ISSN:2319-2607 IISUniv.J.Sc.Tech. Vol.2(1),60-65 (2013)
RESEARCH ARTICLE

Development and Sensory Evaluation of Value Added Products from processed Carrot leaves (*TS – 77 {LALI}*)

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Abstract

Green leafy vegetables are a store house of many micronutrients and they occupy an important place in the diets of millions of people in India. They are even cheap in cost but because of lack of nutrition education people are unaware of their rich composition. Hence the present study was planned to develop and evaluate the commonly consumed recipes by incorporating processed (Blanching and Dehydration) Carrot leaves. Blanching stops all life processes and dehydration makes them a concentrated source of nutrients and hence they can be used as natural fortificant. Nutritional estimations (Moisture, Ash, Fiber, Phenol, Calcium, Iron, Phosphorus, Vitamin C, Oxalate, Phytate) of both fresh and processed leaves was performed by standard techniques. The dried sample was used for development of value added products (Atta-ladoo, Besan-ladoo and Panjiri) at 0% (control), 5%, 10% and 15% level. Organoleptic evaluation was done by using 5 point hedonic scale by semi trained panel. On comparing the results, it could be evaluated that blanched dehydrated leaf powder became a concentrated source of nutrients in comparison to the fresh leaves. The leaf powder was acceptable at 5% percent level while in sweet recipes it was acceptable to the extent of 10%. Therefore, it can be concluded that incorporation of dehydrated carrot leaves in various conventional food items can improve the nutritional quality of the products as well as add variety in the diet.

Keywords

Biochemical analysis, Blanching, Dehydration, Green leafy vegetables, Sensory evaluation

Introduction

Nutrition is at the threshold of new, revolutionary developments and its potentialities for improvement of health are vast however, still maximum population in developing countries is affected by malnutrition particularly micronutrient deficiencies (Singh *et al*, 2007). In India serious micronutrient deficiency disorders associated with vitamin A, Iron and Iodine are encountered due to dietary insufficiency and are designated as 'hidden hunger'. Micronutrients are life sustaining nutrients that are needed in small quantities for effective functioning of brain, the immune system, and their deficiency has a considerable negative effect on health and learning abilities. The result is devastating public health problem effecting people throughout the socioeconomic spectrum. Iron deficiency is the most wide spread micronutrient deficiency in the world effecting more than 2 billion people. Study conducted by Hass and Brownile, 2001 highlighted that the mean prevalence of iron deficiency anemia in pregnant women , infant and children was 50%, 25% in preschool children, 40% in school children, 30-55% in adolescent and 35% in non pregnant women. In India, 79% of children (6 to 35 months) and women (15 to 49 years) are anemic (Krishnaswamy, 2009). The most sustainable approaches to increasing the micronutrient status of populations are food based strategies, which include food production, dietary diversification and food fortification. Food based interventions focus on food – natural, processed, fortified or in combination – as the primary tool for improving the quality of diet and for overcoming and preventing malnutrition and nutritional deficiencies. The basis of this approach is to increase the production and consumption of foods, especially those rich in micronutrients, as well as their absorption and utilization in the body (Allen *et al*, 2006). India is fortunately blessed with a wide variety of inexpensive foods rich in micronutrients particularly green leafy vegetables which are inexpensive and locally available (Kowsalya and Chandrasekhar, 2003). Green leafy vegetables are micronutrient dense nature's gift to mankind that provides more vitamins per mouthful than any other food. It is a treasure trove of micronutrients, plays a crucial role in alleviating hunger and ensuring food security. Therefore, they occupy an important place in the diets of millions of people in India (Olukayode and Adebayo, 2010). However, because of lack of nutrition education,

