A REVIEW

FOOD SCIENCE
RESEARCH JOURNAL

e ISSN-2230-9403 ■ Visit us : *www.researchjournal.co.in*
Volume 5 | Issue 2 | October, 2014 | 168-173
DOI : 10.15740/HAS/FSRJ/5.2/168-173

Nutritional evaluation of value added products using dehydrated greens for security of haematinic nutrient

ANCHAL SINGH, KIRAN GROVER AND NITISHA SHARMA

Green leafy vegetables (GLVs) are known to be inexpensive rich sources of micronutrients such as vitamin A, iron, β-carotene, etc. and utilizing them is one way of ensuring the micronutrient intake. Dehydration is one of the traditional methods of preservation, which converts the food in to light weight, easily transportable and storable product. It facilitates the utilization of the dried leaves in other parts of the country or world where this vegetable is unavailable in plenty. In addition to increasing variety in the menu, reducing wastage, labour and storage space, dehydrated vegetables are simple to use and have longer shelf-life than fresh vegetables. On one hand dehydrated greens are concentrated form of iron and on the other home preparations based on cereals and pulses contain negligible amount of iron so addition of dehydrated greens as natural means into it become a long term sustainable, culturally acceptable, rational applicable, feasible, cost effective and suitable approach to attain iron security and combat iron deficiency anaemia.

Key Words : Anaemia, Dehydration, Micronutrients, Iron security

How to cite this article : Singh, Anchal, Grover, Kiran and Sharma, Nitisha (2014). Nutritional evaluation of value added products using dehydrated greens for security of haematinic nutrient. *Food Sci. Res. J.*, **5**(2): 168-173.

INTRODUCTION

Green leafy vegetables (GLVs) are micronutrient dense nature's gift to mankind that provide more vitamins per mouthful than any other food. The diverse agro-climatic conditions of India have blessed with a wide variety of inexpensive foods rich in carotenoids and iron such as green leafy vegetables. The use of commonly available green leafy vegetables such as Bengal gram leaves, spinach and fenugreek leaves eradicate the underlying micronutrient deficiencies. Nutritional composition of spinach leaves was estimated as moisture (92.1%), protein (2.0%), fat (0.7%), ash (1.7%), fibre (0.6%), carbohydrates (2.9%) and energy (26%) (Gopalan *et al.*, 2012). Bengal gram leaves are still under exploited in different parts of India and their nutrient potential has not yet been adequately studied. Nutrient content of Bengal gram leaves indicated that the protein, calcium and iron content in Bengal gram leaves was 5.80g/100g, 337.56mg/100g and 22.34 mg/100g, respectively (Bisla *et al.*, 2012). Amongst the leaves of amaranth, cauliflower, mint, coriander and carrot, Bengal gram leaves have got the highest content of ascorbic acid, β- carotene and total iron (Singh and Mishra, 2001).

The intake of iron and other blood forming nutrients is influenced by availability of foods like green leafy vegetables or oranges or guavas, which influenced iron security and anaemia status. Green leafy vegetables are one of the most valued components of Indian diets for their colour, flavour and therapeutic effects. The frequency of consumption of green leafy vegetables by the adolescent girls is reported to be higher during rainy and winter compared to summer. Irrespective of locality, girls recorded higher mean haemoglobin level during winter (9.88g/dl) and rainy (9.87g/dl) season compared to summer (9.63 g/dl) (Deepa *et al.*, 2004). Rainy and winter

MEMBERS OF RESEARCH FORUM

Author for correspondence :
ANCHAL SINGH, Department of Food and Nutrition, Punjab Agricultural University, LUDHIANA (PUNJAB) INDIA
Email: aanchalsingh.singh@gmail.com

Associate Authors' :
KIRAN GROVER AND NITISHA SHARMA, Department of Food and Nutrition, Punjab Agricultural University, LUDHIANA (PUNJAB) INDIA

seasons are ascribed to availability and consumption of green leafy vegetables and other foods rich in blood forming nutrients like orange, papaya, guava, carrot, grapes, *amla* and pumpkin. This is contributed to improvement in haemoglobin level.

Steps for dehydration of green leafy vegetables :

The following dehydration technique can be used for dehydration of GLVs and iron security at household level :

Sorting :

Collect the fresh leaves and remove the stems and other unwanted parts from green leafy vegetables.

