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Value addition to traditional products for iron security

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Green leafy vegetables constitute the treasure trove of nutrients in addition to being cheap and easily available. Dehydration of GLVs concentrates nutrients thus providing nutridense food for nutrient security. Hence, an investigation was undertaken to develop green leafy vegetable based designer foods for iron security of adolescent girls with the objective to utilize dehydrated GLV in traditional products to ensure iron security. *Bhajis* and *Pooris* with rehydrated *Rajagira, Chapathi* and *Thalipattu* with sautéed *Rajagira* received higher scores with acceptability scores of 85.33, 92.44, 88.89 and 90.44, respectively and hence, were ranked first. The analyzed protein, iron and β-carotene content in all the value added products ranged from 8.43 to17.97 g, 10.59 to 14.90 mg and 1937 to 3462 µg per serving, respectively and were able to meet 12.98 to 27.64, 37.82 to 53.21 and 80.70 to 144.25 per cent of RDA, respectively for the adolescent girls. Hence, the consumption of value added products from *Rajagira* might serve as a means of combating anemia and to improve the health.

Key Words : Anemia, Green leafy vegetables, Traditional products

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INTRODUCTION

Anaemia is a major public health problem among the population of reproductive age in general and adolescent girls in particular. Despite the fact that Anaemia Prophylaxis Programme is launched in 1970 by Government of India to allay this disorder, the problem still exists in the country with higher magnitude, due to less compliance for pharmaceutical approach by population.

At this juncture, it is essential to look for sustainable, culturally acceptable, cost effective strategy with multiple benefits. Pharmaceutical approach with iron-folic acid tablets provides sole nutrients with low compliance rate. As Dr. Gopalan puts it, food based approach is excellent strategy to combat malnutrition since it provides a package of nutrients and satisfaction, is culturally acceptable and sustainable in addition to being cost effective.

India is bestowed with a number of iron rich foods including cereals, pulses, oilseeds, nuts, vegetables and dry fruits. The country is the second largest producer of vegetables in the world next only to China with a production of 66 million tonnes (Arora, 2005). Wide array of GLVs are available in the country, many of them flooding the market during season and are sold at throw away prices.

The leaves of *Rajagira* scientifically called *Amaranthus paniculatus* are cheapest available in all seasons in most parts of the country and are rich in iron content (Karva, 2008). With this in view the present study was planned with objectives to evaluate the acceptability of value added traditional products

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and to estimate the blood forming nutrients in value added products.

METHODOLOGY

The rajagira leaves were procured from local market and sorted with tender stem and healthy leaves. Sorted leaves were washed by dipping in water for one minute. The procedure was repeated till the vegetable are devoid of dirt and soil.

On the basis of survey (data published elsewhere), a total of six recipes (*Chapathi, Poori, Thalipattu* and *Bhaji* with different pulses) which are traditionally prepared and consumed daily by higher proportion of adolescent girls were selected for value addition. Dehydrated, rehydrated and fresh (sauted or unsauted) GLVs were incorporated in selected recipes. Amount of GLVs to be incorporated was determined based on the iron content so as to meet minimum of 1/3rd requirement of iron for adolescent girls.

Sensory evaluation of the value added products:

The sensory parameters such as appearance, texture, taste, flavour and overall acceptability of the products were evaluated on a nine point hedonic scale using ten trained panel of judges.

Consumer acceptability of the value added products:

Since the ultimatum of any product is acceptability by the consumers, recipes which received highest rank at laboratory level were tested for acceptability by consumers. Girls residing in hostels, laborers, staff and students of the University served as consumers. One serving of the product was provided to each consumer and were requested to indicate the opinion as 'like, dislike or neutral'.

Nutrient composition of value added products:

Nutrient composition of the selected standardized recipes incorporated with *Rajagira* such as *Chapathi, Poori, Thallipattu* and *Bhaji* with different pulses was computed by Annapurna software. Further blood forming nutrients including moisture (AOAC, 1990), protein (micro kjeldahl method of AOAC 1990), iron (Atomic Absorption Spectrophotometer method of Lindsay and Norwell, 1978) and β-carotene (Anonymous, 1951) were analyzed.

