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Studies on evaluation of physical and chemical composition of beetroot (*Beta vulgaris* L.)

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Abstract
The present study was carried out to analyze physical and chemical composition of beetroot (*Beta vulgaris* L.). The freshly harvested beetroot selected for evaluation of different physicochemical and mineral composition. Results obtained indicated that colour of beetroot was dark red in colour, length was 16.25 cm, diameter was 5.43 cm and mass of beetroot was observed to be 180g. Further, chemical and mineral composition was reported and results showed that moisture content was found to be 87.4 percent, carbohydrate 7.59 percent, Protein 1.35 percent, fat 0.3 percent and betalain content of beetroot was recorded to be 14.20 mg/100g. The other parameters such as viscosity, acidity and pH of beetroot juice were indicated 0.72 Pa s, 0.014 percent and 6.3 respectively. The mineral showed highest in sodium 72.58, potassium 30.12 followed by zinc and iron 0.21 and 0.75 mg/100g respectively.

Keywords: Betalain, *Beta vulgaris*, physical properties and chemical properties

Introduction
Beetroot (*Beta vulgaris* L.) is crop belonging to the *Chenopodiaceae* family having, bright crimson colour. It is famous for its juice value and medicinal properties; and known by several common names like beet, chard, spinach beet. (Yashwantkumar, 2015)[12]. Beetroot or table Beet is biennial plant that is cultivated for its thick flashy roots in early spring. Members of this family are dicotyledonous. It is an erect annual herb with tuberous root stocks. 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. (Yadav, *et al*. 2016) [11]. Beetroot is grown for food uses (pickles, salad, juice) rather than for sugar production. In contrast to other fruits, the main sugar in beetroot is sucrose with only small amounts of glucose and fructose (Bavec *et al.* 2010) [2]. Because fructose reduces human exercise capacity, a low fructose and a high sucrose content is preferable, for example, in sports drinks (Murray *et al.* 1989) [8]. The intense red color of beetroots derives from high concentrations of betalains. Betalains are used as natural colorants by the food industry, but have also received increasing attention due to possible health benefits in humans, especially their antioxidant and anti-inflammatory activities (Georgiev *et al.* 2010) [6]; Zielinska *et al.* 2009) [13]. The betalains that are mainly found in beetroot are betacyanins and betaxanthins (Gandia *et al*. 2010) [5]. Today, beetroot is grown in many countries worldwide, is regularly consumed as part of the normal diet, and commonly used in manufacturing as a food colouring agent known as E162 (Clifford *et al*. 2015) [3]. Effects of a commercially available beetroot juice on inflammation is strongly involved in the development and progression of several clinical conditions including coronary heart disease and cancer, beneficial effect of beetroot extract may relate to this anti-inflammatory capacity (Jurgen *et al.* 2015) [7].
The beetroot (*Beta vulgaris*) being an alkaline food with pH from 7.5 to 8.0 has been acclaimed for its health benefits, in particular for its disease fighting antioxidant potential, significant amount of vitamin C and vitamins B1, B2, niacin, B6, B12 whilst the leaves are an excellent source of vitamin A. The juice of beetroot is also consumed as a natural remedy for sexual weakness and to expel kidney and bladder stones. The claimed therapeutic use of beetroot includes its antitumor, carminative, emmenagogue and hemostatic and renal protective properties and is a potential herb used in cardiovascular conditions.

Beetroot is known to be a powerful antioxidant. (Dambalkar *et al.* 2015) [4].

Materials and Methods

The present investigation was carried out in Department of Food Engineering with collaboration of Department of Food Science and Technology and Department of Food Chemistry and Nutrition, College of Food Technology, VNMKV, Parbhani during year 2017-18.

Materials

Raw materials

Fresh beetroots were obtained from the local village area of the Parbhani region. The experiments were generally performed immediately after procurement.

Chemicals and glasswares

The chemicals of analytical grade and glasswares required during investigation were used in the department of Food Engineering.

Methods

Physico-chemical properties

Physical properties such as viscosity, pH, sugar, proximate analysis.

Viscosity: The viscosity of the beetroot juice was determined with the aid of a Lovibond Brookfield viscometer using spindle S-62 at 100 rpm.

pH: The pH of the beetroot juice was determined using digital pH meter. Twenty (20ml) of the juice was transferred into a beaker and the pH was determined after the meter was calibrated using standard buffer of pH 4.0 and 7.0, sufficient time was allowed for stabilization before readings were taken.

