

## **Development and nutritional evaluation of value added salty snacks using drumstick (*Moringa oleifera*) leaves**

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### **Abstract**

*The present study was conducted to see the effect of supplementation of drumstick leaves to commonly consumed preparations. Four value added products, namely missi roti, kabuli channa, dalia and vegetable poha were prepared by adding drumstick leaves (DL) at levels of 25% and 40% and were evaluated organoleptically in comparison to control samples and spinach leaves supplemented products at the same levels. All the products were found to be acceptable at 25% level of drumstick leaves supplementation obtaining scores in the range of 7.4 for kabuli channa to 7.68 for missi roti. The products made from spinach leaves were found to be highly acceptable at 25% level and obtained scores comparable or even higher than control and were even moderately acceptable at 40% levels. Products like vegetable poha and dalia were highly acceptable at 25% spinach leaves supplementation level with an overall acceptability score of 7.93 and 8.3 respectively. With supplementation of 25% DL, the scores of these products were 7.55 for both. DL supplemented missi roti, pancake and kabuli channa were also moderately acceptable with score of 7.6, 7.25 and 7.4 respectively. On increasing the drumstick leaves supplementation level to 40%, a decrease in all the sensory attributes was observed, with the overall acceptability scores ranging from 6.13 for missi roti to 6.38 for dalia. The most acceptable level of the drumstick leaves supplemented products i.e. 25% were analyzed for nutritional composition and antinutritional factors, along with control and spinach leaves supplemented products at the same level. The highest protein content was present in 25% drumstick leaves supplemented kabuli channa as 19.00 g/100 dry matter (DM). The highest fiber, ash and energy content was found in kabuli channa as 4.23, 3.45g and 437 Kcal/100g DM respectively. DL supplemented products were rich sources of  $\beta$ -carotene, ascorbic acid and calcium. Kabuli channa with DL supplementation at a level of 25% had the highest  $\beta$ -carotene and ascorbic acid content respectively as 1946.5  $\mu$ g and 14.70 mg/100g DM. Maximum increase in calcium was observed in vegetable poha as 6.5 fold. Supplemented products had lower levels of phytates and polyphenols but increased oxalates as compared to control. Incorporation of Spinach leaves and DL in traditional cereal and pulse preparations are recommended to enhance the  $\beta$ -carotene, ascorbic acid and calcium content of diets for combating vitamin and mineral deficiencies.*

**Key words:** Drumstick leaves, Nutritional evaluation, Organoleptic evaluation, Spinach leaves, Supplementation

### **Introduction**

Green leafy vegetables are one of the most valued components of Indian diets for their colour, flavor and therapeutic effects. Green leafy vegetables serve as good sources of water soluble vitamins and vitamin A as well as minerals such as calcium, phosphorus and iron. They contain sufficient amounts of  $\beta$ -carotene and other pro vitamin A, carotenoids

that can be absorbed and converted to vitamin A in the human body (Van den Berg *et al* 2000). It is reported that 25% of the world's total blinds (15 million) are from India of whom about a fifth can trace the origin to Vitamin A deficiency (Rajyalakshmi *et al* 2001). At least, 254 million pre-school aged children globally suffer from clinical and sub-clinical vitamin A

deficiency (WHO 2009). India is blessed with a wide variety of inexpensive foods rich in carotenoids (Kowsalya and Chandrasekhar 2003). The use of green leafy vegetables to eradicate underlying micronutrient deficiencies has been advocated for a long time. One such green leafy vegetable is Drumstick leaves (*Moringa oleifera*), which is a perennial tree and grows throughout most of the tropics (Makkar and Becker 1996). It belongs to the family of Moringaceae, a fast growing drought-resistant tree native to sub-himalayan tracts of northern India but now distributed worldwide in the tropics and the sub-tropics. Drumstick leaves have the highest known contents of total carotene (40,139 $\mu$ g/100g) and  $\beta$ -carotene (19,210 $\mu$ g/100g) (Seshadri and Nambiar 2003). Keeping in view the nutritive value of drumstick leaves, the present study was designed to develop and standardize value added salty products using drumstick leaves.

