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Nutritional composition and value added products of beetroot: A review

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Abstract

Beetroot is taproot portion of beet plant. Dark red-colored beet roots are very popular for human consumption, in the form of cooked and raw as salad or juice. Beetroot colour is also available in the market in the form of powder which may be dried by tray drier or spray drier. Beetroot has wide application in food industry as a natural food colourant and several value added products. In this review paper cultivation of beetroot, its health benefits and several value added food products made from beetroot has been discussed. The green leafy part of the beet root is also of nutritional value, containing beta-carotene and other carotenoids. Beetroot juice and its extract has wide range of application in many beverages, cereal jams, jellies, candies, ice cream, yoghurt, dairy products, sauces and processed meats. Beetroots main benefits are that it contains very few calories with no fat and is a great source of fiber.

Keywords: Carotenoids, beta-carotene, extract, beverages, calories

1. Introduction

Beetroot (*Beta vulgaris* L.) crop belongs to the Chenopodiaceae family having, bright crimson color. It is popular for its medicinal properties and juice value; and known by many common names like beet, chard, sea beet, spinach beet, garden beet, white beet and *Chukander* (in Hindi). Beetroot gives the best value from June to November, and for storing it, the beetroot leaves should be cut 50 mm above the root (Kumar, 2015) [52].

It contains vitamins A, B1, B2, B6 and C. It is also a good source of calcium, magnesium, copper, phosphorus, sodium and iron (Mathlouthi, 2001; Neha *et al.*, 2018) [59, 61]. 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. The bright red color of beet root is due to the red pigments known as betalains (Gokhale and Lele, 2011) [28].

The deep-red roots of beetroot are eaten boiled either as a cooked vegetable, or as a salad after cooking and adding oil and vinegar, or raw and shredded, either alone or combined with any salad vegetable. In commercial production it is largely processed into boiled and sterilized beets or into pickles. Yellow-colored beetroots are grown on a very small scale for home consumption (Grubben *et al.*, 2004; Kumar, 2015) [30, 52].

Beetroot is one of the richest sources of folate (Rauha *et al.*, 2005) [70]. It contains vitamins A, B1, B2, B6 and C. It is also a good source of calcium, magnesium, copper, phosphorus, sodium and iron (Mathlouthi, 2001; Neha *et al.*, 2018) [59, 61]. Results from several studies have demonstrated that betalains from beetroots possess powerful antiradical and antioxidant activity (Kujala *et al.*, 2002) [51]. 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 color is betacyanin; a powerful agent, thought to suppress the development of some types of cancer (Dwivedi *et al.*, 2017) [22].

Beetroot contains several highly bioactive phenolics, such as rutin, epicatechin and caffeic acid which are also known to be excellent antioxidants (Georgiev *et al.*, 2010; Frank *et al.*, 2005; Manach *et al.*, 2005) [27, 26, 56]. Furthermore, nitrite and other NO donors akin to beetroot have been shown to suppress radical formation and directly scavenge potentially damaging reactive oxygen and nitrogen species (RONS) (Lundberg *et al.*, 2011; Wink *et al.*, 2001 and Wink *et al.*, 2011) [55, 83, 82].

There are various varieties of beets such as: Crimson globe, Egyptian early yellow, Sunset, Globe, Blood-red (long) etc. It is several of the cultivated varieties of *Beta vulgaris* grown for their edible tap roots and their greens. Many beet products are made from other *Beta vulgaris* varieties, particularly sugar beet. (Panda. H; Chaudhari and Nikam, 2015) [8]. Beetroot extract is used in beverages, dairy products, cereals jams, jellies, candies, ice cream, yoghurt, sauces and processed meats (Deshmukh *et al.*, 2018) [16].

