

A REVIEW ON *BETA VULGARIS* (BEET ROOT)

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ABSTRACT

Beta vulgaris is commonly known as Beetroot. It is the taproot portion of the beet plant. There are varieties of Beetroot which are cultivated in Egypt, India, Europe and Ukraine. It is used in Indian traditional system of medicine, specifically used to enhance the activity of sex hormones. It ranks among the ten most potent vegetables with respect to antioxidant property. It makes an excellent dietary supplement being not only rich in minerals, nutrients and vitamins but also has unique phytoconstituents, which have several medicinal properties. Several parts of this plant are used in medicinal system such as anti-oxidant, anti-depressant, anti-microbial, anti-fungal, anti-inflammatory, diuretic, expectorant and carminative. This article briefly reviews the introduction history, cultivation and pharmacological activities of beetroot. This is an attempt to compile and document information on different aspects of *Beta vulgaris* and highlight the need for research and development.

Keywords: Beetroot, *Beta vulgaris*, Anti hypertensive, Antioxidant, Anti cancer, Super food.

INTRODUCTION

Chenopodiaceae family includes approximately 1400 species divided into 105 genera. Members of this family are dicotyledonous. Beet root, scientifically known as *Beta vulgaris* is one of the well known plants belonging to this family. It is an erect annual herb with tuberous root stocks. There are basically four varieties of Beetroot namely known as Detroit dark red, Crimson Globe are commonly grown in India and another two varieties are Crosby Egyptian. It has numerous cultivated varieties, the most well known of which is the root vegetable known as the beetroot or garden beet. Other cultivated varieties include the leaf vegetable chard; the sugar beet, used to produce table sugar; and mangelwurzel, which is a fodder crop. Three subspecies are typically recognised. All cultivated varieties fall into the subspecies *Beta vulgaris* subsp. *vulgaris*. *Beta vulgaris* subsp. *maritima*, commonly known as the sea beet, is the wild ancestor of these and is found throughout the Mediterranean, the Atlantic coast of Europe, the Near East, and India. It is used in Indian traditional system of medicine, specifically used to enhance the activity of sex hormones. It ranks among the ten most potent vegetables with respect to antioxidant property. It makes an excellent dietary supplement being not only rich in minerals, nutrients and vitamins but also has

unique phytoconstituents, which have several medicinal properties. Several parts of this plant are used in medicinal system such as anti-oxidant, anti-depressant, anti-microbial, anti-fungal, anti-inflammatory, diuretic, expectorant and carminative. It is one of the natural food which boosts the energy in athletes as it has one of the highest nitrates and sugar contents plant. Beet root contains Betaine (Betacyanin pigment responsible for its red colour) is used as natural food colour in dairy and meat products. It can be taken as salad during pregnancy because it is helpful in the growth of foetus. Mettupalyam vegetables commission Mandy in Tamil Nadu (India) is the major market for Beetroot. Thus, Beetroot has attracted much attention as a health promoting functional food.^{1,2}

HISTORICAL BACKGROUND

Beets are native to the Mediterranean. Although the leaves have been eaten since before written history, the beetroot was generally used medicinally and did not become a popular food until French recognized their potential in the 1800's. Beet powder is used as a coloring agent for many foods. Some frozen pizzas use beet powder to color the tomato sauce. The most common garden beet is a deep ruby red in color, but yellow, white, and even candy striped are available in specialty markets. Outside the

United States, beets are generally referred to as beetroot. It is estimated that about two-thirds of commercial beet crops end up canned. They state the earliest written mention of the beet comes from 8th century Mesopotamia. The Greek Peripatetic Theophrastus later describes the beet as similar to the radish, while Aristotle also mentions the plant. Zohary and Hopf also argue that it is very probable that beetroot cultivars were also grown at the time, and some Roman recipes support this. Later English and German sources show that beetroots were commonly cultivated in Medieval Europe.³

ORIGIN OF BEETROOT

The ancient Babylonians were the first to use it for various applications. Early Greeks and Romans used the root for its medicinal properties and the leaves as vegetables. Moving ahead with the time, beetroot held an important place in medicine. In England, beetroot juice or broth was recommended as an easily digested food for the aged, weak, or infirm. Even in mythology, Aphrodite is said to have eaten beets to retain her beauty. In folk magic, if a woman and man eat from the same beet, they will fall in love. In Africa, beets are used as an antidote to cyanide poisoning.³



CULTIVATION⁴

Cultivars: The choice of cultivar is influenced by days to maturity, root size and shape, foliage size, exterior surface smoothness, interior colour and degree of zoning. The hybrid (F1) cultivars available for summer production offer many advantages. Although these beets are expensive, they are worth growing because they are better quality, more adaptable to extreme high temperatures and so are more uniform in shape, produce greater yields and have better internal colour. Hybrids also taste better, especially out of season.