Total soluble solid (TSS)

The TSS content of juice was determined with the help of Erma hand refractometer of 0-32 range in duplicate (A.O.A.C., 2005) [1]. The sugar content percentage (soluble sugar) was read from the scale of the refractometer when held close to the eye.

Titratable acidity

The titratable acidity was determined by the procedure as reported by Ranganna (1986) [10].

Reducing sugar: The reducing sugars were estimated by the volumetric method as reported by Ranganna (1986) [10].

Total sugar: Total sugars were determined by volumetric method as reported by Ranganna (1986) [10].

Proximate composition:

Different chemical properties of samples were analysed for moisture content, ash, fat, protein and total carbohydrate. All the determinations were done in triplicate and the results were expressed as the average value.

Moisture content:

Moisture content was determined adopting AOAC (2005) [1] method as following:

$$\% \text{ Moisture content} = \frac{\text{Loss in weight}}{\text{Weight of sample}} \times 100$$

Fat

AOAC (2005) [1] method using Soxhlet apparatus was used to determined crude fat content of the sample. The percent of crude fat was expressed as follows:

$$\% \text{ Crude Fat} = \frac{\text{Weight of dried ether soluble material}}{\text{Weight of sample}} \times 100$$

Protein

Protein content was determined using AOAC (2005) [1] method. Percentage of nitrogen and protein calculated by the following equation:

$$\% \text{ Nitrogen} = \frac{T_S - T_B \times \text{Normality of acid} \times 0.014}{\text{Weight of sample}} \times 100$$

Where, Ts = Titre volume of the sample (ml), TB = Titre volume of Blank (ml), 0.014= M eq. of N_2.

% Protein = Nitrogen × 6.25

Total carbohydrate

Total carbohydrate content of the samples was determined as total carbohydrate by difference that is by subtracting the measured protein, fat, ash and moisture from 100 phenol sulphuric acid method as given by AOAC (2005) [1]

Ash

Drying the sample at 100^0C and charned over an electric heater. It was then ashed in muffle furnace at 550^0 C for 5 hrs by AOAC (2005) [1]. It was calculated using the following formula:

$$\% \text{ Ash content} = \frac{AW}{IW} \times 100$$

Where, AW = Weight of Ash and IW= Initial weight of dry matter

Results and Discussion

The extracted beetroot juice were evaluated for various physicochemical properties are presented as follows.

Physical properties

The data pertaining to various physical properties like mass, length, colour, diameter, shape, edible index and waste index were determined and the average values are presented in table 1.

Table 1: Physical properties of beetroot

Physical parameters	Average value
Mass	180 gm
Length	16.25 cm
Colour	Dark red
Diameter	5.43 cm
Shape	Round
Viscosity	0.72 Pa s
Edible index	91.03%
Waste index	8.07%

*Each value is the average of 3 determinations

The physical properties of beetroot was measured and results reported that mass was found 180 (g), length 16.25cm, diameter 5.43cm, round in shape. Properties like edible index and waste index was noted as 91.03 and 8.07% respectively.

Chemical properties and mineral composition if beetroot

The data pertaining to various chemical and mineral composition such as moisture, fat, carbohydrates, protein, ash and crude fiber were determined and results obtained are illustrated in Table. 2 and Table. 3

Table 2: Proximate composition of beetroot

Nutrients	Average value
Proteins	1.35 ±0.2%
Fats	0.3 ±0.1%
Carbohydrates	7.59 ±0.4%
Dietary fibre	1.9 ±0.2%
Moisture	87.4 ±0.3%
Ash	1.4 ±0.2%

* Each value is average of three determinations**.**

Results given in the table. 2 indicated that the moisture content was 87.4%, fat 0.3%, protein 1.35%, carbohydrates 7.59%, crude fiber 1.9%, and ash 1.4%. The results found to be similar with (Odoh and Okoro 2013) [9].