Washing :

Wash the leaves with slightly warm water to remove the dirt particles. Drain out the excess water from leaves.

Blanching :

Blanch the leaves (enclosed in muslin cloth) in a stainless steel pan for 2 minutes at 80^0C and dry them by following suitable and available technique.

Drying :

The leaves can be dried by using a variety of common household methods for drying which are as following :

Sun drying :

After blanching and air drying for few minutes put on filter paper. Place the trays at place where adequate area of sun light is available. Solar drying can be used for the drying of green leafy vegetables.

Shadow drying :

Spread the blanched and air dried leaves on filter papers and keep it in well ventilated room.

Cabinet tray drying :

In this technique, blanched greens are spread on tray and placed in cabinet dryer at 60^0C for 5 hours.

Oven drying :

The blanched and air dried leaves are kept in single layer loaded tray in preheated oven (60°C). Maintain the temperature at 60°C and the process is carried out.

***Storage* :**

Dehydrated GLVs is packed in low density polyethylene bags and in air tight aluminum containers for future use.

Development and nutritional evaluation of value added products :

Dehydrated leafy vegetables are concentrated source of several nutrients including iron and β-carotene. Development of the products by incorporation of the dehydrated GLVs in traditional preparations can assist to meet the daily nutritional requirements of the adolescent girls. These products if included in routine diet can help to reduce the incidence of iron deficiency anaemia. Relevant literatures pertaining to these aspects are reviewed in this section.

Vijayalakshmi and Devdas (1994) carried out a study on enhancing the nutritive value of convenience foods by incorporating green leafy vegetables. It was concluded from the study that addition of coriander and curry leaves in *vadai* mix and *bhaji* mix increased the nutritive value of convenience foods with respect to protein, β-carotene, calcium and iron. The protein, β-carotene, calcium and iron contents before adding greens were 16 g, 0.0 µg, 42 mg and 13 mg in *vadai* mix and 16 g, 0 µg, 50 mg and 7 mg in *bhaji* mix which increased to 12 g, 2171 µg, 181 mg and 12.9 mg (*vadai* mix) and 12 g, 2170 µg, 187 mg and 8.9 mg in *bhaji* mix, respectively.

The acceptability of products with cauliflower leaves was carried out by Kowsalya and Mohandas (1999). The study revealed that cauliflower leaves were used in the common south Indian preparations such as, *poriyal* and *kootu*. The drumstick leaves *poriyal* and *kootu* were used as standard for comparison. Identical scores were obtained for both standard and test *poriyal* with respect to appearance (4), color (4), and texture (3.8) on four point numerical rating scale. The higher total score was obtained for cauliflower leaf *poriyal* (19.8) with 90 per cent of panel members opting it. Standard and test *kootu* was equally acceptable for appearance and colour (4) but the total score was highest for drumstick leaves *kootu* (19.6).

Lakshmi and Vimala (2000) dehydrated amaranth, curry leaves, *gogu* and mint leaves to prepare powders for incorporation in different products which were evaluated by panel of trained judges. The food products prepared using powders of amaranth (soup, *dhal* with greens and *pesarattu*), curry leaves (hot powder, *pakodi* and *pesarattu*), *gogu* (*dhal* with greens, *chutney* and mutton curry) and mint (vegetable *biryani*, *chutney* and bone soup) were rated as highly acceptable for all the sensory attributes and were scored from good (4) to excellent (5) on five point scale. However, soup with amaranth powder received slightly lower scores of 3.8 for overall acceptability, taste and flavour. Value added traditional products of Bangalore were acceptable with scores of 4.2 (*upma* and *dosa*) 4.1 (*majjigehuli*, *ambode* and *ladoo*) to 3.9 (*Bisebele bhath*) on five point scale in a study conducted at Bangalore (Anonymous, 2003). *Masala* bun with *knolkhol* greens received lowest scores of 3.3. Report from Hisar indicated that value added products (VAPs) with underutilized leafy vegetables, fruits and other vegetables were highly acceptable with scores of more than 7.0 on nine point hedonic

scale (Anonymous, 2003). *Oogal namakpara* of Pantanagar was less acceptable with score of 7.0. Other VAPs namely, soy *chat*, soy *mathari*, soy leaves *pakora* received the overall acceptable scores of 7.5 and 8.0.

