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Original Research Article

Exploration of the Nourishing, Antioxidant and Product Development Potential of Beetroot (*Beta Vulgaris)* Flour

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ABSTRACT

Beetroot (*Beta vulgaris)* is a traditional and popular vegetable in many parts of the world including India. It is the taproot portion of the beet plant. It is especially rich in fiber as well as in sugars and has a moderate caloric value. It also has several bioactive compounds like betalains, carotenoids and is a powerful dietary source of nutrients. The present study was designed to evaluate proximate and antioxidant potential of beetroot flour which was prepared by dehydration technique. Beetroot flour was then used to develop food products incorporating it, followed by sensory evaluation of them. The results of the study accord appropriate proximate value and high antioxidant potential to beetroot flour. The products developed were *Beetroot Barfi* and *Beetroot Kanjhi* having 1%, 2%, 3%, and 4% incorporation of beetroot flour. The results indicate that the *Beetroot Barfi* having 1% and *Beetroot Kanjhi* having 4% incorporation of beetroot flour was accepted as well as their respective standard. The study is expected to extend the use of beetroot, a commonly grown yet marginalized foodstuff, in the form of its flour blended food products to provide nutrients and health enhancing phytochemicals to the masses.

Keywords: Beetroot flour, Proximate, Antioxidant, Sensory Evaluation

INTRODUCTION

The pleasing colour and nutritious roots of beet plant has always attracted researchers to study and develop its food products. [1,2] Beetroot (*Beta vulgaris*) though is available in several varieties from color yellow to red, but the most cultivated and widely used is the deep red coloured beets[3]. It is known for its richness of antioxidants in the form of betalains and other phytochemicals having anti- cancer and therapeutic properties. [3-5] It contains bio-active constituents, antioxidants including betalains, carotenoids, phenolic compounds and goodness of other nutrients, in the meanwhile providing lesser calories to the consumer. [6, 7] It also has little amounts of ascorbic acid, B-vitamins, iron, calcium, potassium, magnesium and sodium. [8, 9]

Since beetroot is a perishable vegetable it may be dehydrated and its mineral content may increase (especially iron and calcium) quantitatively due to reduction of water mass. Though there is loss of antioxidants up to some extent, but still may possess health benefits along with its quality pinkish color. [10] Hence it may be used as a colouring agent in biscuits, cakes and other preparations to enhance its

aesthetic appeal and give valuable nutrients as used in related researches. [11]

Colour is an important quality indicator which determines consumer acceptance of foods. [8] Study on frozen pizzas used beet powder to colour the tomato sauce. [9] Yadav *et al.* concluded that addition of beetroot powder enhanced the quality and flavour of yogurt. On addition of beetroot powder, acidity and other nutrients were increased in yogurt. Overall acceptability of the beetroot powder incorporated yogurt was found highly acceptable by consumers. [12] It has shown to be an interesting ingredient for the production of bakery and confectionery products, especially cakes and related products along with its beneficial nutrients. Cake prepared with 20 per cent beetroot powder incorporation had better physical and sensory characteristics. [2]

Apart from its quality color, it has insoluble fibre which may be used in the form of prebiotic to develop symbiotic beverages also seen in studies. [13] In a study beetroot was used for developing probiotic beet juice through lactic acid fermentation with *L. casei.* The symbiotic beetroot beverage showed sensory characteristics acceptable to health-conscious customers. [7]

The present study aims at developing beetroot flour using dehydration technique from fresh beetroots and to produce food product using its flour. After which, nutritional evaluation including proximate and antioxidant analysis of beetroot flour was done. The study emphasizes on improvising food products using beetroot vegetable and develops new food products using household adaptable culinary skills.

MATERIALS AND METHODS

This study involved evaluation of nutritional, antioxidant and product development potential of beetroot flour. The materials required were fresh beetroots to produce its flour, chemicals for conducing laboratory tests and ingredients required for food product development. The work has been accomplished in the department of Food science and Nutrition, Banasthali Vidyapith, Rajasthan.

