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A review on bioactive compounds presents in garden beet and beetroot powder and their potential prebiotic properties

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Abstract

The garden beetroot, or *Beta vulgaris* as it is called in science, is a biennial plant that is a member of the *Amaranthaceae* family's subfamily Betoideae. It is one of the several cultivated varieties of *Beta vulgaris* grown for their edible taproots and leaves. It has been used as a food source for thousands of years. It contains a wide range of bioactive compounds, such as phenolic acid, pectic-oligosaccharides, saponins, alkaloids, steroids, triterpenes, catechins, flavonoids, and flavonols. Beetroot powder is the main source of prebiotic, because of the presence of pectin oligo-saccharide. Beet root powder is used in bakery industry because of its prebiotic activities. In this review article, we will discuss about potential probiotic properties of beetroot plant and powder.

Keywords: Bioactive compounds, probiotic activity, antioxidant activity, flavonoids, catechins

1. Introduction

The garden beet, scientifically known as, *Beta vulgaris*, belongs to the subfamily Betoideae of family *Amaranthaceae*, is a biennial plant (Szwajgier *et al.*, 2022) [15]. It is one of the several cultivated varieties of *Beta vulgaris* grown for their edible taproots and leaves. Garden beet is one of the root vegetables; hence alternatively known as beet root. Several beneficial characteristics of ground beet makes it one of the research interests. The medicinal properties, analgesic, hepatoprotective, antioxidant, antimicrobial, anti-inflammatory, antimigraine, antihypertension, antiviral, antihyperglycemic, anti-progestogenic, antiallergic, antithrombotic, anti-tumorigenic and many more attract researcher's interest (Masih *et al.*, 2019) [10]. A diverse range of bioactive compounds in ground beet are responsible for aforementioned medicinal properties. Betalains, Phenolic Acid, Pectic-oligosaccharides, Saponins, Alkaloids, Steroids, Alkaloids, Steroids, Triterpenes, Catechins, Flavonoids are some of these bioactive compounds found in ground beet plants. Not only is the bioactive compounds, garden beet also an abundant source of several nutrients, e.g- dietary fibre, minerals, vitamin B complex (Pandita *et al.*, 2020) [12].

2. Bioactive Compound of Garden beet and potential health benefits

2.1 Betalains

A group of reddish pigments, termed as betalains, which is one of the important and major component of *Beta vulgaris*. This pigment can also be present in other fruits and vegetables, where betalains are substituted by red anthocyanin pigment (Fu *et al.*, 2020) [6]. This is one of the important bioactive molecules. Researchers revealed the beneficial effects of betalains; can be listed as, oxidative stress relieving properties found in betalains, as well as nitrative stress relieving property, also it shows the preventive characteristics of DNA, decreases the level of blood low density lipid. Several studies have shown the autophagy and cell apoptosis prevention capability of betalains, also betalains shows their inhibitory nature from cell proliferation (Hadipour *et al.*, 2020) [7].

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2.2 Phenolic Acid

Beetroot is capable in production of an adequate amount of phenolic acid under HPLC analysis. The phenolic compounds and phenolic acids, present in beetroot shows a huge number of healthful benefits. Phenolic compounds are popular anti-oxidant, known for their anti-oxidative properties (Chhikara *et al.*, 2019)^[2]. They have impact over human for their anti-aging quality. Phenolic compounds have important contribution in defence response, by boosting the immune system. Studies found the inhibitory characteristics of phenolic acid from cell proliferation, also the anti-inflammatory characteristics are being possessed by phenolic compounds. These aforesaid properties of phenolic compounds decrease chances of cardiovascular diseases, diabetes, insulin resistance and many more along with proliferative diseases like osteoarthritis, degenerative diseases like osteoporosis (Milton-Laskibar *et al.*, 2021)^[11].

2.3 Flavonoids

The important group of bioactive compounds, found in beetroot is Flavonoids. Those are composed of benzopyrone ring, which houses phenolic groups in various alternative sites (Chen *et al.*, 2021)^[1]. Flavonoids show positive changes in various chronic diseases, concluded by food researchers. Anti-carcinogenic properties of flavonoids have been found, in one of the subgroups- Hesperidin (Hsp). Quercetin, is another group of flavonoids, have proven to be effective in reversal and cure of colorectal cancer. Flavonoids has inhibitory role over some neurodegenerative changes, like Alzheimer's, dementia, Parkinson's diseases (Stanisic *et al.*, 2020)^[14]. From physiological point of view the developments of new blood vessels mechanism, which is termed as Angiogenesis, leads to several chronic diseases if they are not under proper regulatory control of metabolism. Angiogenesis may be a curse of metabolism because of their long run effects and development of the inflammatory malfunctions like multiple sclerosis, asthma, endometrioses and cirrhosis. Through many signalling paths; flavonoids have shown their regulatory properties in controlling blood vessel developments (Khater *et al.*, 2020)^[9].