Table 1: Taxonomical classification of beetroot

| | |
|------------------|----------------|
| Kingdom : | Plantae |
| Subkingdom : | Tracheobionta |
| Super division : | Spermatophyta |
| Division : | Magnoliophyta |
| Class : | Magnoliopsida |
| Subclass : | Caryophyllidae |
| Order : | Caryophyllales |
| Family : | Chenopodiaceae |
| Genus : | Beta |
| Species : | B. vulgaris |

Source: Deshmukh *et al.*, 2018 [16]

2. Beetroot cultivation

The best quality and root color are obtained when the air temperature ranges between 10 and 18°C. Nitrogen fertilizer, abundant rainfall and high temperatures provide rapid development which leads to white rings in the interior of the beetroot. The minimum soil temperature required for beet germination is 5 °C, with an optimum range of 10 to 30 °C, an optimum temperature of 30 °C and a maximum temperature of 35 °C. Beets require a cold period of 2 weeks at 4 to 10 °C or longer to initiate flowers. They can tolerate frosts and mild freezes. Beets prefer deep, friable, well drained, sandy loams to silt loams. High organic matter in the soil is desirable and will help ensure an adequate moisture supply. The beet has a fairly large root system extending downward in the soil 1 m or more unless

restricted (Compendium of Beet Diseases and Insects, 1986; Kumar, 2015) [52].

The plant has a root system composed of a main root and smaller roots reaching up to 60 cm in depth, with lateral branching. It also possesses a tuberous, purplish-red, part, globular in shape, with a sweet taste, which develops almost on the surface of the soil (Ravichandran *et al.*, 2013) [71]. The beetroot plant is biennial, requiring a period of intense cold to go through the reproductive stage of the cycle (Sedyama *et al.*, 2011) [75].

According to Lange *et al.* (Lange *et al.*, 1999) [53], subspecies *Beta vulgaris* ssp. *Vulgaris* cultivars can be subdivided into four other groups: (1) Leaf Beet Group, a cultivar with edible leaves and petioles and with roots with no significantly increased diameter; (2) Sugar Beet Group, a white colored strain grown in the US and Europe for sugar production; (3) Fodder Beet Group, a cultivar intended for feeding herds and (4) Garden Beet Group, the only group cultivated in Brazil that has an edible tuberous part.

3. Nutritional Composition of beetroot

Beetroot (*Beta vulgaris* rubra) is an important raw material of plant origin with proven positive effects on the human body. They can be eaten raw, steamed, boiled and roasted. Red beetroot is a rich source of minerals (manganese, iron, sodium, potassium, magnesium, copper). Beetroot contains a lot of antioxidants, vitamins (A, B, C), fiber and natural dyes. Red beetroot is also rich in phenol compounds, which have antioxidant properties. These colorful root vegetables help to protect against heart disease and certain cancers (colon cancer) (Kavalcova *et al.*, 2015) [47]. Beetroots are rich in other valuable compounds such as carotenoids (Dias *et al.*, 2009) [27], glycine betaine (de Zwart *et al.*, 2003) [15], saponins (Atamanova *et al.*, 2005) [4], betacyanins (Patkai *et al.*, 1997) [64], folates (Jastrebova *et al.*, 2003) [39], betanin, polyphenols and flavonoids (Vali *et al.*, 2007) [79]. Therefore, beetroot ingestion may be considered a factor in cancer prevention (Kapadia *et al.*, 1996; Ingle *et al.*, 2017) [46].