Statistical analysis:

The one factor Completely Randomized Design was used to interpret the results of mean acceptability scores of VAPs of *Rajagira* and analyzed nutrient composition of the value added products.

OBSERVATIONS AND ASSESSMENT

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

Sensory evaluation of the value added products:

All the products prepared by incorporating *Rajagira* in different forms were acceptable with scores of above 6.0 ranging from moderately good (6.4) to excellent (8.6) on nine point hedonic scale (Fig. 1 and 2).

Acceptability of cereal based value added products (VAPs) with *Rajagira* leaves is depicted in Fig.1. The *Chapathi* incorporated with sauted leafy vegetable exhibited highest scores for all the sensory parameters compared to dehydrated and rehydrated forms. However, the form of *Rajagira* whether sauted, dehydrated or rehydrated did not significantly influence the scores for colour and appearance or aroma. Incorporation of dehydrated leafy vegetable in *Chapathi* resulted in lower level of acceptability with regard to all the sensory parameters studied. Nevertheless, all the three forms of rajagira incorporated *Chapathies* recieved scores between good and excellent, with mean scores ranging between 7.7 (texture) to 8.1 (aroma).

The texture and overall acceptability of *Poori* (Fig. 1) with sauted *Rajagira* were scored between moderately good and very good with scores of 6.8 and 6.9, respectively, whereas, all the other parameters were scored between very good and extremely good. While aroma of *Poori* with dehydrated *Rajagira* was scored as extremely good (8.0), the other parameters received the scores between very good and extremely good. However, rehydrated *Rajagira* incorporated *Poori* was highly accepted with scores between extremely good and excellent and were significantly higher compared to that with sauted leafy vegetable as indicated by 'F' test.

The acceptability scores for *Thalipattu* with incorporation of *Rajagira* in different forms are depicted in the Fig. 1. The *Thalipattu* in which sauted leafy vegetable was incorporated received significantly highest scores (8.6) with respect to overall acceptability.

However, the form of *Rajagira* whether sauted, dehydrated or rehydrated did not significantly influence the scores for colour and appearance, taste and aroma. The texture of *Thalipattu* with rehydrated *Rajagira* was scored between extremely good and excellent with 8.6 scores. Incorporation of dehydrated leafy vegetable in *Thalipattu* resulted in lower level of acceptability with regard to all the sensory parameters studied. In spite of the numerical differences, all the three forms of *Rajagira* incorporated *Thalipattu* were acceptable and scored between good and excellent, with mean scores ranging between 7.6 (colour and appearance and texture) to 8.6 (texture). The results are in concurrence with those of Lakshmi and Vimala (2000); Unde *et al.* (2000); Kaur and Kochar (2005) Singh and Awasthi (2003); Shah (2005) and Nande *et al.* (2007).