Development of beetroot flour

Beet root was washed with water, dried and then diced to thin slices. [14] Sliced product was subsequently placed on a stainless steel mesh belt and dried on a commercial forced-air dryer at ca. 60ºC and 40% relative humidity. Drying time was 24 hour and maximum product temperature was 60ºC. Dried product was then grounded using mechanical grinder to make beetroot flour. [15, 16]

Nutritional and antioxidant analysis of beetroot flour

The parameters of nutritional analysis were moisture, ash, crude fiber, fat, protein, carbohydrate, iron, calcium. For this, standard techniques, chemicals and equipments were used. [15, 16] The assessment of antioxidant activity was done by DPPH, TPC, TFC and betanin using standard techniques and equipments. [17, 4]

Food product development and sensory protocol

Food products were prepared from the dried and grinded powder of beetroot. Two recipes: *beetroot barfi and kanjhi* were developed with the incorporation of 1%, 2%, 3% and 4% of beetroot flour. For *Beetroot barfi:* Take ¼ cup water in a pan and sugar to it and make it into sugar syrup. Then in another pan and add *khoya* and melt it under heat. Add melted *khoya* to sugar syrup and then add coconut powder and beetroot flour of desired set amount. Heat the mixture gently for 2 minutes and immediately pour it in a greased pan. Leave to cool for 5 hours. Sliced them into square pieces and then serve. For *beetroot kanjhi:* Take 500ml water in a jar and add beetroot flour, rock salt, mustard seeds in it. Take 1 probiotic capsule and remove its outer covering and put the contents in the jar. Cover the lid and shake the jar vigorously to mix all the contents. Keep the jar for 24 hour to achieve desired fermentation and served it chilled. For sensory analysis 9-point hedonic scale was used for analyzing

different sensory attributes like appearance, color, flavor, texture and overall acceptability by a panel of trained members selected in the triangle test for sensory evaluation of food products.

RESULTS AND DISCUSSIONS

Nutritional analysis

The proximate analysis of beetroot flour is given in table 3.1. Proximate analysis of the beetroot flour gave the values as- 6.3g moisture, 7.89g ash, 1.53g fat, 5.08g crude fibre, 77.74g carbohydrate, 1.61g protein, 4.14mg iron, 160.32mg calcium and 4.2mg vitamin C in 100g beetroot flour respectively. The present investigation revealed that beetroot flour is good source of carbohydrate, crude fibre, iron, calcium and vitamin C. Thus could be potentially be utilized as an ingredient in many dishes to enhance the nutritional value of food. Antioxidant analysis showed good intensity of antioxidant activity in beetroot flour investigated by DPPH as shown in figure 3.1. The graph evaluated the IC_{50} value of methanol extract of beetroot flour which was 0.012mg/ml as compared to standard taken as ascorbic acid was 0.007mg/ml, which indicates good intensity of antioxidant activity. This was also evident by total phenol content (TPC) was found to be 67.6mgGAE/ml as show in figure 3.2, total flavanoid content (TFC): 2.46mgQE/ml as shown in figure 3.3 and betanin: 87mg/100g. Hence, being plant based food stuff; it can provide the health enhancing phytochemicals to the masses.

Table 3.1: 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

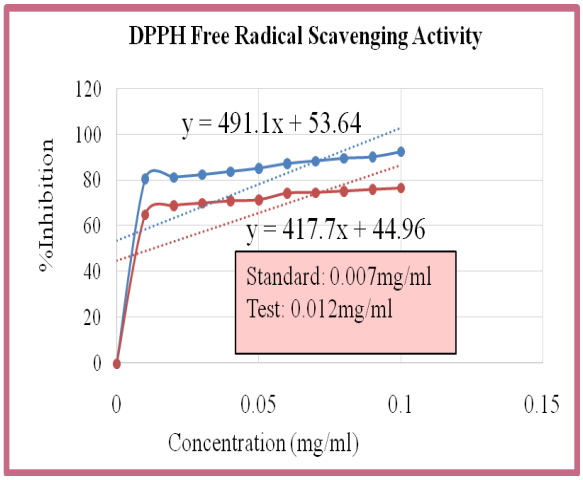

Figure 3.1 DPPH free radical scavenging activity of Beetroot Flour in methanol extract