Table 3: Mineral composition of beetroot

Minerals	Average value (mg/100g)
Iron	0.75 ±1.20
Potassium	30.12 ± 0.29
Calcium	12.20±1.20
Mangnese	0.79 ± 1.98
Copper	0.09 ± 0.47
Sodium	72.58 ± 1.12
Zinc	0.21 ± 1.01

The mineral composition of beetroot were analyzed and results revealed that iron was 0.76, potassium, copper 0.08, sodium 73.60 and zinc 4.9 (mg/100g) respectively. Results reported are in close agreement with (Odoh and Okoro 2013) [9].

Table 4: Chemical properties of beetroot juice

Chemical parameters	Average value
TSS (^{0}Bx)	9.0
pH	6.3
Titrable Acidity	0.014
Reducing sugar	4.20%
Total sugar	7.93%
Ascorbic acid (mg/100g)	10.01
Betalain (mg/100g)	14.20

* Each value is average of three determinations**.**

The chemical composition of beetroot juice were analyzed and results revealed that TSS was 9.0, pH 6.3, acidity was 0.014, reducing sugar found to 4.20 with total sugar of 7.93%. The ascorbic acid and betalain content of beetroot juice were 10.01 and 14.20 mg/100g respectively. Results reported are in close agreement with (Dambalkar 2015) [4].

Conclusion

It could be finally concluded that beetroot is good source of protein, carbohydrate and dietary fiber. Beetroot is good source of minerals such as sodium and potassium. The beetroot is good source of betalain, which makes it potential source for exploration and value addition in food beverages in combination with various fruit juices.

References

1. AOAC. Methods of analysis, 17th ed. Association of official Analytical Chemists, Washington, DC, 2005.
2. Bavec M, Turinek M, Grobelnik MS, Slatnar A, Bavec F. Influence of industrial and alternative farming systems on contents of sugars, organic acids, total phenolic content, and the antioxidant activity of red beet (*Beta vulgaris* L. ssp. *vulgaris*). Journal of Agricultural and Food Chemistry. 2010; 58(22):11825-11831.
3. Clifford T, Stevenson EJ, Howatson G, West DJ. The Potential Benefits of Red Beetroot Supplementation in Health and Disease. Journal of Nutrients. 2015; 7:2801-2822.
4. Dambalkar VS, Rudrawar BD, Poojari VR. Study of physico-chemical properties and sensory attributes of beetroot-orange RTS drink. International Journal of Science and Research. 2015; 4(10):589-594.
5. Gandia F, Escribano J, Garcia F. Structural implications on color, fluorescence, and antiradical activity in betalains. An International Journal of Plant Biology. 2010; 232(2):449-460.
6. Georgiev VG, Weber J, Kneschke EM, Denev PN, Bley T, Pavlov AI. Antioxidant activity and phenolic content of betalain extracts from intact plants and hairy root cultures of the red beetroot (*Beta vulgaris)*. Journal of Plant Foods for Human Nutrition. 2010; 65(2):105-111.
7. Jurgen W, Gundula W, Stefan H, Pinar U, Peter L, Ulrike M *et al*. Compositional characteristics of commercial beetroot products and beetroot juice prepared from seven beetroot varieties grown in Upper Austria. Journal of Food Composition and Analysis. 2015; 42:46-55.
8. Murray R, Paul GL, Seifert JG, Eddy DE, Halaby GA. The effects of glucose, fructose, and sucrose ingestion during exercise. Medicine and Science in Sports and Exercise. 1989; 21(3):275-282.
9. Odoh UE, Okoro EC. Quantitative phytochemical, proximate/nutritive composition analysis of *Beta vulgaris* Linnaeus (*chenopodiaceae*). International Journal of Current Research. 2013; 5(12):3723-3728.
10. Ranganna S. Handbook of analysis and quality control for fruit and vegetable products, second edition, 1986.
11. Yadav M, Chawla H, Parle M, Sharma K. Beetroot: A Health Promoting Functional Food. Inventi Rapid: Nutraceuticals. 2015, 2016; (1):1-5
12. Yashwantkumar. Beetroot: A Super Food. International Journal of Engineering Studies and Technical approach, 2015, 01(3).
13. Zielinska PM, Olejnik A, Dobrowolska Z, Grajek W. *In vitro* effects of beetroot juice and chips on oxidative metabolism and apoptosis in neutrophils from obese individuals. Phytotherapy Research. 2009; 23(1):49-55.