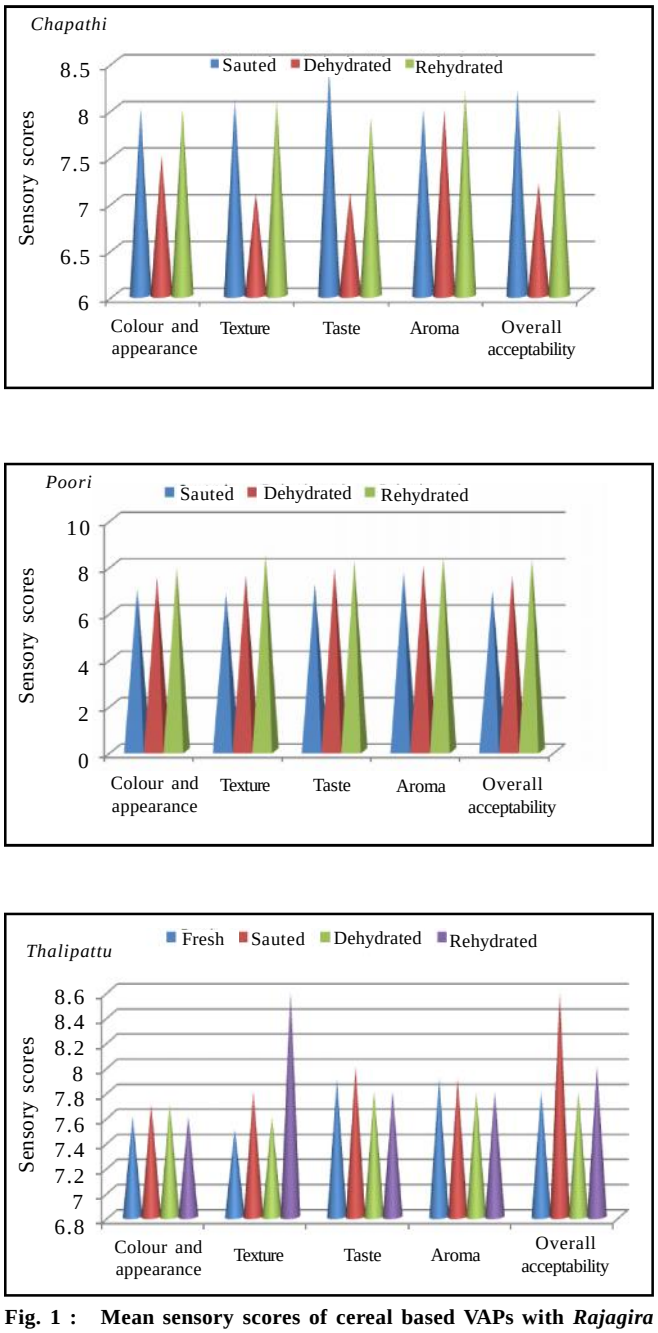

Fig. 1 : Mean sensory scores of cereal based VAPs with *Rajagira* leaves

Fig. 2 indicates mean sensory scores of pulse based VAPs with Rajagira leaves. The highest scores were received by the green gram *Dhal bhaji* with rehydrated *Rajagira* irrespective of all sensory parameters. *Bhaji* with fresh *Rajagira* was scored between very good and extremely good for the colour and appearance with scores of 7.6 and between extremely good and excellent for overall acceptability with score of 8.1. Whereas, the *Bhaji* with rehydrated *Rajagira* was scored between very good and extremely good for texture (7.7) and between extremely good and excellent for taste (8.2). With regard to aroma, *Bhaji* with rehydrated and fresh *Rajagira* received significantly higher scores (7.4 each) than *Bhaji* with dehydrated *Rajagira* (6.7). Though *Bhaji* with dehydrated *Rajagira* received lowest scores for all the sensory parameters studied, it was above the acceptable level of 6.00.

The mean acceptability scores for *Bhaji* (red gram *Dhal* based) and *Bhaji* (whole green gram based) with incorporation of fresh, rehydrated and dehydrated *Rajagira* is depicted in the Fig. 2. Both *Bhajis* with rehydrated *Rajagira* recorded highest scores for all the sensory parameters, ranging between extremely good (8) and excellent (9). However, the form of *Rajagira* whether fresh, dehydrated or rehydrated did not significantly influence the scores for texture and aroma of *Bhaji* though rehydrated form received higher scores. Incorporation of dehydrated leafy vegetable in *Bhaji* resulted in lower level of acceptability with regard to all the sensory parameters studied, compared to fresh and rehydrated. Higher acceptability of *Bhajis* with rehydrated *Rajagira* compared to other two may probably be because of bright colour of the leaves, well cooked, soft fibres and good blendability with pulses. The rehydration process enhances the softness of fibres in addition augmenting colour. Though, all three forms of *Rajagira* differed significantly with regard to sensory parameters, they were acceptable at the laboratory level by panel of judges. The results are in accordance with