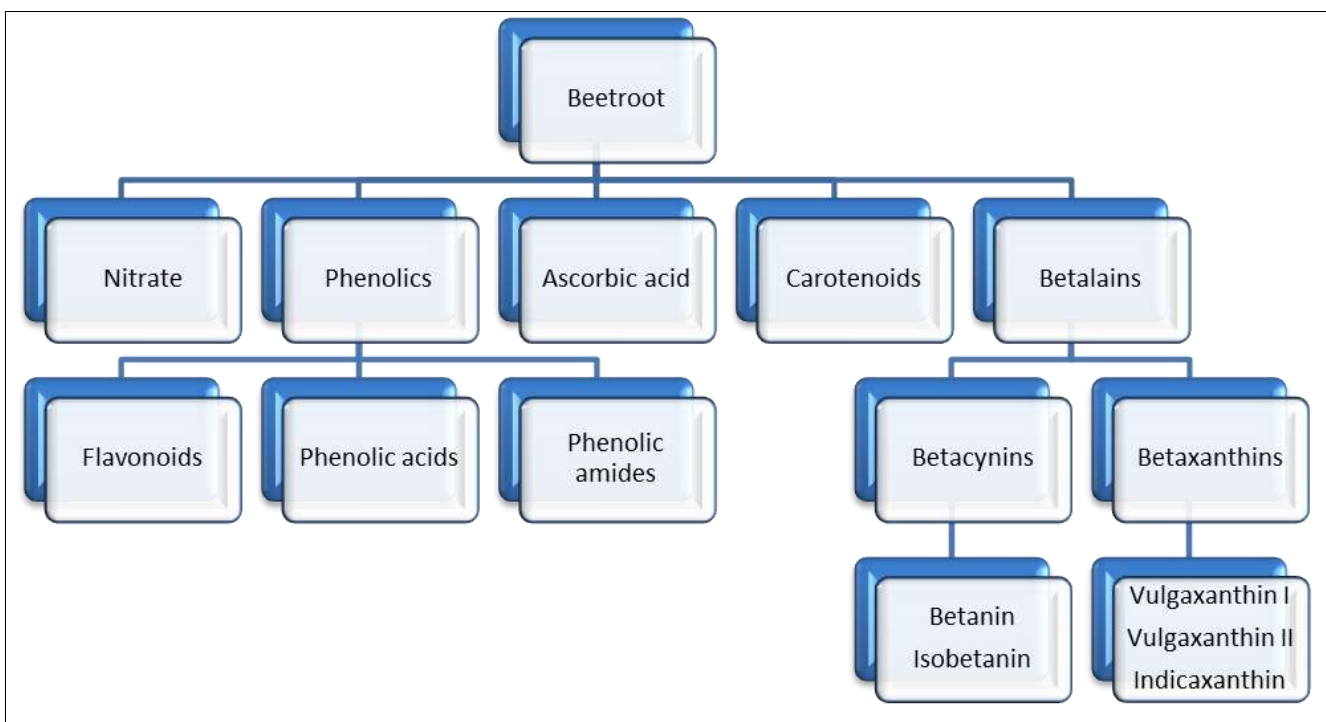


Fig 1: Overview of potentially bioactive compounds in beetroot (source Clifford *et al.*, 2015) [10].

Table 2: Composition of beetroot

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

Source: Deshmukh *et al.*, 2018)^[16]

4. Health benefits of beetroot

Beetroot is gaining popularity as a 'super food' due to its health beneficial value. Some of the major health benefits of beetroot are as follow:

- Lower blood pressure and increased blood flow.
- It is helpful in tumor reduction, decreases the risk of obesity and overall mortality, heart disease, diabetes and promotes healthy hair, increase energy, and overall lower weight.
- Several parts of beet root have numerous medicinal properties such as anti-oxidant, anti-microbial, antihypertensive, hepato-protective, antiinflammatory, antihyperglycaemic, anti-cancer and diuretic. Due to its high fiber content, it prevents constipation and promotes regularity for healthy digestive tract. Beetroot juice improves oxygenation to the brain, slowing the progression of dementia in older adults. (Tulp and Bohlin, 2004; Anonymous, 2015c; Deshmukh *et al.*, 2018)^[2, 78, 16].
- It helps to preserve brain function with nitrates that improve blood flow and beet having the ability to increase the production of Glutathione naturally in body, that compound helps to prevent colon cancer (Anonymous, 2015d)^[3].
- Beet root wine helps the healing of gastric ulcer. It increases the urinary output due to its rich potassium content, and cures hypo-glycaemia. It is also helpful in treatment of jaundice, hepatitis, nausea and vomiting due to biliousness, tuberculosis, piles, cholera, diarrhoea, dysentery and lowered state of body resistant after major surgical operation etc. The cellulose content of the beet acts as a bulk residue, increases peristalsis and eases the passage of stool, hence its regular use prevents habitual constipation and lowers blood pressure in hypertensive persons (Panda. H; Chaudhari and Nikam, 2015)^[8].