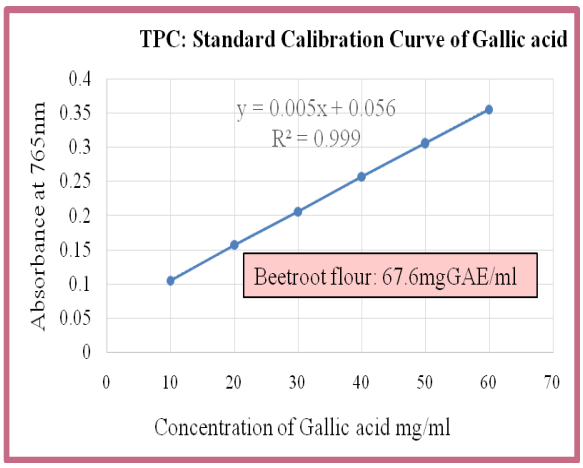

Figure 3.2 Standard Calibration Curve of Gallic acid with TPC content of beetroot flour 67.6mgGAE/ml

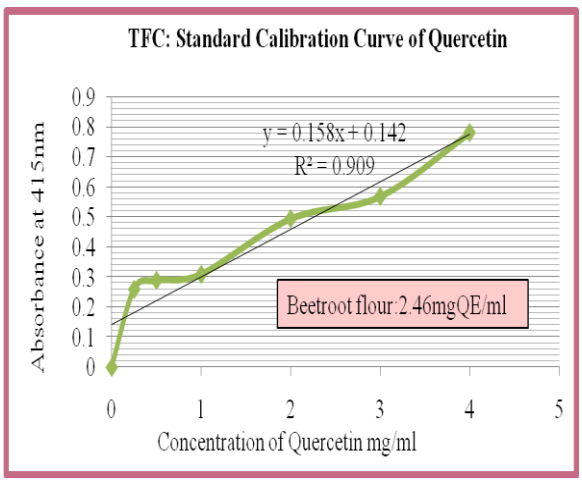

Figure 3.3 Standard Calibration Curve of Quercitin in Methanol with TFC 2.46mgQE/ml in beetroot flour

Sensory analysis

On the basis of sensory evaluation of food products obtained by incorporating 1%, 2%, 3% and 4% beetroot flour, the overall acceptability was found quite

satisfactory as compared to standard (Std.). All the products developed were acceptable. However, in *Beetroot Barfi* most acceptable variant was the one having 1% incorporated beetroot flour as shown in detail in table 3.2.1 and figure 3.2.1. While in *Beetroot Kanjhi*, variant having 4% incorporated beetroot flour was most acceptable as shown in detail in table 3.2.2 and figure 3.2.2.

Table 3.2.1 Acceptability scores of "*Beetroot barfi*" incorporating different ratio of beetroot flour in terms of colour, appearance, flavour, texture, taste, and overall acceptability.

Variants	Colour	Appearance	Flavour	Texture	Taste	Overall acceptability
Std.	6.64±0.55	7.20±0.79	7.48±0.83	7.52±0.84	8.04±0.89	8.34±0.97
A	8.20±0.66	7.66±0.66	8.13±0.73	8.60±0.51	8.51±0.54	8.67±0.88
B	8.13±0.73	7.76±0.68	7.74±0.87	7.90±0.83	7.74±0.82	8.28±0.85
C	8.37±0.48	7.50±0.77	7.20±0.73	7.74±0.63	7.66±0.86	8.24±0.77
D	8.04±0.66	7.43±0.69	6.40±0.81	7.43±0.75	7.02±0.84	7.82±1.16

