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Development and evalution of a spinach based antioxidant rich beverage

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Abstract
Free radicals are generated in the body during normal course of metabolism in addition to consumption of faulty food habits, pollution, stress etc. Antioxidants are necessary to counteract the harmful effects of these free radicals. The balance between oxidants and antioxidants plays an important role in maintaining health. Therefore foods rich in antioxidants need to be included in our daily diet to increase antioxidant intake. Beverages provide a means of providing nutrients in a concentrated form which are easy to consume and digest.

In this study a spinach based beverage was developed. It was evaluated for organoleptic properties by a panel of judges from the department of Food and Nutrition. Smt. V.H.D. Central Institute of Home Science, Bangalore. Hedonic scale was used for evaluation and the beverage got a mean overall acceptability of 4.1 out of 5. 250 ml of the developed spinach beverage provides 8625 mg of trolox equivalents.

Keywords: spinach based, antioxidant rich, beverage, organoleptic evaluation

1. Introduction

Modern unhealthy lifestyle has taken a toll on the health by accelerating the production of free radicals. These free radicals are highly reactive atom or molecules with one or more unpaired electrons. These initiate the peroxidation of the membrane lipids, aggression of tissue proteins and membranes, or damage to DNA and enzymes. Research has shown that this free radical induced harmful effects lead to pathological conditions such as arthritis, hemorrhagic shock, coronary diseases, cataract, cancer and AIDS, as well as age-related degenerative brain disorders. So antioxidants become necessary to counteract these free radicals. Epidemiological studies have proved beyond doubt that people who consume fruits and vegetables regularly enjoy better quality of life.

Spinach (*Spinacia oleracea*) is a commonly consumed green leafy vegetable, which is rich in micronutrients and phytochemicals. It has functional ingredients such as lutein, betaine, flavonoids, neoxanthin and galactolipids. The total antioxidant capacity of any food depends on the presence of different antioxidant constituents such as alpha tocopherol, beta carotene, vitamin C, selenium or phenolic compounds etc. The high antioxidant activity of spinach is due to high alpha tocopherol, beta carotene and ferulic acid [1]. Margalit Bergman *et al.* (2001) [2] have isolated the active fractions from aqueous spinach extracts have been chemically identified (There are 4 hydrophobic fractions (glucuronic acidderivatives of flavonoids), 3 fractions of trans and cis isomers of p-coumaric acidderivatives and others are mesotartarate derivatives of p-coumaric acid. There is a variation in the flavonoid content among different genotypes of spinach (Mi Jin Cho *et al*. (2008) [3]. The correlation between antioxidant capacity and total flavonoid content was found to be high (0.96).

Spinach rich in functional foods if it is included in the daily diet can considerably enhance the health benefits. Any food in the form of beverage can be consumed more easily than in other forms. So an attempt has been made to develop a beverage rich in antioxidants using spinach as a main ingredient.

2. Materials and Methods

2.1 Standardization of the product

Spinach was washed in running water after trimming the roots. Equal quantity of spinach along with stalk and water were boiled at 100° C for five minutes and then it was grinded in a grinder into a fine thick liquid. To this a pinch of salt and cumin powder were added for taste.

2.2 Development of the score card

A score card was prepared keeping in mind the quality characteristics of the test drink. A 5- point hedonic rating scale was used for rating attributes such as colour, taste, flavour and overall acceptability. Highest score (5) was assigned to the most preferred characteristic and 1 to the most undesired characteristic. Mean score for each attribute was calculated.

2.3 Acceptability of the product

Acceptability of beverage was tested by a selected panel of judges. A panel of 40 judges from the staff of Department of Food and Nutrition and the volunteers of the clinical trial were selected for the evaluation of the test drink.

Suitable statistical tests were used for analysis of the data.

3. Results & Discussion

The spinach used in the preparation of the beverage is shown in plate 1. The prepared beverage is shown in fig. 2.

Fig 1: Spinach *Beta vulgaris* var. bengalensis

Fig 2: Spinach based beverage

3.1 Composition of the beverage

The beverage which was standardized had the following composition.

Table 1: Food Composition of the spinach beverage per serving (250 ml)

Sl. No	Ingredient	Quantity
1	Spinach raw	125 g
2	Water	125 ml
3	Salt	To taste
5	Cumin powder	A pinch

The developed beverage provides 127 KJ of energy per serving and is a rich source of micronutrients. The micronutrient content was calculated based on the Food Composition Table (2017) [4].

Table 2: The Micronutrient composition of the beverage

Nutrients	Quantity /per serving(250 ml)
Dietary fibre (g)	2.97
Total folates (µg)	177.5
Ascorbic Acid (mg)	40.5
α tocopherol (mg)	1.58
Lutein(µg)	4812
Zeaxanthin (µg)	21.53
β Carotene (µg)	3256
Calcium (mg)	102
Iron (mg)	3.68
Potassium (mg)	781
Selenium (µg)	2.61

3.2 Antioxidant capacity of the developed beverage

Table 3: The antioxidant capacity of the spinach beverage/ serving

DPPH (mg of trolox equivalent/serving)	FRAP (mg of $FeSO_4$ equivalent/serving)
8625	3995

The antioxidant capacity of the beverage was calculated based on values of the cooked spinach given by Sreeramulu *et al.* (2013) [5] where it was mentioned that conventional cooking increases antioxidant capacity by 300 per cent in DPPH method and 231 per cent in FRAP method in case of spinach. The total antioxidant capacity of the spinach beverage is given in the Table 3. The authors have explained that the increase in antioxidant capacity after heating could be due to release of antioxidant components stored in pectin or cellulose network of plant foods during thermal processing. Sometimes heat can break supra molecular structure resulting in the formation of new compounds with antioxidant activity.

3.3 Organoleptic evaluation of the developed beverage

Table 4. Gives the mean scores for the beverage as tested by the panelists. Overall, the developed beverage was found to be acceptable with a score of 4.1 on a 5 point scale.

Table 4: Mean sensory scores for the spinach beverage

Attribute	Colour	Taste	Flavour	Overall acceptability
Mean Score	4.8	3.8	4.0	4.1

4. Conclusion

An antioxidant rich beverage has been developed using spinach which is easily available, commonly consumed and low cost. There are very few studies which have used vegetable as a base for preparation of beverages. This beverage provides a concentrated source of micronutrients also.

5. References

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