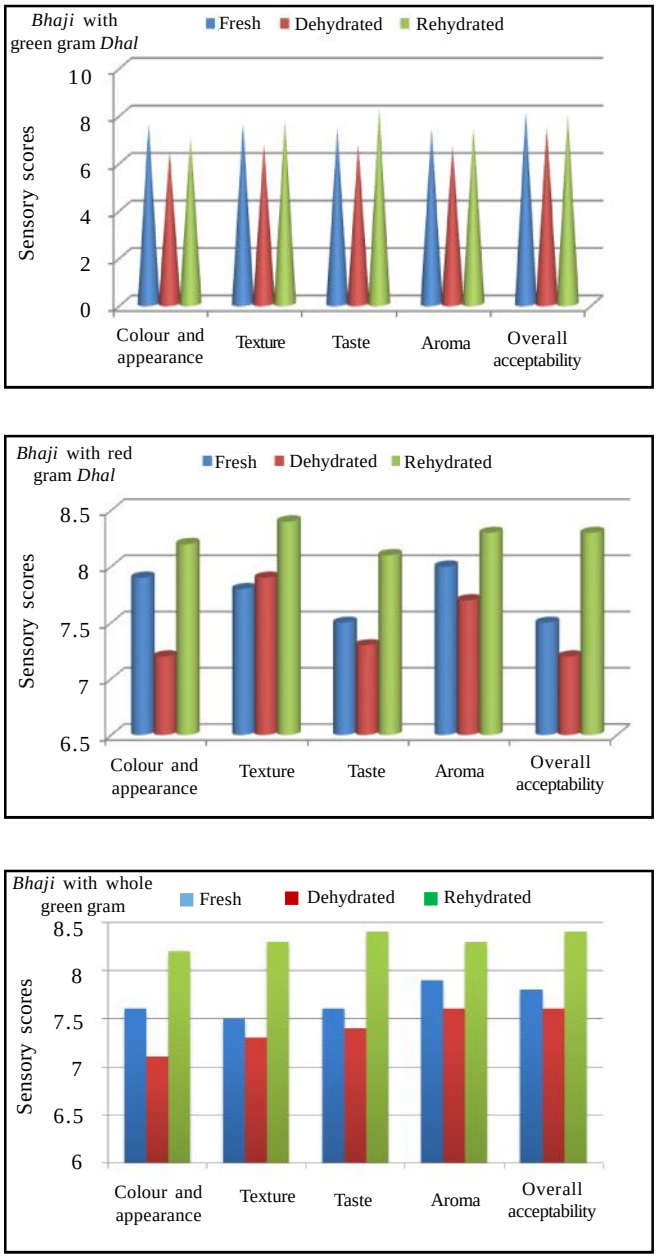

Fig. 2 : Mean sensory scores of pulse based VAPs with *Rajagira* leaves

those of Lalitha and Sathya (2003); Anonymous (2003); Shah (2005) and Nambiar and Parnami (2007).

Table 1 indicates the ranks of the value added products based on acceptability indices. The *Rajagira* incorporated in the rehydrated form in *Poori* and *Bhaji* with green gram *Dhal*, red gram *Dhal* and whole green gram were ranked I with highest scores of 91.78, 85.33, 91.78, and 92.44, respectively. *Chapathi* and *Thalipattu* with sauted *Rajagira* were ranked I with highest scores of 90.44 and 88.89, respectively. It was obvious that fresh vegetable when incorporated in products like *Thalipattu* and *Bhaji* with different pulses were not accepted in line with rehydrated GLV and hence, were ranked III and II. Dehydrated leafy vegetable when incorporated in different products were ranked third with lower sensory scores ranging from 75.0 to 86.0 except *Poori* which was ranked second.

Consumer acceptability of the value added products:

Chapathi and *Rajagira bhaji* with green gram *Dhal* were evaluated by 300 adolescent girls to indicate their acceptability (Fig. 3). Among 300 consumers majority of them liked *Chapathi* (90.33%) and *Bhaji* (84.33%). Around 8.34 and 12.67 per cent of the consumers neither liked nor disliked the products *viz.*, *Chapathi* and *Bhaji*, respectively. Very few consumers (1.33 and 3.00 %) did not like *Chapathi* and *Bhaji* with rehydrated *Rajagira*, respectively.

Composition of blood forming nutrients in VAPs :

The composition of blood forming nutrients (by analysis) of VAPs (with rehydrated *Rajagira*) and its per cent adequacy (per serving) for adolescent girls is given in Table 2.

