

Value-Added Beetroot Products with Nutritious Properties

Dhanashree R. Jadhav¹, Sagar M. Chavan² and Chetna D. Bhamare¹

¹M. Tech. Student, ²Assistant Professor, D Y Patil Agriculture and Technical University, Talsande

*Corresponding Author: ghanashreejadhav259@gmail.com



Red beetroot (*Beta vulgaris* L.), also known as beet, garden beet, table beet, etc., is a traditional and popular vegetable in the world. It is the red root vegetable especially popular in Eastern and Central Europe where it is the main ingredient of borscht, vinaigrette salad, Russian "herring under fur" salad, pickled cabbage with beetroot. The bright red colour of beet root is due to the red pigments known as betalains. Now, beetroot is regularly consumed as part of the normal diet, either fresh or after thermal processing and commonly used in manufacturing as a food colouring or flavouring agent known as E162. Its powder is used as a natural red food colorant which is used to applied in dry mixes (soups, Indian curry mixes), sweets, jams, jellies, etc.

Results from several studies have demonstrated that betalains from beetroots possess powerful antiradical and antioxidant activity. Beetroots have long been used for medicinal purposes, primarily for disorders of the liver as they help to stimulate the liver's detoxification processes. The plant pigment that gives beetroot its rich, purple-crimson colour is betacyanin; a powerful agent, thought to suppress the development of some types of cancer. With the increasing consumer demand for functional foods, beetroot's potential as a base for value-added

products has gained attention. This article delves into the development of value-added beetroot products, emphasizing their nutritious properties and market potential.

Nutritional Profile of Beetroot

Beetroots is a vegetable with a low-fat content but rich in carbohydrates, starch, soluble fibers, proteins, being a product with moderate caloric value. Beetroots are one of the richest sources of folate and vitamins A, B1, B2, B6 and C. They have an important content of B-vitamins (B₁- thiamine, B₂-riboflavin, B₃-niacin, B₅-pantothenic acid, B₆-pyridoxine, B₉-folates and B₁₂-cyanocobalamin), as well as folic acid. They have a good source of minerals like manganese (good for bone health), magnesium, potassium, sodium, phosphorus, iron, zinc, copper, boron, silica and selenium. They have powerful antioxidants such as triterpenes, sesquiterpenoids, carotenoids, coumarins, flavonoids (tiliroside, astragalin, rhamnocitrin, rhamnetin, kaempferol), betalains and phenolic compounds. Other bioactive compounds that are found in beets are: saponins, alkaloids (calystegine B₁, calystegine B₂, calystegine C₁, calystegine B₃, ipomine), amino acids (threonine, valine, cystine, methionine, isoleucine, leucine, lysine, phenylalanine, histidine, arginine, glutamic acid, proline, alanine, tyrosine - in leaves) and tannins.

Table 1 Nutritional Profile of Beetroot

Constituent	Per cent	Constituent	mg
Water	87.5	Phosphorus	40
Fat	0.17	Calcium	16
Protein	1.61	Magnesium	23
Carbohydrates	9.56	Iron	0.80
Fibre	2.8	Zinc	0.35
Energy	43 kcal	Vitamin C	4.9
Potassium	325 mg	Vitamin B2	0.04
Sodium	78 mg	Vitamin B6	0.067
Vitamin A	36 mg	Vitamin E	0.30
Folacin	109 mcg	Niacin	0.334

(Source: Deshmukh *et al.*, 2018)

Value Added Products of Beetroot

The concept of value-added products involves enhancing the intrinsic value of raw beetroot through processing, packaging and fortification. Below are some innovative beetroot-based products with enhanced nutritional properties:

Beetroot Juice and Smoothies: Beetroot juice is a popular product due to its high nitrate content, which has been linked to improved athletic performance and reduced blood pressure. Fortified versions may include additional vitamins or superfoods like ginger and turmeric to boost antioxidant levels and flavour profiles. Nitrate enrichment by beetroot juice improves exercise tolerance through vascular control and elevated oxygen delivery to skeletal muscles. Beetroot juice and its extract has wide range of application in many beverages, cereals jams, jellies, candies, ice cream, yoghurt, dairy products, sauces and processed meats.

Beetroot beverages: The study was prepared non-dairy probiotic drink using beetroot juice at pH 6.5 and optimum fermentation temperature of 37 °C and examined viability of *Lactobacillus rhamnosus*, *Lactobacillus plantarum* and *Lactobacillus delbrueckii*sb. There was gradual decline in pH and sugar content with time. Total phenols, flavonoids and antioxidant activity were enhanced in probiotic drink as compared to fresh juice sample. Study revealed that beetroot drink is a good approach for non-dairy probiotic, free from cholesterol and with health promoting components (Panghal *et al.*, 2017).