Nalwade *et al.* (2002) studied the proximate composition, calcium, iron and β-carotene contents of green leafy vegetable preparations. The moisture content varied from 80.86 g in Bengal gram leaves curry to 90.75 g/100 g in spinach curry. Ash content varied from 1.20 g to 2.80 g in *ambat chukka* and drumstick curry. Other preparations like *palak*, *methi*, shepu, green gram *dal* curries recorded similar values (2 to 2.26%). Iron content of the vegetable preparations differed from 0.26 to 27.33 mg per cent with highest in *methi* green gram curry and lowest in drumstick leaves curry. Colocasia curry registered highest β-carotene (10,321 µg/100 g) followed by shepu *mung dhal* curry (5094 µg/100 g) whereas, bengal gram leaves curry recorded lowest β-carotene (12.28 µg/100 g).

Sathya *et al.* (2002) developed some recipes and analysed them for *in vitro* iron availability and found the highest iron availability for *sun dal* with 423 µg/100g followed by drumstick leaves *kootu* 321, cabbage *kootu* 312, *pakoda* 289, *agathi kootu* 219, *masiyalo* 216 and *adai* 112 µg/100g. In *vitro* iron availabilities of iron were 2.79 and 3.03 per cent in bathu and spinach leaves, respectively.

Vijayalakshmi *et al.* (2003) enhanced the nutritive value of convenience foods by incorporating green leafy vegetables and reported the range of *in vitro* iron bioavailability in various standardized mungbean recipes from 2.9 to 7.9 per cent. Kaur and Bajwa (2003) studied effect of green leafy vegetables on the quality attributes of vegetable impregnated *paneer*. The leafy vegetables (coriander and mint) were blanched (steam or water) prior to impregnation in *paneer* and then evaluated for sensory scores by using nine point hedonic scale. The study revealed that steam blanched coriander in *paneer* received higher scores for colour (7.67) compared to water blanched (7.17) and unblanched (6.08). Colour influenced on appearance of *paneer*, the unblanched samples receiving significantly lower scores than blanched. The coriander-impregnated *paneer* with unblanched leaves had comparatively stronger coriander flavour which was contributed to higher flavour profile (8.50). The overall acceptability was found to be highest for the samples prepared by incorporating steam blanched coriander (7.32). However, texture was not affected by incorporation of coriander. Similarly, *paneer* with steam blanched mint leaves received higher scores for all sensory attributes compared to water blanched and unblanched.

Kulkarni (2003) developed number of value added food products using underutilized leafy vegetables. The nutrients such as protein, iron, ß-carotene and ascorbic acid ranged from 2.43 g (ground nut *chutney* with *chakramuni* leaves) to 15.71 g (barnyard millet *upma* with drumstick leaves), 1.40 mg (groundnut chutney with *chakramuni* leaves) to 12.94 mg (little millet *dosa* with *chakramuni* leaves), 15.63 µg (groundnut chutney with *chakramuni* leaves) to 2338.09 µg (drumstick *chapathi* with soybean) and 0.40 mg (coconut *chutney*) to 946.80 mg (both variations of *turdal bhaji* with *chakramuni* and *chandanabatta* leaves) per serving, respectively. Singh and Awasthi (2003) calculated nutrient composition of the products namely, biscuits, *murukku*, *mathri* and *namakpare* incorporated by *kachnar*, drumstick, colocasia and curry leaves. The protein, iron and β-carotene contents of the products ranged from 11.6 to 23.8 g /100 g, 2.16 to 5.62 mg /100 g and 819.2 to 3017.75 µg /100 g, respectively. Sadana and Hira (2004) evaluated the nutrient content of *saags* prepared from unconventional leaves namely kail, Palampur dark green, Chinese sarson no.1 and Palampur light green. Nutritional evalution of prepared recipes revealed that these greens were rich sources of calcium, iron, β-carotene and ascorbic acid.

