

Acceptability and nutrient content of developed iron rich toffee

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The use of green leafy vegetables requires promotion among selected populations to improve micronutrient status. In the present study locally available, uncommonly consumed, low cost, iron rich green leafy vegetables were selected for development of iron rich toffee. Based on results of iron content, rajkeera leaves (*Amaranthus paniculatus*) and Bengal gram leaves (*Cicer arietinum* L.) were selected. Leaves were dried in mechanical dryer and powder was prepared. Six variations of toffee were prepared using different amounts of green leafy vegetable powder. Acceptability and nutrient content was analyzed. The variation Ist recorded the highest score for acceptability and iron content.

Key Words : Development of iron rich toffee, Organoleptic evaluation, Nutrient analysis

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INTRODUCTION

Micronutrient malnutrition is a cause of concern in developing countries. Nutritionally caused blindness, iodine deficiency disorders and iron deficiency anaemia are some of the major problems of micronutrient deficiency seen especially in children. Micronutrient deficiencies are also expressed in terms of increased mortality, morbidity and disability rates (Narasinga Rao, 1997).

One of the measures to prevent malnutrition among the population is through food based approaches, which concentrate on change or improvement in food habits by creating awareness among selected populations

(FAO, 1996 and Anonymous, 1997). Green leafy vegetables are less expensive and easily available sources of micronutrients. The use of green leafy vegetables requires promotion among selected populations to improve micronutrient status (Gopalan, 1997). Dehydration is one of the best method of preservation of leafy vegetables because it reduces the cost of storage and transportation by reducing both the weight and volume of the final product. The dehydration of leafy vegetables increases its nutritional content. The present study was conducted with the objective to develop iron rich toffee utilizing green leafy vegetable powder and to evaluate the acceptability and nutritional quality.

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METHODOLOGY

Underutilized, low cost, rich in iron content rajgira leaves (*Amaranthus paniculatus*) and bengalgram leaves (*Cicer arietinum* L.) were selected for the development of iron rich toffee. Six variations of iron rich toffees were developed using the different proportion of green leafy vegetables, acceptability and nutrient content were evaluated.

Table A : Development of iron rich toffees

Variation	Description of recipe
I	Rajkeera leaves + Amla jam + Sugar (30 g+60 g+10 g)
II	Rajkeera leaves + Amla jam + Sugar (22 g+68 g+10 g)
III	Rajkeera leaves +Bengal gram leaves + Amla jam + Sugar (15 g+ 15 g +60 g+10 g)
IV	Rajkeera leaves +Bengal gram leaves + Amla jam + Sugar (10 g+ 10 g +70 g+10 g)
V	Bengal gram leaves + Amla jam + Sugar (30 g+60 g+10 g)
VI	Bengal gram leaves + Amla jam + Sugar (22 g+68 g+10 g)

Preparation of green leafy vegetables powder :

The rajgira leaves and bengalgram leaves were procured from the local market in one lot. The leaves were cleaned, washed and dried in mechanical dryer. The fine powder of dried leaves was prepared using mixer in the laboratory and stored.

Development of iron rich toffee :

Looking to the importance of green leafy vegetables six variation of iron rich toffees were developed by using rajgira leaves and bengalgram leaves in different proportion. In all the variations sugar, lime juice and ginger juice was added in same amount and amla jam was added in different amount. The details of development of iron rich toffees is given in Table A.

Sensory evaluation :

Evaluation of iron rich toffee for acceptability test was carried out by following ranking method. Six variations of iron rich toffees were served to ten trained judges to score for different sensory characters namely colour, texture, taste, flavour and overall acceptability at room temperature with the help of score card, using 9 point hedonic scale (Srilaxmi, 2005).

Nutrient analysis:

The nutrient content developed iron rich toffee was analyzed. The moisture total protein, fat, fibre, total minerals, total iron and vitamin C was carried out as per procedures prescribed by A.O.A.C. (1975). Carbohydrate content was calculated by difference method. Calcium was estimated by EDTA method.