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people are unaware of their rich nutrient composition. Owning to their high moisture content, they are highly perishable and are sold at throw away prices in the peak season. (Karva *et al*, 2010). By employing suitable preservation techniques that are user friendly and sustainable at the household level like Blanching and Dehydration, we can prevent wastage during glut and increase availability of vegetables in the diet during lean periods (Karva *et al*, 2010). Blanching stops all life processes, inactivates enzymes, fixes green color and removes certain harsh flavors common in green leafy vegetables (Singh *et al*, 2007). Dehydration is one of the simplest method of preserving the green leafy vegetables. By dehydration, the moisture content of the food is reduced and the growth of microorganisms is retarded, therefore, its shelf life improves. It also makes them a concentrated source of vitamins and minerals and thus they become a very suitable "Natural Fortificant" (Joshi and Mehta, 2010). Dehydrated greens can be utilized in multiple ways by incorporating into existing products and formulation of health foods. A number of researches have been conducted to highlight beneficial effect of value addition through locally available micronutrient rich food like green leafy vegetables. However, the consumption of green leafy vegetables in Indian population is limited to 5-10 g per day (NNMB, 1997) as against the recommendations of 100 g by Indian Council of Medical Research (ICMR, 1998). Hence, the present study was planned to add value to various indigenous recipes by incorporating blanched dehydrated iron rich carrot leaves in various recipes in different proportions and conduct their organoleptic evaluation.

Materials and Method

Carrot leaves (*Daucus carota*), TS – 77 (LALI) were procured from Horticulture Centre of Durgapura. Thereafter the leaves were prepared for further experimentation by following methods.

Sorting

Insect infested, damaged, discolored and decayed leaves were discarded before washing the leaves, as decayed leaves give a bad flavor to the whole batch (Adeyeye and Otokiti, 1999).

Washing

The stalks of the leaves were cut from the main branches. The leaves were then washed thoroughly three to four times with plenty of water to remove all the adhering dust, dirt particles. The leaves were then tied together in small bunches and was hung in an airy space to drain away the extra water of the leaves. The residual moisture was evaporated at a room temperature, before the actual drying process on a clean paper with constant turning over to avert fungal growth. After air drying, all the branches of the leaves were removed and only the leaves of carrot were used for processing. The leaves were then weighed and prepared for biochemical estimation. Initially, estimation of fresh leaves was conducted. These leaves were then blanched and dehydrated and again estimated to see the effect of blanching on nutrient retention.

Blanching

Blanching was done by boiling vegetables (88°C) briefly for 5-6 minutes, chilling them in ice water at 2°C for 2 to 3 minutes, blanching preserves texture, color and flavor. This causes the vegetables to cool rapidly, keeping it from overcooking which could turn it mushy and affects the beautiful green color. This is usually carried out in order to reduce the bitter taste and make it more palatable (Oboh, 2005).

Oven drying

Leaves were loaded on the trays forming one single layer of the dehydrator and were dried in the dehydrator by forced air technique. The oven was preheated to 60°C and then the loaded tray was added, until all the leaves were done. The temperature was maintained at 60°C. The leaves were left for one hour for drying. Vegetables were sufficiently dried till they became crisp and brittle to touch. The leaves took approximately three to four hours for complete drying.

Biochemical Analysis

The biochemical analysis was done to analyze the fresh sample as well as the blanched dehydrated sample for Moisture (percent), Ash (g/100g) and Phenols (mg/100g), Iron (mg/100g), Calcium (mg/100g), Phosphorus (mg/100g), Vitamin C (mg/100g) and Fiber (g/100g), Oxalates (mg/100g) and Phytates (g/100g). The nutritional analysis was done using the standard procedures (NNMB, 2003; AOAC, 2004; Sharma, 2007; Rangana, 2010).

The moisture content was determined by drying in an oven at 100°C until constant weight, ash by incineration in a muffle furnace at 550°C for 48 hours. Phenol content was determined by UV spectrophotometeric method. Total calcium and iron in ash solution was determined titration method and spectrophtometrically respectively. Phosphorus content was determined by titration method. Ascorbic acid was determined by the visual titration method of reduction of 2,6-dichlorophenol indophenols dye. Crude fiber was determined by successive digestion of the defatted sample with 0.25 N sulphuric acid and 0.31 N sodium hydroxide solutions. Oxalate content was determined by precipitated with calcium oxalate and subsequent titration with potassium permanganate.

Phytates was analyzed by the extraction of 0.5 M nitric acid and treated with ferric ammonium sulphate and isoamyl alcohol.

Statistical Analysis

Results were expressed as the mean ± the standard deviation of five reading analysis. All data generated were statistically analyzed, using one way Analysis of Variance (ANOVA). Significance was accepted at $p<0.05$ (SPSS, Version 12.0 for Windows).