Jemima and Bhavani (2004) reported that the *porial* prepared with cauliflower leaves provided 16.4, 262.9 and 13.85 mg /100 g of iron, calcium and vitamin C, respectively, whereas, fresh cauliflower leaves had 25.1 mg of iron, 260 mg of calcium and 29 mg of ascorbic acid per 100 g. Punia *et al.* (2004) investigated the nutrient composition of amaranth (*Amaranthus tricolor*) and kondhara (*Digeria arvensis*) leaves incorporated products. *Puri* and *paranthas* were prepared with amaranthus leaves. Bengalgram *dhal*, greengram *dhal*, *raitha* and *sag* were prepared with kondhara leaves. Protein, fat, minerals, crude fibre, carbohydrates and energy contents of the products varied from 11.48 to 30.44, 7.25 to 28.77, 2.64 to 21.33, 0.25 to 5.75, 38.56 to 70.72 g/100 g and 367 to 33 kcal/100g on dry weight basis. Calcium, iron, ascorbic acid and β-carotene contents of products were 127.30 to 3350, 1.50 to 4.10, 5.41 to 60.83 mg/100 g and about 1710 to 10557 µg/100 g on dry weight basis, respectively. Singh *et al.* (2004) studied the nutritional evaluation of products prepared from dried spinach leaves and estimated that, the moisture and protein contents of cake, biscuits, *pakora*, *vada*, *namakpara* and *kurmura* ranged from 1.43 to 40.87 per cent and 9.61 to 16.62 per cent, respectively. Ascorbic acid content was higher in products prepared from fresh spinach as compared to that prepared from dried powder. β-carotene content was found to be highest in *namakpara* prepared from dried leaves. Total iron content of spinach products ranged from 4.10 to 15.00 mg /100 g on dry weight basis. Ionizable iron and *in vitro* iron (% of total iron) was reported to be maximum in biscuits. The investigation revealed that the products developed with the spinach contained appreciable amounts of iron and β-carotene.

Lakshmi and Radhapriya (2004) studied the nutritive value of fresh and dried drumstick leaves which were found

to be rich sources of iron, calcium and total carotene. They reported that incorporation of flowers at 5, 10 and 15 per cent, into chapati, adai, vadai, dry curry, chutney powder and masala powder incorporation at 5 and 10 per cent levels were better accepted than at 15 per cent levels. Singh *et al.* (2005) carried out a study on nutritional evaluation of products prepared from cauliflower leaf powder. The study showed that protein content was maximum in *kurmura* (12.25%) and minimum in biscuit (7.42%). Ascorbic acid and β-carotene contents of biscuit, cake, *namakpara*, *kurmura* ranged from 2.21 to 4.29 mg and 2.04 to 4.98 mg, respectively. Total iron content was highest in cake (9.90 mg) and ionizable iron was found to be higher in biscuit (2.63 mg). Das *et al.* (2005) determined the *in vitro* availability of iron from common foods stuffs of plant origin. The samples were analyzed spectrophotometrically using derivative spectroscopy for total and *in vitro* available iron (ionizable iron). Though rice had lowest total iron content (0.61 ± 0.09 mg/100g), the per cent ionizable iron was highest (29.50 ± 4.75%) as compared to all other cereals and millets tested and also comparable to some of the whole pulses analyzed. Similarly, maize with comparatively lower total iron content (2.73 ± 0.14 mg/100g), had a higher per cent ionizable iron (25.30 ± 1.46%). The whole pulses were found to contain total iron ranging from 4.40 ± 0.30 mg/100g in blackgram to 6.36 ± 0.55 mg/100g in rajmah, but except Bengal gram (white) (21.71 ± 0.53%), pea (35.66 ± 4.44%) and rajmah (24.05 ± 1.42%), others showed very low ionizable iron (3.41 ± 0.22-6.53 ± 1.31%). Split pulses had a better per centage of ionizable iron (13.80 ± 0.73-31.70 ± 1.74%) compared to whole pulses, which could possibly due to removal of some inhibiting factors present in the seed coat. Though green leafy vegetables had comparatively lower amount of total iron (1.82 ± 0.11-3.76 ± 0.23 mg/ 100g), it had a high ionizable iron from 30.22 ± 1.10 to 52.13 ± 1.90 per cent.