OBSERVATIONS AND ASSESSMENT

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Mean acceptability scores of organoleptic characteristics of developed toffees :

The mean values of organoleptic scores for the acceptability of iron rich toffee prepared by utilizing selected green leafy vegetables powder with amla jam, lemon juice and ginger juice are given in Table 1 .The mean score for colour of I, II, III, IV, V and VI variations of iron rich toffee were found to be 7.41, 6.83, 7.25, 7.41, 6.83, and 7.25, respectively. The maximum score of 7.41 was obtained for colour of variation I and IV whereas the minimum score of 6.83 was recorded for colour of variation II and V. Statistical analysis revealed that the score obtained for colour of iron rich toffee of was not differed significantly. On the whole, among the prepared variations of iron rich toffees variation I and IV was found to be most accepted with regard to colour. The score regarded for the taste 7.58, 7.08, 7.41, 7.25, 7.08, and 7.41 for variation I, II, III, IV, V, VI, respectively. The highest score of 7.58 for the taste was recorded by the variation I whereas lowest score 7.08 was secured by the variation II and V. Statistical results showed that the taste of iron rich toffee of six variations differed non significantly. From the findings it can be inferred that variation I was found to be the most acceptable in the context of taste. The mean score secured for flavour of iron rich toffees was ranging from 8.0-6.83. The highest score of 8.08 for the flavour was secured by variation II while the minimum score of 6.83 was secured by variation V. Statistical analysis showed that the score obtained for flavour of variation II was differed significantly with variation V and VI. On the whole it can be concluded that variation II was considered as most accepted in terms of flavour.

The score registered for the texture of iron rich toffee prepared by utilizing selected green leafy vegetable powder with amla jam, ginger juice and lemon juice were between 7.75 to 7.16. The maximum score was recorded by variation III and the minimum score was recorded by

variation II, V and VI. Statistical analysis showed that, the score obtained for texture of iron rich toffee differed non significantly. In conclusion it can be said that the variation III was found to be highly acceptable in terms of texture. The mean scores for overall acceptability of iron rich toffee variations I to VI was ranging from 7.0-7.58. The maximum score (7.58) was obtained by the variation I and II, followed by IV, III, VI, while the minimum score (7.0) was obtained by variation V. The score recorded for overall acceptability which was non significant statistically.

In the light of above results it can be concluded that variation I was found to be most acceptable in terms of more organoleptic characteristics as compared to others variation. According to Lahade (2009) the incorporation of 15–20 per cent of rajkeera leaves powder is highly acceptable in the preparation of different snacks in terms of organoleptic characteristics. The results of the present study are in conformity.

Nutritional composition of iron rich toffee :

The nutrient content of iron rich toffees *viz.*, moisture (g %), protein (g %), fat (g %), total minerals (g %), fibre (g %), CHO (g %), energy (kcal), vitamin C (mg %), calcium (mg %), iron (mg %) were analyzed and is presented in Table 2. The moisture content was ranged from 12.25- 11.0 g/100 g. Variation IV recorded highest value 12.25 g/100 g followed by variation I, II, III 12.0 g/100 g, whereas the variation VI and V recorded 11.25 and 11.0 g/ 100 g, respectively. The protein content of developed iron rich toffee was 7.93, 6.75, 6.12, 5.68, 6.04 and 5.86 g/ 100 g for variation I, II, III, IV, V, and variation VI, respectively. It is clear from the result that variation IV registered highest value of moisture whereas variation I recorded highest protein content. The

estimated value for total minerals g/100g in variations I, II, III, IV, V and VI was 2.51, 2.51, 2.66, 2.55, 2.58 and 2.01 g/100g, respectively. The highest value of total mineral was recorded in variation III followed by variation. Lakshmi and Vimala (2000) and Banerjee *et al.* (2015) conducted a study on dehydration of green leafy vegetables. It was found that inspite of considerable losses in vitamins green leafy vegetables powder retained good amount of protein, fibre and minerals (Ca, Mg, Fe) and fair amount of ascorbic acid and β carotene. The reason for increasing the concentrations of nutrients in the powders was due to the removal of moisture by drying. The findings of the study conducted by Kawatra and Singh (2006) indicated that the protein g/ 100 g, total iron mg/100g and ascorbic acid mg/100 of rajgira leaves powder is 26.3 g/100g, 26.8 mg/ 100g and 92.9 mg/ 100g, respectively. Thus it can be confined that rajgira leaves powder is a rich source of protein, iron and ascorbic acid and its utilization in the development of product can enhance the nutritional quality which if consumed regularly can have important contribution in meeting macro and micro nutrients which has health benefits for vulnerable population. The mean values obtained for fibre g/100g were 0.50, 0.35, 0.52, 0.32, 0.45, 0.35 g/100 g for variations I, II, III, IV, V and VI, respectively. It is clear from the result that variation III registered the high value of fibre (0.52), while the minimum value was recorded for variation IV (0.32). The content of CHO g/100g was high in variation IV 79.69 while it was low in variation I 76.14 g/100g. In recent years it is suggested that more amount of dietary fibre must be present in the diet. Dietary fibre helps to relieve constipation and lower blood cholesterol level. High fibre diets are beneficial in control of blood sugar and serum lipids. The ability of fibre is to absorb the water; these indigestible substances serve a