Moisture content of *Rajagira bhaji* (with green gram *Dhal*) was significantly higher (65.26 g) followed

Table 1: Ranks of the value added products based on acceptability indices

Sr. No.	Products	Unsauted	Sauted	Dehydrated	Rehydrated
1.	*Chapathi*	_	I (90.44)	III (82.00)	II (89.33)
2.	*Poori*	_	III (79.11)	II (85.78)	I (91.78)
3.	*Thalipattu*	III (86.00)	I (88.89)	III (86.00)	II (88.44)
4.	*Bhaji-I*	II (84.67)	_	III (75.56.)	I (85.33)
5.	*Bhaji-II*	II (86.00)	_	III (82.89)	I (91.78)
6.	*Bhaji-III*	II (85.33)	_	III (82.22)	I (92.44)

Figures in parenthesis indicate acceptability indices

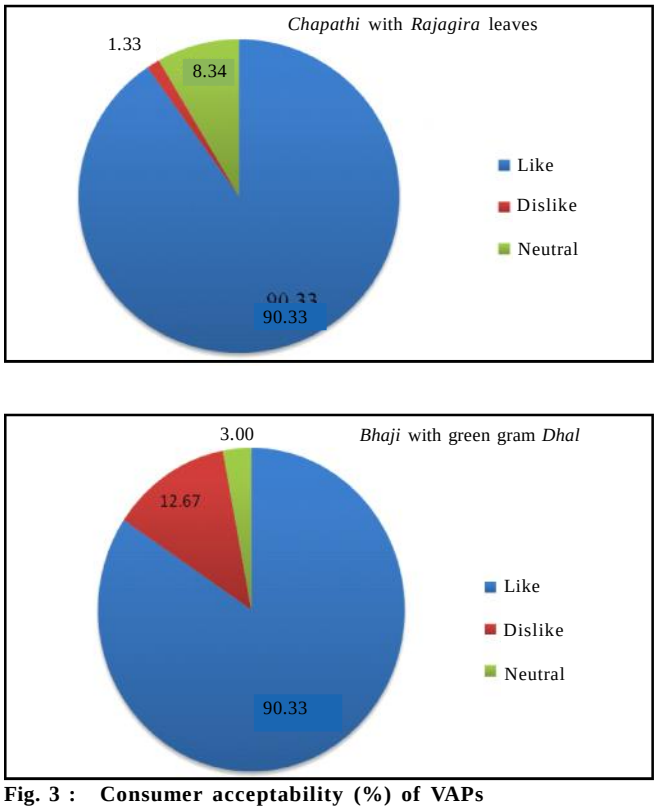

Fig. 3 : Consumer acceptability (%) of VAPs

by *Rajagira Thalipattu* (31.98 g), *Poori* (28.76 g) and *Chapathi* (27.61 g) per serving. *Thalipattu* contained significantly higher amounts of protein (17.97 g), iron (14.90 g) and β-carotene (3462µg) per serving compared to other value added products *viz.*, *Chapathi, Poori, Bhaji*. Obviously, *Thalipattu* could meet higher requirements of these blood forming nutrients (28, 53 and 144%, respectively) than other VAPs. This may be attributed to the large serving size and combination of variety of ingredients specially cereals and pulses, in proportion of 2:1 and with the addition of GLV, the composition improved further.

Bhaji with green gram provided significantly lower amounts of protein (8.44 g / serving), iron (10.59 mg / serving) and β-carotene (1937 µg / serving) meeting 13, 38 and 81 per cent of the recommendations of adolescent girls. Value added *Chapathi* and *Poori* did not differ significantly with regard to the quantity of iron present in them. *Poori* recorded significantly lower amounts of protein (9.35 g) and β-carotene (2300 µg) compared to *Chapathi* (10.46 g and 2490 µg, respectively).

The energy content of *Chapathi* and *Poori* was 328 and 233 Kcal, respectively which was augmented

Table 2 : Composition $ and adequacy (%) of blood forming nutrients in VAPs (per serving)

Sr. No.	Products	Moisture (g)	Protein		Iron		β-carotene	
			(g)	Adequacy (%)	(mg)	Adequacy (%)	(µg)	Adequacy (%)
1.	*Chapathi*	27.61	10.46	16.15	12.70	45.35	2490	103.75
2.	*Poori*	28.76	9.35	14.38	12.25	43.75	2300	95.83
3.	*Thalipattu*	31.98	17.97	27.64	14.90	53.21	3462	144.25
4.	*Bhaji*	65.26	8.43	12.98	10.59	37.82	1937	80.70
Mean		38.40	11.55		12.61		2547.25	
S.E.±		0.52	0.01		0.46		0.41	
C.D. (P=0.01)		2.25	0.04		1.97		1.76	
'F' value		1198.92**	227578.7**		15.10**		2547165.5**	