Kaur and Kochar (2005) carried out a study on organoleptic evaluation of preparations using underexploited greens (greens of cauliflower, radish, turnip and carrot). To evaluate the products for sensory attributes Hopkin's seven point scale was used. The study revealed that the most acceptable level for *prantha* with radish and cauliflower greens was 30 per cent whereas, in case of carrot and turnip greens, it was 50 per cent. The respective scores for overall acceptability ranged from 5.42 (cauliflower greens) to 6.02 (radish greens). *Bhurji* prepared by using cauliflower greens scored highest (6.08). *Puri* with turnip and carrot greens was scored 5.54 and 6.52 at 50 and 60 per cent incorporation, respectively. Acceptable *pulav* could be developed by incorporating carrot and turnip greens at 30 and 40 per cent with scores 5.78 and 5.52, respectively. *Pakora* prepared by incorporating cauliflower and radish leaves at 40 per cent was best acceptable with scores of 5.42 and 6.30, respectively. Reema *et al.* (2004) prepared burfi, pinni, sevian from germinated wheat flour supplemented with green gram/soy flour, incorporating 5 per cent dried carrot greens in burfi and 5 per cent colocasia greens in sevian. Sevian were found to be nutritionally superior due to higher ascorbic acid, β-carotene, protein, iron, calcium and zinc content as compared to *burfi*.

Shah (2005) carried out a study on proximate composition of recipes with Bengal gram leaves. The study revealed that protein and iron content in *shev*, *chakli*, *mung dal* and *udad dal wada* were 16.66 g and 7.8 mg, 11.66 g and 21.58 mg, 21.58 g and 9.50 mg, 16.91 g and 9.10 mg, respectively. Singh *et al.* (2005) carried out a study on nutritional evaluation of products prepared from cauliflower leaf powder. The study showed that protein content was maximum in *kurmura* (12.25%) and minimum in biscuit (7.42%). Ascorbic acid and ß-carotene contents of biscuit, cake, *namakpara*, *kurmura* ranged from 2.21 to 4.29 mg and 2.04 to 4.98 mg, respectively. Total iron content was highest in cake (9.90 mg) and ionizable iron was maximum in biscuit (2.63 mg). Singh and Kawatra (2006) studied the ionizable iron content of products *viz.*, *pakora*, *vada*, *namakpara*, *kurmura* biscuit and cake prepared with addition of fresh and dried powder of amaranthus leaves. Ionizable iron content of products ranged from 1.3 in *kurmura* to 2.9 mg/100 g in biscuit prepared from dried leaves. Ionizable iron expressed as per cent of total iron was highest in biscuit (57.4%) followed by cake (27.5%) and *namakpara* prepared with dried and fresh amaranthus leaves (25 and 23.7%, respectively), *pakora* with fresh leaves (19.3%), *kurmura* with dried leaves (16.1%), *vada* (16.2%) and *kurmura* with fresh leaves (22.4%). Pandey *et al.* (2006) studied the nutritional evaluation of leafy vegetable *parantha*. The moisture content of different *paranthas* varied significantly and ranged from 30.50 to 39.85 per cent. The *paranthas* prepared from different leaves varied significantly for protein content. Protein content was found to be highest in *bathua parantha* (28.36%) followed by *palak parantha* (24.19%) and *chaulai parantha* (22.52%). Total mineral content of Bathua parantha, chaulai parantha and palak parantha were found to be 2.69, 4.22 and 1.29 per cent, respectively. The carbohydrate and energy content of bathua, chaulai and palak parantha were found to be 50.91, 50.96, 52.61 and 373, 347 and 359 Kcal, respectively.

Nande *et al.* (2007) evaluated the nutritive value of the recipes prepared from spinach and betel leaves. The data revealed that betel leaves recipes had higher content of all nutrients but there was no significant difference between them. Among all the recipes prepared, coconut *burfi*, cutlet and *muthia*, *muthia* with spinach and betel leaves showed highest content of protein (11.29 and 11.49 g, respectively), carotene (1081.21 and 1114.05 µg, respectively), folic acid (61.18 and 51.87 µg, respectively) and iron (4.07 and 5.80 mg/100g,