Table 1 : Mean acceptability scores of organoleptic characteristics of developed toffees

(n= 6)

Variation	Colour	Taste	Flavour	Texture	Overall acceptability
I	7.41	7.58	7.58	7.58	7.58
II	6.83	7.08	8.08	7.16	7.58
III	7.25	7.41	7.25	7.75	7.1
IV	7.41	7.25	7.58	7.41	7.41
V	6.83	7.08	6.83	7.16	7.00
VI	7.25	7.41	7.1	7.16	7.16
F value	0.871 ^{NS}	0.688 ^{NS}	2.92*	0.793 ^{NS}	1.06 ^{NS}
S.E. \pm	0.287	0.243	0.251	0.282	0.235
C.D. (P=0.05)	0.796	0.709	0.697	0.781	0.652

NS = Non-significant

* indicates significance of value at P=0.05

useful purpose in helping with the elimination of intestinal wastes. They stimulate the peristaltic (rhythmic) movements of the gastrointestinal tract by adding bulk to the intestinal contents. The estimated values for vitamin C were 37.33, 29.08, 26.01, 15.07, 14.80 and 13.25 mg/100g for variation I, II, III, IV, V and VI, respectively. The highest value (37.33mg/100g) for vitamin C was recorded in variation I followed by variation II (29.08mg/100g). It is clear from the result that vitamin C content of the prepared toffees varied from 37.33 to 13.25 mg/100g. The difference is due to the proportion of rajgira leaves utilized in the preparation of toffees. The variation in which more amounts of rajgira leaves were used showed the highest value for vitamin C content. The vitamin C content of rajgira leaves powder reported by Singh and Kawatra (2006) is 92.8 mg/100g. Ascorbic acid (vitamin C) is the most potent enhancer of non haem iron absorption even in the presence of inhibitors such as phytates, tannates and calcium. It can reduce ferric iron to ferrous iron which can be better absorbed. According to NIN (1992) addition of ascorbic acid to cereals and pulses enhanced the available iron. Mineral elements form an important group of nutrients necessary for the growth and upkeep of the body. About four to five per cent of body weight is made up of mineral element. The minerals calcium and iron are normally included in the nutritional planning. Like vitamins minerals cannot be synthesized by human body and must be provided in a diet which are necessary for the regulatory system and for efficient metabolism of protein, CHO, fat and other regulatory functions, but the trace element are found to be deficient

in the diet of population.

Mineral composition of iron rich toffee :

The contents of calcium (mg/100g), iron (mg/100g) of iron rich toffee are presented in Table 3. The estimated value for calcium (mg/100g) and iron (mg/100g) for variation I, II, III, IV, V and VI were 280, 232, 212, 188, 160, 132 mg/100g and 31.80, 24.95, 28.30, 20.30, 19.90 and 14.15mg/100g, respectively. It is inferred from the result that variation I contained the highest value of iron (31.80 mg/100g) and calcium (280 mg/100g). Singh *et al.* (2005) reported that the product prepared from spinach leaves and dried powder are rich in iron and β carotene. The findings of the study conducted by Yogita (2007) indicated that the leaves varying in colour from green to deep purple are known to have high levels of different minerals like calcium and iron.

In a nutshell the results of the nutrient content of iron rich toffee revealed that variation I contained the highest amount of protein, vitamin C, iron and calcium. Rajkeera leaves considered as good source of iron and β carotene and it is within reach but the consumption is not as it should be (Rao, 1993). Lahade (2009) prepared snacks with and without incorporation of rajkeera leaves powder the nutrient content was more in the snacks with incorporation of rajkeera leaves while the snacks prepared without incorporation showed lower nutrient content. Karva *et al.* (2010) conducted study on dehydration of selected green leafy vegetables in sun, shade, hot air and microwave oven. Prior to dehydration pretreatment was given. Among the selected green leafy

Table 2 : Nutrient composition of developed toffees per 100g (Dry weight basis)