2.4 Pectic-oligosaccharides

Pecto-oligosaccharide has been found in *Beta vulgaris* and also extracted by researchers via micro-wave assisted extraction procedure. Pecto-oligosaccharide, is one of the potential prebiotics, which shows the effective result in colonization of LAB microbes in human small intestine. Pectic-oligosaccharide is one of the major components presents in beet root, consumption and recommendation is being beneficial for a varied number of chronic diseases (De Oliveira *et al.*, 2021)^[4]. The diseases like Lactose intolerances, coeliac disorders, Irritable bowel disorders have shown marked improvement by improving the beneficial microbial colonization in human small intestine (Wilkowska *et al.*, 2019)^[16].

2.5 Saponins and Alkaloids

Other bioactive compounds present in beetroot are saponin and alkaloids. Researchers have proven that saponins contribute in lowering of insulin resistance of human pancreas, risk of cancer incidence, also improves cardiovascular health by suppressing the triglyceride level in blood stream. Dental caries inhibitory activities of saponin, also been revealed in studies (Spórna-Kucab *et al.*, 2022)^[13].

Alkaloids, found in beetroot, are categorised as one of the classes of conventionally growing organic molecule which houses one nitrogen atom. A varied range of positive physiological changes have been observed by researchers in alkaloid consumption. The reason also has been found that alkaloid contributes to antitumor activities, anti-inflammatory

activities, antibacterial properties, anesthetic characteristics, antimutagenic natures (Huang *et al.*, 2022)^[8].

3. Beet Root Powder

Beet root powder is one of the natural food pigments, commonly used in food products development. Many food scientists and researchers have taken interest in production of beetroot powder from harvested ground beets, and application in bakery industries (Deshmukh and Deshmukh, 2021)^[5]. Commonly dairy items are high in sugar contents, and deficit of antioxidants, essential minerals, vitamin; hence beetroot powder is one of the favourable choices in bakery, because of the prebiotic activities of beet root powder. Several methods for producing beet root powder from *Beta vulgaris* has been done in trial; dehydration of red beet root (*Beta vulgaris*), using hot air drying (Dasore *et al.*, 2020)^[3].

In this process, the beet root samples are being treated by hot running water for aseptis. Once the washing is done the subjected vegetables being are peeled off; and have to cut into several uniform slices. The slices are being spread over uniformly in trays. The thickness of the sliced pieces should be kept uniform manner for homogenous hot air drying. Betalain pigment should be taken care of, in this whole procedure; to keep the coloration intact. The uniformly kept slices are blown under dry air; inside preheated dryer cabinet; one hour drying is needed. Post procedure the weight must be taken in laboratory weighing scale to determine the moisture loss. After optimum moisture loss, the texture of the beet samples turns into crunchier form. Moisture alteration, makes the beet root samples dried and fit for grinding. Hunter lab colour parameters, have to be used in every step of beet root sample drying procedure. Finally, the moisture lost beet root samples taken into grinding for getting the powdery texture of the dried beet root sample (Dasore *et al.*, 2020)^[3].

3.1 Prebiotic Properties of Beet Root Powder

Processed beetroot powder is a novel source of prebiotic, because of the presence of pectin-oligosaccharide. This is one of the major components, which is non-volatile and present after processing of beetroot powder. Pectic oligosaccharide, which is a undigestible oligosaccharide, shows profound prebiotic characteristics. POS contributes their positive capability of enhancing colonization or growth of LAB & bifidobacteria in human host. This is one of the major nutritional sources of LAB in human colon and guts. This results into improvement of microbiota inside human small intestine (Wongkaew *et al.*, 2022)^[17].

4. Conclusion

One of the nutritionally enriched vegetables from vegetable kingdom is *Beta vulgaris* because of the presence of diversified bioactive compounds, vitamins, phenols, carotenoids, nitrate, betalains. This review literature is focused on the potential health benefits studied extensively. Also, the prebiotic activities which found in processed beetroot powder has been elaborated. The bakery industry, beverage industries will be benefited with the establishment of the fact that beetroot powder is the novel source of prebiotics. Extensive research of prebiotic characteristics is to be required for future studies.

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6. Conflict of interest disclosure: Authors declare no conflict of interest.

7. Authors' contributions

Conceptualization: Souvik Tewari; Writing - original draft preparation: Paromita Mukherjee and Talknice Zvamaziva Jombo.

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