Climatic requirements

Temperature: Beetroot is a cool-weather crop that is hardy and tolerates some freezing. It grows best in spring and autumn, but does well in summer on the Highveld and in winter in the Low veld. Excessively hot weather causes the appearance of alternating light and dark red concentric circles in the root known as zoning. On the other hand, very cold weather results in slow or no growth of the plant. Prolonged periods of low temperatures during winter can induce bolting. Beetroot seeds germinate at soil temperatures from 4,5 to 30 °C, with the optimum being 18 to 24 °C.

Rainfall: Beetroot needs a lot of water for fast growth. The volume needed could vary Beetroot needs a lot of water for fast growth. The volume needed could vary Beetroot needs a lot of water for fast growth The volume needed could vary from 2 mm on a cold winter day to 8 mm on a hot summer day.

Soil requirements: Beetroot does best on deep and well-drained, loose, loamy to sandy soils. Heavy clay soils or soils which crust after rain or irrigation may cause establishment problems and the production of misshapen roots. Beetroot prefers a soil pH of 5.8 to 7.0, but can tolerate a pH of up to 7,6. Acid soils are likely to create nutrient deficiency problems and should be avoided or limed to raise the pH. Mature beets are fairly tolerant to salinity, whereas seedlings are relatively sensitive.

1. Propagation: Beetroot is propagated by seed.

2. Soil preparation: The seedbed should be well prepared by ploughing 15 to 20 cm deep to break up clods. The soil should also be as level as possible, have a good crumb structure and enough moisture, and be free of unrotted plant material.

3. Planting: The seedbed should be well prepared by ploughing 15 to 20 cm deep to break up clods. The soil should also be as level as possible, have a good crumb structure and enough moisture, and be free of unrotted plant material. The sowing times differ with production areas. In winter rainfall areas, seed may be sown from August to end of March and from end of August to middle of March in areas with cool summer. However, seed is sown from March to August in the Low veld regions of the

Mpumalanga and KwaZulu-Natal. Sowing in the Transvaal Middle veld takes place from August to middle of April.

4. Fertilization: A continuous supply of nitrogen, phosphate and potassium is essential throughout the season to obtain high yields and good quality. Nitrogen fertilizing is important and 300 to 400 kg/ha of limestone, ammonium nitrate or ammonium sulphate, depending on soil analyses, are applied in 2 or 3 dressings during the growing season. About 150 kg/ha of nitrogen is usually applied at planting time and the rest when the plants are about 10 to 15 cm high. A total of 500 to 600 kg/ha of superphosphate and 200 to 300 kg/ha of potassium chloride are applied just before sowing. Alternatively, a fertilizer mixture of 2:3:2 at 1000 to 1200 kg/ha may be applied. It should be noted that these are general recommendations and actual amounts of fertilizers should be based on soil analyses. Soils heavily fertilized with coarse compost and kraal manure encourage the formation of side roots, making the crop unattractive.

5. Irrigation: The soil should never be allowed to become dry and it should be kept moist to a depth of 20 to 25 cm. The plantings should receive light water applications daily until the young seedlings come up. About 30 mm of water should be supplied per irrigation. Large fluctuations in soil moisture content will result in poor quality roots that are malformed and have many small hairs or side roots.

6. Weed control: Weeds must be controlled before they can compete with beet seedlings and interfere with their growth. All weeds between the rows must be removed by hand to avoid damaging the roots. Weed control can also be achieved chemically by applying herbicides and instructions on the container should be thoroughly followed.

7. Pest control: Use registered chemicals. Crop rotation can also assist.

8. Disease control

a. Cercospora leaf spot (*Cercospora beticola*): This is a common disease in beetroots caused by a fungus which enters the leaves and causes small round spots of about 3 mm in diameter. These spots are also found on the flowers and seed on plants grown for seed production. The spots are at first brown with a dark purple border

and later turn grey in the center. The tissue in the centre falls as the spots age.

CONTROL

- Crop rotation
- Seed treatment with registered chemicals
- Avoiding over watering

b. Downy mildew (*Peronospora schachtii*): The disease is seed-borne and it can affect the crop early in the season. Leaves of infected plants partly or completely turn yellow and curl downwards. The diseased patches later turn brown. A grey fungal growth can be seen on the underside of the leaves. Flowers and the crown can also be infected.

c. Brown rust (*Uromyces betae*) Infected plants are recognised by large numbers of orange or red-brown pustules on the leaves.

CONTROL

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e. (*Actinomyces scabies*) The beetroots infected with scab develop rough, irregular, surface scabs. The disease is prevalent in soils containing too much lime.

CONTROL

- Soil analysis to determine level of lime and get advice on that.

f. Root rot, damping-off (*Phoma betae*): The disease is common on compact soil. Germination of infected plants is weak. Young seedlings grow poorly, turn yellow, wilt, topple over and die and the roots turn black. Seedlings that are not severely affected produce small, malformed beetroots.

CONTROL

- Seed should only be sown in soils with a good structure.
- Seed should be treated with thiram.
- Practice crop rotation.
- The crop should not lack sufficient boron.
- Planting should be at the right time and not too deep.

g. Heart rot this is caused by boron deficiency. Heart rot is characterised by black marks on the

root surface and cracks. Black blotches are visible in the flesh if the beetroot is cut open.