Beetroot Chips: A healthier alternative to traditional potato chips, beetroot chips are baked or air-fried, preserving their nutritional content while providing a crunchy, flavourful snack. These can be spiced or mixed with other root vegetables for variety.

Beetroot Candy: The beetroot candy is a healthy substitute of the artificial flavoured candy available in the local market (Fatma *et al.*, 2016).

Beetroot Powders: Dehydrated beetroot powders retain most of the vegetable's nutrients and offer versatility. They can be used in smoothies, soups, or as natural food colorants. The powder form also enhances shelf life and convenience.

The suitability of beetroot powder as a potential source of dietary fibre for baked rolls was investigated in this study. Beetroot powder was characterised by high total dietary fibre (65.71 %) and showed good hydration properties. The influence of beetroot powder addition (substitution levels 2–10 %) on the farinographic properties of wheat dough, physical characteristics and sensory attributes of baked rolls was also studied. It was found that increasing level of beetroot powder in dough increased water absorption, delayed dough development time, and prolonged dough stability, while mixing tolerance index decreased. Physical properties of baked rolls (volume and specific volume) were significantly reduced with the increasing level of beetroot powder in products. Increased beetroot powder addition also reduced lightness, while redness of products increased. Results also indicated that baked rolls containing 2 mass % of beetroot powder were the most acceptable for assessors, higher levels of powder adversely affected sensory attributes and overall acceptance of products (unpleasant earth-like odour and taste) (Zlatica Kohajdová *et al.*, 2018).

Beetroot-Infused Baked Goods: Incorporating beetroot into breads, muffins and cakes adds a nutritional boost and a unique flavour. Beetroot's natural sweetness allows for reduced sugar content in these products, making them healthier alternatives to conventional baked goods.

Beetroot Cookies: The study improves the nutritional qualities of cookies with incorporation of different levels of beetroot powder (0, 5, 7, 10, 15 and 20 %) and examined for its physical and chemical composition. The proximate composition of cookies enriched with beetroot powder from 5 to 20 % indicated that protein from 7.39 to 9.12 %, crude fibre from 0.95 to 1.90 % and ash content from 0.93 to 1.89 % was increased. The incorporation of beetroot powder in cookies lowered the lightness (L*) and yellowness (b*) but increased redness (a*) of cookies. The hardness of the cookies was increased with increasing the level of beetroot powder. Sensory evaluation of cookies concluded that the cookies prepared with addition of 10% beetroot powder were more acceptable as compared to others (Ingle *et al.*, 2014).

Beetroot Hummus: Combining beetroot with chickpeas creates a nutrient-rich dip high in protein, fibre, and antioxidants. The vibrant colour and earthy-sweet taste of beetroot hummus make it an appealing and healthy addition to any diet.

Beetroot in dairy industry: The study develops yoghurt incorporated with beetroot puree and its effect on the physicochemical properties (pH, titratable acidity, colour, and viscosity) and consumer acceptance were optimized based on the resulting using response surface methods (Mercia, 2024).



Fig. 2: Beetroot Products

Health Benefits of Beetroot and its Products

The nutritional properties of beetroot translate into numerous health benefits:

Cardiovascular Health: Nitrates in beetroot help lower blood pressure and improve blood flow, reducing the risk of heart disease.

Anti-Inflammatory and Antioxidant Effects: Betalains and other antioxidants combat oxidative stress and inflammation, protecting against chronic diseases.

Improved Digestion: High fibre content supports a healthy digestive system and prevents constipation.

Enhanced Athletic Performance: Beetroot juice has been shown to improve endurance and performance in athletes by increasing oxygen uptake and reducing fatigue.

Market Potential of Beetroot Products

The global market for beetroot products is expanding, driven by the growing interest in health and wellness. Consumers are increasingly seeking out natural, nutrient-rich foods, creating opportunities for innovative beetroot-based products. The key trend includes clean label products, functional foods and sustainability. Consumers prefer products with

simple, recognizable ingredients and minimal processing. Products that offer additional health benefits beyond basic nutrition are in high demand. Beetroot is a relatively low-impact crop, aligning with consumer preferences for environmentally friendly products.

Conclusions

Beetroot is exceptionally healthy, boasting a range of benefits that make it ideal for value-added products. Packed with nutrients like fibre, vitamins, and minerals, it supports digestive health and boosts immunity. Its rich colour indicates high antioxidant content, offering protection against oxidative stress and inflammation. Incorporating beetroot into value-added products enhances their nutritional profile, making them more appealing and beneficial for consumers. Whether in juices, snacks, or condiments, beetroot's versatility allows for creative and nutritious additions to a variety of products, catering to health-conscious consumers seeking functional foods.

Incorporating beetroot into various food products not only enhances their nutritional value but also introduces consumers to new and exciting ways to enjoy this versatile vegetable. The future looks bright for beetroot and its value-added derivatives, promising both health benefits and market success.

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