respectively). Nambiar and Parnami (2007) conducted a study to standardize and organoleptically evaluate freshly blanched leaves of the drumstick tree (*Moringa oleifera*) incorporated into three recipes commonly consumed in India: *mung* (*Phaseolus aureus*), *kabuli channa* (*Cicer arietinum*) and *desi channa* (*Cicer arietinum*). One serving of each of these recipes (30 g raw weight of pulses) could incorporate a maximum of 20 g of fresh drumstick leaves. All three recipes were found to be acceptable by the panel of judges, with an overall composite score ranging from 3.06-3.53 (on a scale of 1 to 5). The drumstick leaf recipes were micronutrient rich and each serving could provide 3955 µg β-carotene (665 retinol equivalents or RE), 46 mg ascorbic acid and 1.6 mg iron. Meal planners typically use a benchmark of one third of the RDA, and these recipes could achieve 24, 341, 15 and 496 per cent of that level for adult women in energy, vitamin C, iron and β-carotene, respectively. Even if only one sixth of the β-carotene is considered as bioavailable for vitamin A (RE), these recipes would still meet 82.5 per cent to 83.3 per cent of the RDA for adult women. Nalwade *et al.* (2008) estimated the bioavailability of iron and calcium from 14 leafy vegetables. The per cent bioavailability of iron was highest in *tandulga* (62.47%) followed by *paatar* (54.95%). *Ghol* had the minimum amount of bioavailable iron (4.99%) and other vegetables like *sarate*, drumstick, *wavdinga pan, cheel, kunjeer*, *rajgira*, *kantemath, chopdamath*, *tarwata*, beetgreens and *pokla* leaves had 33.07, 30.74, 30.64, 27.28, 22.55, 16.67, 12.20, 10.43, 8.24, 7.15 and 5.37 per cent bioavailable iron, respectively.

Kaur and Kochar (2009) developed commonly consumed food preparations by separately incorporating fresh and dry carrot greens, applying different cooking methods. Levels of incorporation of fresh carrot greens in different food preparations ranged 40 to 80 per cent whereas powder of dry carrot greens was added in different preparations at 7, 8 and 9 per cent levels. Organoleptic evaluation of all food preparations were conducted by a panel of ten judges using Hopkin's seven point scale. In fresh carrot greens incorporated food preparations, the maximum and most acceptable level (80%) of incorporation of under exploited carrot greens was in *saag* and minimum (40%) in *puri* and *kadhi*. In dry carrot greens incorporated food preparations, the most and best level (9 %) of incorporation of greens was in *mathri* and minimum (7%) in *matrey*. Among all the fresh carrot greens incorporated food preparations, *gulabjamun* scored highest (6.96 + 0.27) overall acceptability scores while *laddoo* scored minimum (5.52 + 0.68). In dry carrot greens incorporated food preparations tacques scored highest (6.31 +0.28) and *laddoo* scored minimum (5.98 + 0.69) overall acceptability scores. Karva *et al.* (2010) revealed the post harvest processing of green leafy vegetables for iron security. The five commonly consumed green leafy vegetables (GLVs) of Dharwad city *viz.*, *rajagira*, *kiraksali*, fenugreek, spinach and *shepu*, were selected for the study. Dehydration protocol was assessed employing different pre–treatments (blanching, sulphitation and blanching + sulphitation, untreated) prior to dehydration in sun, shade, hot air oven and microwave oven. Among all selected GLVs, *rajagira* showed highest iron content of 222.52 mg/100g followed by *kiraksali* (54.59 mg/100g). Verma and Jain (2012) estimated fortification of *mathri* with fresh and dehydrated vegetables and assessment of nutritional quality. Levels of incorporation of fresh greens (spinach, mint and carrot) in *mathri* were 8 per cent whereas powder of dry green vegetables (spinach, mint, carrot and lotus stem) was added in *mathri* at 7 per cent. Result showed that the fresh vegetables *mathri* showed the highest overall acceptability (7.8±0.199) attributes and the score fell in the range of like very much. Nutritional analysis showed that protein and iron content of dried vegetables *mathri i.e.* 7.44g and 5.37mg was higher as compared to fresh vegetables *mathri*.

Conclusion :

Various products prepared by the combination of greens are rich sources of essential macro and micro nutrients. Consumption of these foods in daily diets can help in combating micronutrient deficiencies.

Acknowledgement :

The financial assistance provided by Department of Science and Technology (DST), New Delhi is gratefully acknowledged. The first author wishes to thank DST for grant of Inspire Fellowship.

LITERATURE CITED

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

Bisla, G., Archanna, and Pareek, S. (2012). Development of nutrient dense supplementary products for children by using locally available cereals, soy flour, Bengal gram leaves and cowpea leaves. *Asian J. Pl. Sci. Res*., **2** (4) : 396-402.

Das, P., Raghuramulu, N. and Rao, K.C. (2005). Determination of *in vitro* availability of iron from common foods. *J. Hum. Ecol.*, **18** (1) : 13-20.

Deepa, K.S., Bharati, P. and Kasturiba, B. (2004). Seasonal variations in iron status of adolescent girls in Dharwad taluk. *J. Hum. Ecol.*, **15** (3) : 175-178.