Each value represents average of 4 determinations ** indicate significance of value at P=0.01 $ By analysis

Table 3 : Increase (%) in the blood forming nutrients with incorporation of *Rajagira* leaves

Products / Nutrients	*Chapathi*	*Poori*	*Thalipattu*	*Bhaji-I*	*Bhaji-II*	*Bhaji-III*
Energy	11.18	16.5	8.05	21.38	21.65	21.65
Protein	39.72	47.54	22.22	69.04	78.94	73.17
Iron	386.2	444	233.33	1009.09	1233.33	925
Zinc	7.69	9.09	5.55	16.66	33.33	16.66
Total carotene	41735.3	47300	9854.16	54576.9	28380	37342.1
Total folic	346.51	416.2	118.63	326.75	430.63	4138.88
Vit. C	4050	4050	764.15	920.45	920.45	920.45

by 11.18 (*Chapathi*) and 16.50 per cent (*Poori*) over the traditional non-incorporated product. The protein content was increased by 39.72 per cent in *Chapathi* (10.2 g) and 47.52 per cent in *Poori* (9.0 g). There was a tremendous increase in iron and total carotene contents in all the value added products. The presence of minerals like iron and zinc was to an extent of 14.1 and 1.4 mg in *Chapathi* and 13.6 and 1.2 mg in *Poori* which were enhanced by 386.20 and 7.69 per cent in *Chapathi* and 444.00 and 9.09 per cent in *Poori*. The total carotene content was increased by 41735.29 per cent and 47300.00 per cent in *Chapathi* and *Poori* containing 7112 and 7110 µg per serving, respectively.

The energy (456 Kcal) and protein (16.5 g) content of *Thalipattu* was increased by 8.05 and 22.22 per cent whereas iron (16.0 mg) and zinc (1.9 mg) contents were augmented by 233.33 and 5.55 per cent. The total carotene and total folic acid content of *Thalipattu* was 7167 and 137.3 µg which was augmented to 9854.16 and 118.63 per cent.

Rajagira bhaji with variation of pulses did not show much variation in energy and protein content (193 kcal and 6.8 g in green gram *Dhal* based, 191 kcal and 6.8 g in red gram *Dhal* based, 191 and 7.1 g in whole green gram based which was increased by 21.38 per cent (green gram *Dhal* based) to 21.65 (whole green gram and red gram *Dhal* based) and 69.04 (green gram *Dhal* based) to 78.94 per cent (red gram *Dhal* based), respectively. The iron content was enhanced many fold in *Bhaji* prepared using *Rajagira* leaves (925.00% in *Bhaji* with whole green gram to 1233.33 per cent in that with red gram *Dhal* based, respectively) compared to unincorporated pulse *Bhajis* (12.3 and 12.0 mg, respectively). *Bhaji* with red gram *Dhal* showed lesser content (0.4 mg) of zinc than other variations (0.7 mg) which was enhanced by 28380.00 per cent. While the actual content of the total carotene and total folic acid ranged from 7108 (green gram *Dhal* based) to 7120 µg (red gram *Dhal* based) and 76.3 (whole green gram based) to 97.3 µg (green gram *Dhal* based), respectively in all the variations of *Bhaji*, this increased by 54576.92 and 28380.00 per cent and 4138.88 to 326.75 per cent. The combination of ingredients leads to an increase in essential amino acid content substantially, thus, improving the quality of the products. Similarly a substantial increment in nutrients was observed in the products after addition of GLVs by Nalwade *et al.* (2002); Kaur and Bajwa (2003); Anonymous (2003); Punia *et al.* (2004); Jemima and Bhavani (2004) and Kasturiba *et al.* (2007).

Conclusion:

Thus, it can be concluded from the study that leafy vegetables like *Rajagira*, an underexploited vegetable can be successfully incorporated in traditional routinely consumed products facilitating an improvement in nutritive value without affecting the acceptability. This happens to be the most sustainable strategy to combat widespread micronutrient hidden hunger.