5. Utilization of Beetroot in the form of Various Value Added Products

There are large numbers of red beetroot-based dietary supplements and functional food in the market: juice and juice mixtures (predominantly, with lemon juice), gels, fermented and fractionated juice, dried powder (capsules, tablets, micro-capsulated formulations, crunchy beetroot slices) (Wiczkowski *et al.*, 2018)^[81] and beetroot enriched bread (Hobs *et al.*, 2013; Babarykin *et al.*, 2019)^[5].

5.1 Beetroot Beverages

Beetroot (*Beta vulgaris*) juice contains antioxidants along with nitrates with potential health benefits and hence work

as functional ingredients. Beetroot is getting acute attention as its commercial market is targeting sports drinks on the basis of its active ingredients, inorganic nitrate (NO₃). Nitrate mediated physiological effects in humans, such as vascular control, regulation of blood pressure and enhanced vasodilation has been linked to the dietary uptake of nitrate (Lundberg and Weitzberg, 2005)^[24].

Nitrate enrichment by beetroot juice improves exercise tolerance through vascular control and elevated oxygen delivery to skeletal muscles (Ferguson *et al.*, 2013)^[24]. 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 (Deshmukh *et al.*, 2018)^[16].

The beetroot juice is beneficial for the skin and a mixture of little vinegar to beet juice clears dandruff, relieve running sores and ulcers (Wylie *et al.*, 2013)^[85]. Beetroot juice is reported to help in purification of the blood and identified as a great blood builder being rich in iron content, regenerates and reactivates the red blood cells and delivers fresh oxygen to the body (Coles and Clifton, 2012)^[12]. It is utilized to coloring a variety of foods like dairy products, yogurts, processed cheese, and candy. It changes color on thermal treatment so it is used only in ice-cream, sweets, and another confectionary. Beetroot colors has no allergic or other side-effects and also cheap. (Chhikara *et al.*, 2019)^[9]. Panghal *et al.* (2017)^[63] prepared non-dairy probiotic drink using beetroot juice. They examined probiotic potential on the basis of viability of *Lactobacillus rhamnosus*, *Lactobacillus plantarum* and *Lactobacillus delbrueckii sb.* 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. Probiotic drink was found good in antioxidants, total phenols and flavonoids content. The study depicted that beetroot probiotic drink may act as good alternative to serve lactose intolerant and the persons unable to consume probiotic dairy products due to allergic reactions.

Juice Ingredients

Beetroot juice is not only blessed with a beautiful color but also full of nutrients. A detailed view of these nutrients comes out to be like:

- Vitamins:** Beetroots are a good source of folic acid and vitamin C. It also contains small amounts of vitamins B1, B2, B3, and vitamin A in the form of betacarotene.
- Minerals:** Rich in calcium, magnesium, phosphorus, potassium, and sodium. Also, smaller amounts of iron, copper, zinc, manganese, and selenium.
- Amino acids:** While raw beets are mostly water and carbohydrate, they also contain small amounts of all the amino acids (protein).
- Calories:** One 2" (5 cm) beetroot contains 35 calories.
- Antioxidants:** Its carotenoids and flavonoids can help reduce the oxidation of LDL cholesterol which could lead to damaged artery walls and ultimately heart attacks and strokes.
- Anti-carcinogenic color:** The deep red color of beetroot comes from betacyanin. This prevents from colon cancer.
- Silica:** The rich stock of silica in it does perfect utilization of calcium in the body and is also required for healthy skin, hair, nails and bones (Jasmitha *et al.*, 2018)^[38].

5.2 Beetroot Powder

Beetroot in its fresh form has high water content thus it can be processed into powder form in order to enhance its shelf life. There is growing interest in the use of natural food colors, because synthetic dyes are becoming more and more critically assessed by the consumer. But in food processing, as compared with anthocyanins and carotenoids, betalains are less commonly used, although these water-soluble pigments are stable between pH 3 and 7. To improve the red color of tomato pastes, sauces, soups, desserts, jams, jellies, ice creams, sweets and breakfast cereals, fresh beet/beet powder or extracted pigments are used (Koul *et al.*, 2002; Roy *et al.*, 2004; Ibraheem *et al.*, 2016) [50, 35].