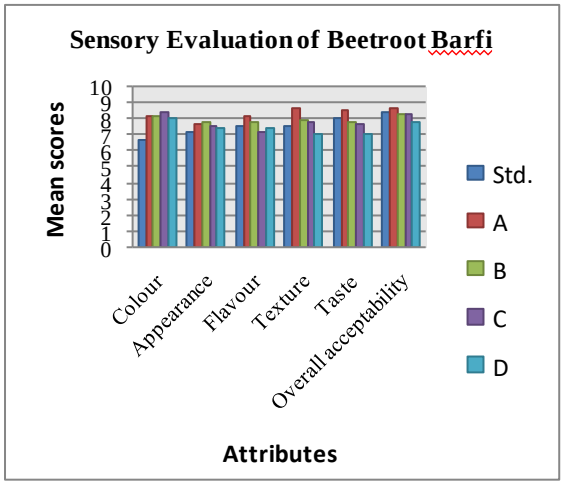

Figure 3.2.1 Bar graph representing sensory evaluation results of "*beetroot barfi*".

Table 3.2.2 Acceptability scores of "*Beetroot Kanjhi*" incorporating different ratio of beetroot flour in terms of colour, appearance, flavour, texture, taste, and overall acceptability.

Variants	Colour	Appearance	Flavour	Texture	Taste	Overall acceptability
Std.	8.04±0.48	8.02±0.43	7.54±0.87	7.88±0.74	8.34±0.95	8.17±0.33
A	7.82±0.65	7.81±0.65	6.49±0.86	6.76±0.83	6.24±0.92	6.55±1.09
B	7.45±0.91	7.45±0.79	6.56±0.92	6.49±0.97	6.67±1.04	6.62±1.17
C	7.95±0.81	7.61±0.76	6.76±0.91	6.89±1.04	7.56±1.06	7.01±0.93
D	8.22±0.67	7.70±0.78	7.30±0.81	6.90±0.75	8.17±0.84	7.99±0.53

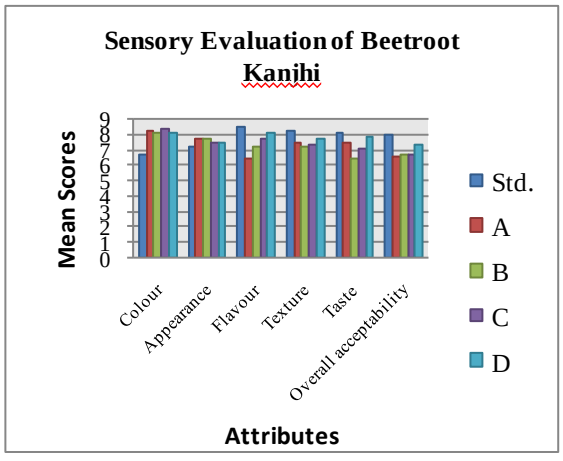

Figure 3.2.2 Bar graph representing sensory evaluation results of "*beetroot kanjhi*".

CONCLUSION

The fresh beetroots are exposed to spoilage due to their high moisture content and needs preservation. One of the effective preservation methods ensuring microbial safety of biological products is drying and dehydration. Dried beetroots can be consumed directly in the form of chips or powdered to flour for easy preparation in various recipes. Beetroot flour is rich in micronutrients and phytochemicals/ antioxidants. Beetroot flour can be used for its colour and as prebiotic as it is high in carbohydrate and fibre. The present study was undertaken to evaluate nutritional, antioxidant and product development

potential of beetroot flour. The food products were developed by considering the important characteristic of beetroot flour being nutritious having a pleasing pinkish colour. Also, beetroot flour preparation can be made by household adaptable method by shade drying. This study will extend the use of beetroot in the form of flour blended food products: *Beetroot Barfi* and *Kanjhi*. Being plant based food stuff; it can provide the health enhancing phytochemicals to the masses. Due to its cultivation in North India including Rajasthan, the study would promote the concept of 'household adaptable food product development' from locally grown foods.

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