CONTROL

It is advisable to plant resistant cultivars.

9. Harvesting

9.1 Harvest maturity Beetroot is usually harvested when the roots reach 3 to 5 cm in diameter, but most roots are lifted when they are 5 to 7.5 cm in diameter.

9.2 Harvesting methods The crop is lifted by hand or mechanically when grown on a large scale, by using a machine which lifts the crop from the soil and cuts off the leaves. For the crop which is to be marketed fresh, the leaves are not removed. Care should be taken in pulling roots from the soil and in their handling so that damage from bruising can be minimised.

Post-harvest handling: Roots may be washed immediately if necessary.

1. Sorting and grading: All diseased roots and those showing mechanical injury are removed during sorting. Old, dead or damaged leaves should be removed if the crop is to be marketed with tops. Beetroot is graded according to size.
2. Packing: After washing, the crop is packed in crates or cartons and kept in a cool and dry environment. Beetroot is sometimes packed in pockets.
3. Storage: The environment must be dry to avoid fungal attack, and the temperature must be kept at 0 °C and the relative humidity at 90 %.
4. Transport: Beetroots should be transported in a well ventilated vehicle and at cool temperatures to avoid fungal infestation. The temperatures should never go below 0 °C because the crop will experience cold-wilting.
5. Marketing

JUICE INGREDIENTS

Beetroot juice is not only blessed with a beautiful color but also packed with nutrients. A detailed view of this parcel 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 beta-carotene.
- Minerals: Rich in calcium, magnesium, phosphorus, potassium, and sodium.

Also, smaller amounts of iron, zinc, copper, 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 flavanoids 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.

PHARMACOLOGICAL ACTIVITIES

Anti-inflammatory effect: The protective effect of (*Beta vulgaris* L.) beet root ethanolic extract (BVEE) on gentamicin-induced nephrotoxicity and to elucidate the potential mechanism was investigated. BVEE treatment significantly reduced the amount of cleaved caspase 3 and Bax, protein expression and increased the Bcl-2 protein expression. BVEE treatment also ameliorated the extent of histologic injury and reduced inflammatory infiltration in renal tubules. These findings suggest that BVEE treatment attenuates renal dysfunction and structural damage through the reduction of oxidative stress, inflammation, and apoptosis in the kidney.⁵

Antioxidant Properties: The effects of home-processing on the antioxidant properties and in vitro bioaccessibility of red beetroot bioactives were investigated. The in vitro digestion method revealed the highest recovery for TP [16%] and TAC [1.3%] in jam. This study provides comparative data to evaluate the effects of various home-processing techniques on antioxidant potential of red beetroot products.⁶

Anti-stress effect, Anti-Anxiety and anti-Depressive effect : The protective effect of *Beta vulgaris* Linn. Ethanolic extract [BVEE] of leaves against acute restraint stress [ARS] induced anxiety- and depressive-like behavior and oxidative stress in mice was investigated. BVEE exhibits anxiolytic and antidepressant activity in stressed mice along with good antioxidant

property suggesting its therapeutic potential in the treatment of stress-related psychiatric disorders. ARS-induced oxidative stress was prevented by BVEE pretreatment in mice.⁷

Anti-cancer: Table beet affects numerous biochemical reactions, enzymes and metabolic-synthesis. According to results, it seems that moderate and permanent consumption of table beet product affects the life expectancy of patients favorably; however, due to the increasing values of EGF, medical control is necessary for patients with prostate cancer treated by chemotherapy.⁸

Antihypertensive effect: *Beta vulgaris* cicla and *Beta vulgaris* rubra shows that BVC extracts possess antihypertensive and hypoglycaemic activity as well as excellent antioxidant activity. BVC contains apigenin flavonoids, namely vitexin, vitexin-2-O-rhamnoside and vitexin-2-O-xyloside, which show antiproliferative activity on cancer cell lines. BVR contains secondary metabolites, called betalains, which are used as natural dyes in food industry and show anticancer activity. In this light, BVC and BVR can be considered functional foods.⁹

Anti-sterility: The interaction of bvORF20, a non-PPR Rf from sugar beet [*Beta vulgaris*], with preSAtp6, the S-orf from sugar beet was investigated. The result illustrated that Post-translational interaction between preSAtP6 and bvORF20 appears to alter the higher order structure of preSAtP6 that may lead to fertility restoration in sugar beet.¹⁰

CONCLUSION

This review paper concludes the all scope of beetroot and their utilization. It emphasis the medicinal, nutritional importance of the beetroot for the consumption of human being. Beetroot have been reported to have therapeutic potential in traditional medicine for the treatment of various diseases. These include antioxidant, anti-inflammatory, antimicrobial, and other activities. This review described many pharmacological activities of *Beta vulgaris* which will give a new direction for the establishment of novel compounds which would be beneficial for scientific research. *Beta vulgaris* is an important drug of indigenous system of medicine and has been known for a number of medicinal

properties in Ayurveda but still its pharmacological potential has not been fully explored. This review tried to provide scientific basis for the further development of pharmacological activities of *Beta vulgaris*.

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