Dinçer *et al.*, (2020) [20] used four colorants (control, carmine, beetroot extract and beetroot extract powder) and two methods (fermentation and heat treatment) in the production of sausages. The study revealed that use of beetroot extract and powder significantly prevented further development of lipid oxidation in sausages due to the antioxidant properties of beetroot, with a prevalence of betalains and phenolic compounds. Also the use of beetroot extract and powder positively affected sensory appearance, color, flavor and overall acceptance of the sausages.

Table 3: Proximate analysis of beetroot flour

| Nutrients | Beetroot flour |
|-----------------------|----------------|
| Moisture (g/100g) | 6.30±0.20 |
| Ash (g/100g) | 7.89±0.10 |
| Fat (g/100g) | 1.53±0.15 |
| Crude Fibre (g/100g) | 5.08±0.16 |
| Carbohydrate (g/100g) | 77.74±1.07 |
| Protein (g/100g) | 1.61±0.33 |
| Iron (mg/100g) | 4.14±0.28 |
| Calcium (mg/100g) | 160.32±2.00 |
| Vitamin-C (mg/100g) | 4.20±0.28 |

Source: Dhawan and Sharma, 2019 [17]

5.3 Beetroot Candy

Considering the nutritional as well as medicinal importance of beetroot it should be the part of human diet. Also, concerning its availability throughout the year, beetroot can be processed into beet root candies (Singh and Hathan, 2013) [77]. The beetroot candy is a healthy substitute of the artificial flavoured candy available in the local market (Fatma *et al.*, 2016) [23]. Fatma *et al.*, (2016) [23] demonstrated an experiment in which efforts were made to develop a nutritious, healthier and tasty beetroot candy, using ingredients like pectin, sugar and citric acid in different proportions. The study showed that the beetroot candy prepared using 65% sugar, 3% pectin and 0.5% citric acid was highly acceptable in terms of sensorial characteristics. The results also revealed that as the concentration of sugar was increased beyond 65% lead to crystallization defect in candy and as the level of pectin was increased beyond 3% the texture was found to be hard along with an unsatisfactory aftertaste.

Dobhal and Awasthi (2019) [21] also prepared beetroot candy by giving two types of preliminary treatments to beetroot, viz., steam-blanching (B1) and boiling (B2). Both types of candies were analyzed for differences in chemical composition, sensory attributes and storage stability. Steam-blanching treatment was found to be better than boiling treatment for making beetroot candy. Among ready-to-eat foods, beetroot candy can become popular because of

minimum volume, higher nutritional value, more convenience and relatively longer shelf life.

5.4 Beetroot Jam

Jam is a product of intermediate moisture that is prepared using the pulp of fruits, sugar, pectin, acid, and other ingredients which lead to keep them for a long time. A good jam has a soft even consistency, without pieces of fruits, a bright color, good flavor, and a semi-jelled structure that is easy to spread.

Beetroot is one of the ideal vegetables in preparation of vegetable jam due to its natural deep reddish purple color (Wruss *et al.*, 2015) [84]. Perumpuli *et al.*, (2018) [65] developed beetroot jam either with mild or cooked methods and using different concentration of beetroot pulp as 50, 55, and 60% (w/w). Following the sensory analysis, the jam prepared by the mild method with 60% of raw beetroot pulp and added strawberry flavor (0.5% w/w) was selected as the best. The TSS content of the final product was found to be 46.1%, and the pH was 3.8. The developed jam was stored under refrigerated conditions for a period of six months without addition of any artificial preservative.

Guiné *et al.*, (2015) [31] also prepared a jam on a basis of pear or apple, to which was added the water from boiling beetroot, without the addition of any conservatives. This work allowed concluding that the developed jam produced with the water from boiling beetroot is low in sugars when compared to the average amount in this type of product, hence being indicated for diets low in sugars.