Gopalan, C., Ramasastri, B.V. and Balasubramaniam (2012). *Nutritive value of Indian foods*., NIN, ICMR, Hyderabad, A.P. (INDIA).

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** (2) : 63-66.

Karva, S., Bharati, P. and Chimmad, B. (2010). Post harvest processing of green leafy vegetables for iron security. *Karnataka J. Agric. Sci.,* **23** (2) : 306-310.

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** (9) : 425-431.

Kaur, T.J. and Kochar, G.K. (2009). Development and sensory evaluation of beta carotene rich food preparations using underexploited carrot greens. *J. Hum. Ecol.,* **28** (3) : 207-212.

Kowsalya, S. and Mohandas, S. (1999). Acceptability nutrient profile of cauliflower leaves. *Indian J. Nutr. Diet.,* **36** (7) : 332-338.

Kulkarni, L.R. (2003). Documentation, valuearization and promotion of underutilized foods for nutrition security of school children. Ph.D. Thesis, University of Agricultural Science, Dharwad, KARNATAKA (INDIA).

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

Lakshmi, U.K. and Radhapriya, D. (2004). Incorporation of dehydrated plantin and drumstick flowers into recipes and their acceptability. *Indian J. Nutr. Dietet.,* **42** (7) : 300-307.

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

Nalwade, V.M., Tejashree, S. and Khan, T.N. (2008). Bioavailability of iron and calcium from uncommon leafy vegetables. *Indian J. Nutr. Dietet.,* **45**: 320-325.

Nambiar, V.S. and Parnami, S. (2007). Standardization and organoleptic evaluation of drumstick (*moringa oleifera*) leaves incorporated into traditional Indian recipes. *J. Trees Life,* **3** : 2-6.

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.

Pandey, M., Abidi, A.B., Singh, Sadhna and Singh, R.P. (2006). Nutritional evaluation of leafy vegetable parantha. *J. Hum Ecol.,* **19** (2) : 155-156.

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

Reema, Hira, C.K. and Sadana, B. (2004). Nutritional evaluation of supplementary foods prepared from germinated cereal and legumes. *J. Food Sci. Technol.,* **41** (6) : 627-629.

Sadana, B. and Hira (2004). Nutritional evaluation of saags prepared from unconventional leaves. *Indian J. Ecol.,* **31** : 167-169.

Sathya, R., Amirthaveni, M. and Vijaylakshmi, P. (2002). Enhancing the bioavailability of iron from mungbean (*Vigna radiata* L.) through simple modifications in cooking. *Indian J. Nutr. Diet.,* **39** : 45-54.

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, G. and Kawatra, A. (2006). Development and nutritional evaluation of recipes prepared using fresh and dried amaranthus (*Amaranthus tricolor*) leaves. *J. Food Sci. Technol.,* **43** (5) : 509-511.

Singh, G., Kawatra, A. and Sehgal, S. (2004). Nutritional evaluation of products developed from dried spinach leaves (*Spinach oleracea*). *Indian Food Packer,* **58**: 68-72.

Singh, G., Kawatra, A. and Sehgal, S. (2005). Development and nutritional evaluation of products prepared from dried powder of cauliflower leaves. *J. Food Sci. Technol.,* **42** (2) : 137-139.

Singh, N. and Mishra, C.P. (2001). Nutritional status of adolescent girls of a slum community of Varanasi. *Indian J. Public Health,* **45** (4) : 128-134.

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

Verma, S. and Jain, S. (2012). Fortification of *Mathri* with fresh and dehydrated vegetables and assessment of nutritional quality. *Raj J. Extn. Edu.,* **20** : 155-158.

Vijayalakshmi, P.S., Amrithaveni, R.P., Devdas, K., Weinberger, S.C. S., Tsou and Shanmugasundaram, S. (2003). Enhancing bioavailability of iron from mungebean and its effects on health of school children. Taiwan AVRDC – the world vegetable center, Technical Bulletin, No. 30, AVRDC Publication **03** : 559-562.

Vijaylakshmi, P. and Devdas, R.P. (1994). Enhancing the nutritive value of convenience foods by incorporating green leafy vegetables. *Indian J. Nutr. Diet.,* **31**: 333-338.

Received : *01.04.2014*; **Accepted :** *25.09.2014*