LITERATURE CITED

Anonymous (1951). *Methods of vitamin assay of the association of vitamin chemists*, Inter Science Publishers, Inc., New York, U.S.A.

AOAC (1990). *Official methods of analysis of the association of official analytical chemists*. 20th Ed., AOAC, Washington, D.C., U.S.A.

Anonymous (2003). Gender perspective in farm and home management and utilization of underutilized foods towards household nutrition security, PSR-62, NATP Report.

Arora, V.P.S. (2005). Marketing and export of horticultural products of Uttaranchal: Status, potential and strategies. *Indian J. Agric. Mktg.*, **19**(2): 195.

Jemima, B. M. and Bhavani, K. (2004). The efficacy of cauliflower greens preparation in improving blood hemoglobin in selected adolescent girls. *Indian J. Nutr. Diet.*, **41**: 63- 66.

Karva, S.L. (2008). Enrichment of traditional foods with green leafy vegetables for iron security of adolescent girls, MHSc Thesis, the University of Agricultural Sciences, Dharwad, Karnataka (India).

Kasturiba, B., Naik, R. K. and Basarkar P.W. (2007). Impact of synthetic vitamin A and horticulture intervention on vitamin A status and iron status of rural school children. *J. Human Ecol.*, **22**(3): 251 – 254.

Kaur, J. and Bajwa, U. (2003). Effect of pre-treatments of green leafy vegetables on the quality attributes of vegetable impregnated *paneer*. *Indian J. Nutr. Diet.*, **40**(6): 632-637.

Kaur, T. J. and Kochar, G. K. (2005). Organoleptic evaluation and retention of vitamin C in commonly consumed food preparations using underexploited greens. *Indian J. Nutr. Diet.*, **42**: 425-431.

Lakshmi, B. and Vimala, V. (2000). Nutritive value of dehydrated green leafy vegetable powders. *J. Food Sci. Tech.*, **37** (5): 465 - 471.

Lalitha, R. and Sathya, K. (2003). Enrichment of instant food mixes with ß-carotene through green leafy vegetables: acceptability characteristics. *Proc. Internat. Food Conference*, SS-02 : 75.

Laxmi and Radhapriya (2005). Incorporation of dehydrated plantain and drumstick flowers in recipes and their acceptability. *Indian J. Nutri. Dietet.*, **42**: 300-306.

Lindsay, W. L. and Norwell, W. A. (1978). Development of DTPA soil test for Zn, Fe, Cu and M. E. No. *J. American Soc. Soil Sci.*, **42**: 421-428.

Nalwade, V. M., Reddy, N. S. and Kokil, V. N. (2002). Proximate composition of calcium, iron and ß-carotene contents of vegetable preparations. *Indian J.Nutr.Diet.*, **39**(2): 81-84.

Nambiar, V. S. and Parnami, S. (2007). Standardization and organoleptic evaluation of drumstick (*Moringa olefera*) leaves incorporated into traditional Indian recipes. *Trees Life J.*, **3**: 2.

Nande, P., Dudhmogre, S. and Vali, S. A. (2007). Evaluation of nutritive value and acceptability of recipes prepared from spinach and betel leaves. *Indian J. Nutr. Diet.*, **44**: 476-483.

Punia, D., Yadav, S., Gupta, M. and Khetar, N. P. (2004). Nutrient composition of amaranth (*Amaranthus tricolor*) and *Kondhara* (*Digeria arvensis*) leaves and their products. *J. Food Sci. Tech.*, **41**(5): 563-566.

Shah, B. A. (2005). Value addition of traditional diets for iron with bengal gram leaves. M.Sc. Thesis, Marathwada Agriculture University, Parbhani, M.S. (India).

Singh, P. and Awasthi, P. (2003). Sensory and nutritional quality evaluation of green leafy vegetable (GLV) powder incorporated food products. *Proc. Internat. Food Conference*, SS-07: 77.

Unde, P.A., Padian, S.M. and Chaudhari, R.S. (2000). Osmotic dehydration of leafy vegetables. *Beverage & Food World*, **26** (1): 26-27.

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