5.5 Beetroot Cookies

Beetroots are low in calories (about 45 Kcal per 100 g) and have zero cholesterol. Ingle *et al.*, (2017) [37] conducted a study to improve the nutritional qualities of cookies with fortification of different levels of beetroot powder and examined for its physical and chemical composition. Nutritional analysis revealed that the increased substitution level of beetroot powder increased the nutritional content (crude protein, crude fiber and minerals) when compared to control cookies. Beetroot powder also provided greater overall acceptability but increased the hardness value of cookies.

Shyamala and Jamuna (2010) [76] reported that beetroot pomace is a good source of dietary fibre, specially the soluble fibre and could be utilized as a source of supplement. Sahni and Shere (2016) [74] prepared fibre rich cookies by substituting refined wheat flour with beetroot pomace powder. This study also showed the similar results like the moisture, crude fibre, protein and ash increased but carbohydrates decreased with the increase in level of incorporation of beetroot pomace powder. The fat content of the cookies showed no noticeable variation. Thus beetroot pomace is an underutilized by-product which is rich source of dietary fibre and can be utilized for developing fibre rich bakery products as is a product of intermediate moisture that is prepared using the pulp of fruits, sugar, pectin, acid, and other ingredients which lead to keep them for a long time. A good jam has a soft even consistency, without pieces of fruits, a bright color, good flavor, and a semi-jelled structure that is easy to spread. Jam is a product of intermediate moisture that is prepared using the pulp of fruits, sugar, pectin, acid, and other ingredients which lead to keep them for a long time. A good jam has a soft even

consistency, without pieces of fruits, a bright color, good flavor, and a semi-jelled structure that is easy to spread.

5.6 Utilisation of beetroot in dairy and food products

Table 3: Utilisation of beetroot in dairy and food products

| Author | Product | Description |
|---|--|--|
| Bandyopadhyay <i>et al.</i> , 2007 [6] | Carrot fortified milk | Studied the effect of beet root extract along with honey on quality attributes (acidity, pH, free fatty acid level and sensory) and carotene retention of carrot fortified milk product during storage at 30 °C. |
| Junqueira-Goncalves <i>et al.</i> , 2011 [42] | Cheese | Developed the Brazilian ham-flavored cream cheese using gamma-irradiated beetroot extract as the colorant. |
| Prudencio <i>et al.</i> , 2008 [89] | Cheese | Studied the effect of Beetroot betalains incorporated Petit suisse cheese stored at 6±1 °C for 40 days in light impermeable packaging on pigment stability by determining half-life time and percentage color retention. |
| Kavitkar <i>et al.</i> , 2017 [48-49] | Lassi | Utilized of beetroot extract as coloring agent in Lassi. |
| Kavitkar <i>et al.</i> , 2017 [48-49] | Flavoured Milk | Studied the effect of beetroot extract on color and sensory quality of flavored milk. |
| Manoharan <i>et al.</i> , 2012 [58] | Strawberry flavored ice cream | Utilized the beetroot juice as a natural coloring agent for ice cream and assess the sensory scored of the resultant product |
| Khade, 2015 | RTS beverage | Studied on preparation and storage of ready to serve beverage from beetroot (<i>Beta vulgaris</i> L.) juice |
| Rachitha, 2016 [67] | Beverage | Formulate beverages by incorporating beetroot juice concentrate. |
| Jayalalitha <i>et al.</i> , | Dairy Based Bio beverage | 2012 A dairy based biobeverage containing higher vitamin A and iron content was prepared with beetroot (<i>Beta vulgaris</i>) juice, carrot juice and dates extract. |
| Yoon <i>et al.</i> , 2005 [88] | Probiotic beet juice | Produced probiotic beet juice by <i>L. acidophilus</i> and other beneficial lactic acid bacteria |
| Flavera <i>et al.</i> , 2007 [25] | Proviva | Developed a probiotic food called Proviva using fermented oat meal gruel, lactic cultures and beetroot juice. |
| Damunupola <i>et al.</i> , 2014 [14] | Yoghurt | Studied on evaluation of quality characteristics of goat milk yogurt incorporated with beetroot juice. |
| Kamate and Padghan, 2018 [44] | Whey beverage | Utilized the beetroot extract for production of beetroot whey beverage by using 20 per cent beetroot extract in 80 per cent paneer whey on weight basis. |
| Vanajakshi <i>et al.</i> , 2015 [80] | A probiotic beverage | Developed probiotic beverage made with one part of moringa leaves paste and two parts of beetroot juice fermented with <i>Lactobacillus plantarum</i> and <i>Enterococcus hirae</i> . |
| Martinez <i>et al.</i> , 2015 [58] | Beetroot orange juice powder | Developed beetroot orange juice powder by spray drying and studied its functional properties, color and betalain content. |
| Kakade <i>et al.</i> , 2015 [43] | Cereals based extruded product | Optimized the process of cereals based extruded product by utilization of beetroot leaves powder using RSM |
| Chaudhari and Nikam, 2015 [8] | Beetroot jelly | Standardized the process for manufacturing of beetroot jelly using 2 per cent pectin, 0.5 per cent citric acid and 61 per cent sugar. |
| Reddy <i>et al.</i> , 2014 [72] | RTE Snacks | Developed the extruded ready to eat snacks using corn, black gram, beetroots and tuber flour blends in a proportion of 60-80: 20:20 respectively and moisture was adjusted to 17-20 per cent. |
| Pinki and Awasthi, 2014 [66] | Cakes | Developed the value added cakes by incorporating beetroot powder and studied its Sensory and nutritional Value. |
| Durge <i>et al.</i> , 2014 | Ice-cream | Utilized the prepared beetroot powder in ice-cream and evaluated its different properties |
| Rachitha, 2016 [67] | Shrikhand, coconut biscuit, instant soup mix and besan burfi | Developed the lime beet juice, amla beet juice, shrikhand, coconut biscuit, instant soup mix and besan burfi using spary dried beetroot powder and vacuum concentrated beetroot juice concentrate. |

