiotic foods right now developing at the rate of 7%. The world market of probiotics is valued at USD 49.4 billion in 2018 and is estimated to reach USD 69.3 within the year 2023.

What are probiotics?

Probiotics are microorganisms that are shown to exercise, health-promoting effects on humans and animals, which literally meaning 'for life'. They are considered as feed supplements with live microbes, which deliver many health benefits on the host by enhancing the balance of intestinal microbiota. The term probiotics is defined by Fuller as "live microorganisms that, when administered in adequate amounts, confer a health benefit on the host". According to WHO/Food and Agriculture Organization (2010) probiotics are an oral supplement or a food product that contains a sufficient number of viable microorganisms to alter the micro flora of the host and has the potential for beneficial health effects on host, which when it is administered in adequate amounts.



Microorganisms used as probiotics

Different microbial species have been used as probiotics. It includes yeast, bacteria or molds. Bifidobacteria and Lactobacillus are the most common genera of microbes that are widely used as probiotics. List of strains (live microorganisms) that can be used as probiotic under FSSAI is given below in the Table 1.

Characteristics of good probiotics

- It should be able to induce some beneficial effect in host animal.
- It should be able to survive the passage through the digestive system and in intestine.
- It should be non-toxic and non-pathogenic
- It should have excess viability
- It should be able to attach to the intestine and colonize

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- It should be acid tolerant and bile salt tolerant
- It must have anti-inflammatory, anti-carcinogenic, and anti-mutagenic activity, immunostimulatory effect, cholesterol lowering effects, can enhance bowel motility
- It should have antimicrobial activity against pathogenic organisms

Health benefits of probiotics

Probiotics have been used for the prevention and treatment of various medical conditions and to support general wellness. Active digestion ability, antagonistic action against pathogens, regulation of gut-beneficial microflora, enhanced colon integrity, down-regulated allergic response and immunomodulation are the health benefits for probiotic bacteria. Hence, one can include probiotics in their diet to overcome several diseases.

Table 1: Microorganisms used as probiotics

Lactobacillus species	Bifidobacterium Species	Yeast
Lactobacillus acidophilus	*Bifidobacterium bifidum*	*Saccharomyces boulardii*
Lactobacillus plantarum	*Bifidobacterium lactis*	*Saccharomyces cerevisiae*
Lactobacillus reuteri	*Bifidobacterium breve*	*Streptococcus thermophilus*
Lactobacillus rhamnosus	*Bifidobacterium longum*	*Bacillus coagulans*
Lactobacillus salivarius	*Bifidbacterium animalis*	
Lactobacillus casei	*Bifidobacterium infantis*	
Lactobasillus brevis		
Lactobacillus johnsonii		
Lactobacillus bulgaricus		
Lactobacillus fermentum		
Lactobacillus caucasicus		
Lactobacillus helveticus		
Lactobacillus lactis		
Lactobacillus amylovorus		
Lactobacillus gallinarum		
Lactobacillus delbrueckii		
Lactobacillus paracasei		
Lactobacillus gasseri		