Variations	Moisture (g)	Protein (g)	Fat (g)	Total mineral (g)	Fibre (g)	CHO (g)	Energy (kcal)	Vit C (mg/100g)
I	12.0	7.93	0.92	2.51	0.50	76.14	344	37.33
II	12.0	6.75	0.84	2.51	0.35	77.85	346	29.08
III	12.0	6.12	0.86	2.66	0.52	77.84	343	26.01
IV	12.25	5.68	0.77	2.55	0.32	78.83	343	15.07
V	11.0	6.04	0.89	2.58	0.45	79.04	348	14.80
VI	11.25	5.86	0.84	2.01	0.35	79.69	350	13.25

Table 3 : Mineral composition of iron rich toffee (mg/100g) (Dry weight basis)

Variations	Calcium (mg)	Iron (mg)
I	280	31.8
II	232	24.95
III	212	28.30
IV	188	20.30
V	160	19.90
VI	132	14.15

vegetables rajkeera shows the highest amount of iron 222.52 mg/100g. Green leafy vegetables, a treasure trove of nutrients in general and micronutrients in particular.

Conclusion :

In the light of result of acceptability and nutrient content variation I was found to be most acceptable in terms of organoleptic characteristics and nutrient content *i.e.* iron, calcium, protein and vitamin C thus, developed iron rich toffee exhibited more amount of iron and vitamin C which is good attribute to control the iron deficiency anaemia. Children who consumed GLV once a week or more frequently had higher iron levels than non consumers (Sheshadri, 1997).

LITERATURE CITED

- A.O.A.C.(1975). *Official methods of analysis association of official analytical chemist*;14th Ed., Washington, D.C., U.S.A.
- Banerjee, S., Joglekar, A. and Mishra, M. (2015).** A critical review on importance of green leafy vegetables. *Internat. J. Appl. Home Sci.*, **2** (3&4) : 124-132.
- FAO (1996). *Scientific considerations in the development of food based dietary guidelines*. Report of a Joint FAO/WHO consultation, GENEVA, SWITZERLAND.
- Gopalan, C. (1997).** *Prevention and control of micronutrient malnutrition through food based approaches in SAARC countries*. Dhaka, Bangladesh, November 17-20pp.
- Karva, Seema, Pushpa, Bharati and Bharati, Chimmad (2010).** Post harvest processing of green leafy vegetable for iron security. *J. Agric. Sci.*, **23**(2) : 306-310.
- Lahade, K.N. (2009).** Acceptability and nutritional evaluation of recipes prepared by incorporation of rajkeera leaves powder. M.Sc. Thesis, Vasant Rao Naik Marathwada Krishi Vidyapeeth, Parbhani (M.S.) INDIA.
- Lakshmi and Vimala (2000).** Nutritive value of dehydrated green leafy vegetable powders. *J. Food Sci.Tech.*, **37**(5): 465-471.
- Narsinga Rao, B.S. (1997).** *Anaemia in India: Prevalence, causes, consequences and control*. Proceedings of colloquium on fortification of wheat flour with iron, UNICEF and CFTRI, Mysore, India, November 25.
- NIN (1992). *Bioavailability of iron and zinc from Indian diets*. Annual Report of National Institute of Nutrition, Hyderabad, India, pp.88-89.
- Panse, V.G. and Sukhatme, P.V. (1985).** *Statistical methods for agricultural works*. ICAR Publications. NEW DELHI (INDIA).
- Sheshadri, S. (1997).** Nutritional anaemia in south Asia. In S. Gillespie, Ed *Malnutrition in South Asia : A regional profile*. ROSA Publication No. 5. Kathmandu, UNICEF Regional office for South Asia.
- Singh, G., Kawatra, A. and Sehegal, S. (2005).** Development and nutritional evaluation of products developed from fresh and dried spinach leaves. *J. Food Sci. Technol.*, **42**(3):502-506.
- Singh, G. and Kawatra, A. (2006).** Development and nutritional evaluation of recipes prepared using fresh and dried amaranthus (*Amaranthus tricolour*) leaves. *J. Food Sci. Technol.*, **43**(5) : 509-511.
- Srilaxmi, B. (2005).** *Dietetics*. ISBN-81-224-1611-8. pp.176.

■ WEBLIOGRAPHY

- Yogita (2007).** Community food system data <http://www.lancaster.unl.edu/factsheets/115-94.htm>.

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