Product Formulation and Sensory evaluation

All the value added products (Atta-ladoo, besan-ladoo and panjiri) were formulated incorporating dried green leafy powder, selected recipes were prepared by roasting and baking methods. The products were prepared by incorporating dehydrated carrot powder in various proportions (5%, 10% and 15%), and its organoleptic evaluation was done against control recipe (without carrot powder). Organoleptic evaluation of all recipes containing different levels of dried leaf powder was done on the basis of their color, taste, flavor/aroma, texture and overall acceptability on a five point rating scale from 5=very good, 4=good, 3=satisfactory, 2=poor, 1=very poor (Gupta and Prakash, 2011).

Results and Discussion

Biochemical Analysis

The results of Biochemical estimations of various nutrients and anti nutrients were analyzed and statistically compared (Table 1). Results showed that there was 95% reduction in moisture content; ash increased by 72% (high ash content is a reflection of the mineral content) and phenol increased by 73% in blanched dehydrated leaves in comparison to their fresh counterparts. There was statistically significant improvement in all the three non nutritional components of food i.e. moisture, ash and phenol. Calcium and Iron content of blanched dehydrated carrot leaves was 1432.74 mg and 36.90 mg/100g being 4 to 5 times greater than the fresh leaves. Hence the difference was statistically significant. The phosphorus and fiber content of fresh leaves was 104.31 mg/100g and 2.01 g/100g. However, the blanched dehydrated leaves had 316.81 mg/100g and 12.52 g/100g of both the nutrients which was 67.07% and 84.02% more than fresh leaves. The difference in the phosphorus and fiber content of the two treatments was also statistically significant. On the other hand, vitamin C content of the processed leaves was less than the fresh leaves as vitamin C is water soluble and prone to losses during blanching and dehydration as it is oxidized rapidly on exposure to heat and air. The vitamin C content of fresh leaves was 69.84 mg/100g however, the blanched dehydrated leaf sample was 35.61 mg/100g, hence, there was 49% of reduction. The Oxalate and Phytate content of fresh *Daucus carota* was estimated to be 43.41 mg and 21.82 mg. However, the blanched dehydrated sample had 326.53 mg and 161.77 mg of these anti nutrients. Statistical comparison of both the samples (fresh and blanched dehydrated leaves) highlighted that there was a significant improvement in levels of all the nutrients except vitamin C. Hence, processing resulted in enhancing the nutritional quality manifolds.

Incorporation in Product and Sensory Evaluation

The Blanched dehydrated leaves being a store house of nutrients were incorporated in various proportions (5%, 10% and 15%) in various indigenous recipes like Atta ladoo, Besan ladoo and Panjiri and their organoleptic evaluation was conducted. An overview of a sensory evaluation (Table 2 and Fig. 1, 2 & 3) highlights that the products were well acceptable at 10% incorporation level

Table 1. Non nutritional content of raw and processed Carrot leaves (*Daucus carota*) (Fresh and Blanched dehydrated)

Type of Leaf	Biochemical parameters	Fresh	Blanched Dehydrated
Daucus carota	Moisture (%)	92.34±0.02	3.72±0.04 (-95.97%) *
	Ash (g)	4.2±0.03	15.4±0.18 (72.72%)*
	Phenol (mg)	59.29±0.05	221.32±0.03 (73.12%)*
	Calcium (mg)	319.22±0.05	1432.74±0.06 (77.71%)*
	Iron (mg)	8.12±0.04	36.90±0.04 (77.99%)*
	Phosphorus (mg)	104.31±0.03	316.81±0.04 (67.07%)*
	Fiber (g)	2.01±0.03	12.52±0.07 (84.02%)*
	Vitamin C (mg)	69.84±0.05	35.61±0.04 (-49.01%)*
	Oxalate (mg)	43.41±0.02	326.53±0.03 (86.70%)*
	Phytate (mg)	21.82±0.03	161.77±0.04 (86.51%)*