Source: Deshmukh *et al.*, 2018 [16]

5.7 Beetroot Bread

Bread is a staple and economical food that is consumed by the majority of adults in western countries. In addition, bread provides an ideal matrix by which functionality can be delivered to the consumer in an accepted food. Bread products have been enriched with various functional components such as omega-3 fatty acids (Yep *et al.*, 2002) [87], soluble fibres (Morris & Morris, 2012) [60], folate (Hertrampf *et al.*, 2003) [32] and plant sterol esters (Clifton *et al.*, 2004) [11].

Ranawana *et al.*, (2016) [69] investigated the effects of fortifying bread (containing oil as an ingredient) with freeze-dried vegetables on its nutritional and physico-chemical attributes. Breads fortified with carrot, tomato, beetroot or broccoli were assessed for nutrition, antioxidant

potential, storage life, shelf stability, textural changes and macronutrient oxidation. As expected, adding vegetables improved the nutritional and antioxidant properties of bread. Beetroot and broccoli significantly improved bread storage life. Beetroot consistently showed positive effects suggesting its addition to bread could be particularly beneficial.

Ranawana *et al.*, (2016) [69] investigated the effect of adding vegetables on the nutritional, physico-chemical, and oxidative properties of wheat bread, and specifically focused on bread that does not contain oil as an added ingredient. Wheat flour breads fortified with freeze-dried beetroot, carrot, tomato, or broccoli were developed and assessed for their nutritional composition, antioxidant potential, oxidative stability, and storage properties. Adding

vegetables improved the nutritional and functional attributes of the oil-free breads. Of the evaluated vegetables, beetroot showed the most promising nutritional and physico-chemical benefits when incorporated into bread that does not contain added oil.

6. Conclusion

Beetroot is a superfood used as therapeutic and functional food ingredients from ancient times. This review paper concludes the all scope of beetroot and their utilization as value added products. It has various applications as a food colouring ingredient in many dairy and food products. It has number of medicinal properties such as antioxidant, anti-microbial, anti-hypertensive, anti-inflammatory, antihyperglycaemic, hepato-protective, anti-cancer etc. It is a multipurpose crop having numerous health benefits providing scientists a new door to develop various value added products.

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