*Significant at 5% level.
Figures in parentheses denote nutrient retention

in comparison with control recipe (0% incorporation). It was realized that the products prepared by the leaves were almost similar and comparable with control recipe in terms of their sensory attributes. On a five point scale, the scores for the overall acceptability of Atta ladoo, Besan ladoo and Panjiri was approximately 3.5 at 10 percent and 4 at 5 percent incorporation level. This reflects that the overall acceptability was almost similar at both levels. However, as the incorporation level was increased to 15%, the acceptability showed drastic reduction being just 2. This can be contributed to the fact that as increasing incorporation resulted in a peculiar dark green color which affected its sensory attributes of the product. The taste became more bitter, leaving a grassy flavor in the mouth and also caused regurgitation after consumption. Thus, it is obvious from the Table 2 and Graph that the Atta-ladoo, Besan-ladoo and Panjiri at 5 percent and 10 percent of incorporation were best acceptable and were comparable to the control recipe with 0% incorporation.

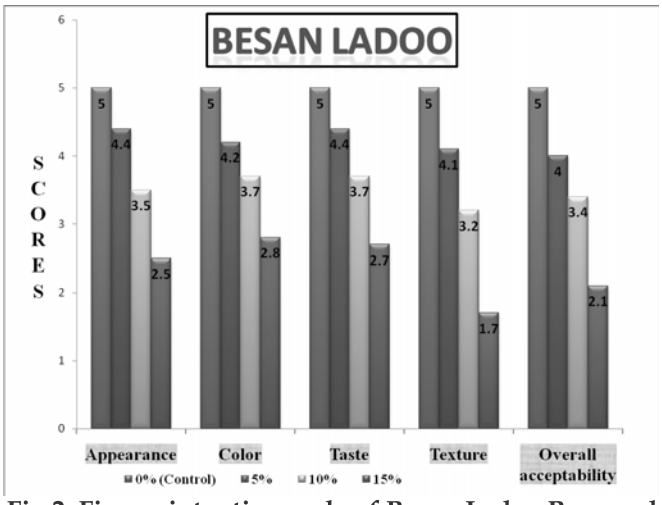

Fig.2. Five point rating scale of Besan Ladoo Prepared by Incorporating Carrot Leaves

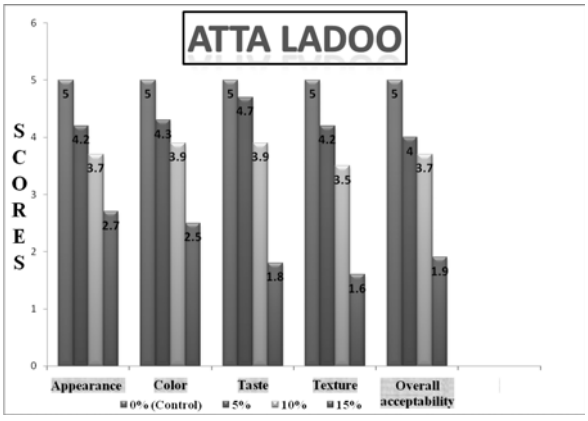

Fig. 1. Five point rating scale of Atta Ladoo Prepared by Incorporating Carrot Leaves

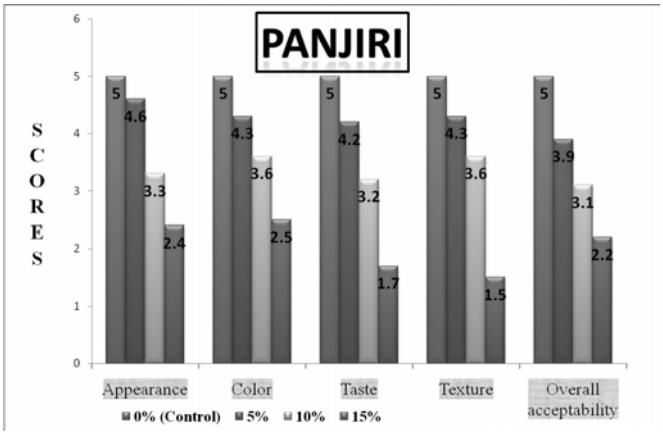

Fig.3. Five point rating scale of Panjiri Prepared by Incorporating Carrot Leaves

Table 2. Five point rating scale of Recipes prepared by incorporating Carrot Leaves

Item	Sensory Characteristics	Percent incorporation			
		0% (control)	5%	10%	15%
Atta ladoo	Appearance	5	4.2±0.02	3.7±0.01	2.7±0.03
	Color	5	4.3±0.02	3.9±0.03	2.5±0.03
	Taste	5	4.7±0.04	3.9±0.04	1.8±0.02
	Texture	5	4.2±0.02	3.5±0.02	1.6±0.04
	Overall acceptability	5	4±0.01	3.7±0.03	1.9±0.01
Besan ladoo	Appearance	5	4.4±0.02	3.5±0.01	2.5±0.01
	Color	5	4.2±0.02	3.7±0.04	2.8±0.03
	Taste	5	4.4±0.04	3.7±0.01	2.7±0.04
	Texture	5	4.1±0.03	3.2±0.03	1.7±0.01
	Overall acceptability	5	4±0.02	3.4±0.02	2.1±0.01
Panjiri	Appearance	5	4.6±0.02	3.3±0.02	2.4±0.03
	Color	5	4.3±0.03	3.6±0.01	2.5±0.03
	Taste	5	4.2±0.01	3.2±0.04	1.7±0.02
	Texture	5	4.3±0.02	3.6±0.03	1.5±0.02
	Overall acceptability	5	3.9±0.02	3.1±0.01	2.2±0.01

The results of the biochemical analysis showed that the leaf samples after dehydration became a concentrated source of all the nutrients. The results are in agreement with the studies done by Lakshmi and Vimla, 2000 which showed that the leaves retained good amounts of iron, fiber and calcium in the various samples of the leaves dried by oven drying. Similar findings were reported by Kowsalya and Vidhya, 2004; Jemina and Bhavani, 2004 in the dehydrated green leafy vegetables of cauliflower. The effect of processing (Blanching and Dehydration) makes the leaves a concentrated source of nutrients and decreases the level of toxicants. Thus, they became a natural fortificant for human consumption (Gupta and Prakash, 2011). There was a significant increase in the mineral and vitamin content of the leaf samples after blanching and dehydration (Yadav and Sehgal, 2003). Micronutrient deficiency also referred as hidden hunger is a major problem in the developing countries which leads to severe consequences affecting the human resources, the major power of the developing countries. Iron, calcium and phosphorus increased manifolds in the dehydrated samples (Bengtsson, 2007). Vitamin C content showed a decrement because it is a heat labile vitamin, which destroys when exposed to direct sunlight and heat. Nambier and Seshadri, 2001 highlighted the significance of drumstick leaves as a source of vitamin A. These leaves could retain 50% of their beta carotene on shade dehydration. The dehydrated leaves could be easily incorporated into traditional, western and Indian recipes without altering their acceptability characteristics. Lakshmi and Vimla, 2000 have also reported that dehydrated green leafy vegetables powders retained good amounts of fiber and minerals. Kowsalya and Indra, 2010 compared dried and processed amaranth leaf powder, which was incorporated at a level of 2.5 to 10% and termed as Amaranthus incorporated nutritious mix (noodles, vermicelli and pasta). The findings revealed that the developed products were highly acceptable from organoleptic evaluation and nutrient content was highly satisfactory. Incorporated cauliflower leaf powder at 10% level in masala biscuits, masala buns, gingelly chikki, wheat soy halwa and nippattun had mean acceptability scores of 3.4, 3.6, 3.4 and 3.9 respectively (Begum *et al*, 2000). Vasundhara and Waghray, 2009 reported the possibility of utilizing fresh colocasia leaves in common dishes to increase the intake of greens as a source of micronutrients. Bajaj *et al*, 1993 explored cooking quality of blanched and dehydrated fenugreek leaves. Color, texture, aroma and overall quality of blanched leaves received significantly higher scores than non-blanched. In food products were developed and standardized six were green, dhals and vegetable combinations and four were snack items. Nutrient content of prepared recipes especially dietary fiber, beta carotene, calcium and iron were higher than the control. Thus, the study suggested that the only dried and blanched dried leaves are a good source of various nutrients that should be consumed in sufficient amounts by various segments of population for possibly improving their health.

Acknowledgement

The authors are thankful to the International College for Girls, The IIS University, Jaipur for providing the necessary infrastructural facilities for the completion of this research. The author wishes to thank the panel judges for the logistical support, their participation and provision of the information for the evaluation of all the products.

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