## Materials and Methods

Commonly consumed food items i.e. wheat flour, refined wheat flour, *dalia*, *poha*, *besan* and *kabuli chana* were procured from the local market along with other ingredients like oil, spices and salt. Bulk samples of drumstick leaves as well as spinach leaves, free from blemishes and damage, were procured from the Department of Vegetable Crops, PAU. Various preparations namely *Missi roti*, *Kabuli chana*, *Vegetable Dalia* and *Vegetable Poha* were prepared in the laboratory. Control products were developed with standardized method, S1 were prepared with 25% spinach leaves, S2 with 40% spinach leaves, D1 with 25% drumstick leaves and D2 with 40% drumstick leaves. The developed products were organoleptically evaluated by a trained panel of 10 judges from Department of Food and Nutrition, College of Home Science, Punjab Agricultural University, Ludhiana using Hedonic rating scale. The developed products were weighed, homogenized and oven dried at 60°C. Dried products were analyzed for proximate composition (AOAC 2000), mineral content (AOAC 2000), vitamin content which includes  $\beta$ -carotene (Rangana 1995), ascorbic acid (AOAC 1996) and anti-nutritional content which includes phytin phosphorous (Haung and Lantzsch 1983), total phenols (AOAC 2000), oxalate (Abeza *et al* 1968) using standard methods.

## Results and Discussion

### *Sensory Attributes of the Drumstick Leaves*

### *Incorporated Recipes*

#### *Missi roti*

Five samples of *missi roti* were prepared using wheat flour and bengal gram flour as control and for test samples, wheat flour and bengal gram flour were supplemented with spinach leaves and drumstick leaves, both at 25% and 40% levels. The mean scores of acceptability trials of *missi roti* by expert panel of judges using nine-point Hedonic Rating scale are presented in Table 1 and Fig. 1. The results showed that the highest scores for all parameters were obtained by *missi roti* with 25% level of supplementation (S1 treatment) followed by S2 (40% SL). The scores for color, appearance and taste of S1 treatment i.e. 8.0 were non-significantly higher than those of S2 treatment being 7.7, 7.6 and 7.7 respectively. The samples of *missi roti* with 25% drumstick leaves supplementation (D1 treatment) obtained scores with non-significant difference with S2 treatment except for appearance which was 7.2 as compared to 7.7 of S2. Both these levels obtained equivalent scores for overall acceptability i.e. 7.68 and found to be moderately acceptable. The D2 treatment with 40% level of drumstick supplementation obtained significantly lower scores as compared to S1, S2 and D1 with an overall acceptability score of 6.13 and thus slightly acceptable. Singhi (2007) reported significantly lower scores in *missa paratha* with respect to all the sensory attributes on addition of cauliflower leaf powder at a higher level i.e. 7.5%, but comparable scores to the control at 5% cauliflower leaf powder supplementation.

#### *Kabuli Channa*

Five samples of *kabuli channa* were prepared using *kabuli chnana dal* as control and for test samples, *kabuli channa dal* was supplemented with spinach leaves and drumstick leaves, both at 25% and 40% levels. The mean scores of acceptability trials of *kabuli chana* by expert panel of judges using nine-point Hedonic Rating scale are presented in Table 1 and Fig. 2. The results revealed that the highest scores for all parameters of sensory evaluation were obtained by S1 treatment (25% SL) in the range of 8.25-8.30 with non-significant difference with the control. With increase in the supplementation level of spinach leaves, the scores decreased non-significantly for all parameters and were liked moderately with a score of 7.85 for all attributes. The D1 treatment (25% DL) obtained scores in the range of 7.4-7.5 and liked moderately by the panelists. The scores varied

significantly from the S1 treatment but non-significantly from the S2 treatment. The samples with D2 treatment (40% DL) were liked slightly and showed significant difference with the D2 treatment in all the attributes thus suggesting loss in the sensory qualities with increase in the level of supplementation. Singhi (2007) also reported a decrease in the scores for all parameters in *kabuli chana*, curry and bengal gram *dal* when supplemented with cauliflower leaf powder. Nambiar and Parnami (2008) determined the most acceptable levels of supplementation to be 20g fresh drumstick leaves /30g raw weight of pulse in case of *kabuli chana*, *Desi chana* and *moong dal*. This level of supplementation of drumstick leaves as suggested by Nambiar and Parnami (2008) was not supported by our findings, the main reason could be the level of maturity of the leaves and the time of the year in which the study was conducted. According to our findings, 25g of drumstick leaves per 100g of the raw pulse was found to be acceptable as compared to the 40g level which was only slightly acceptable.

#### *Dalia*

Five samples of *dalia* were prepared using broken wheat as control and for test samples, the broken wheat was supplemented by spinach leaves and drumstick leaves, both at 25% and 40% levels. The mean scores of acceptability trials of *dalia* by expert panel of judges using nine-point Hedonic Rating scale are presented in Table 1 and Fig. 3. The highest scores for all the attributes were obtained by *dalia* with 25% Spinach leaves supplementation with scores in the range of 8.2-8.35 which was liked very much. These scores were found to be comparatively higher than control which was moderately acceptable with an overall acceptability score of 7.93. The S2 treatment

with 40% spinach leaves supplementation was also found to be liked very much with an overall acceptability score of 8.08. The D1 treatment obtained scores of color and appearance comparable to the control i.e. 7.85 and 7.7 respectively as compared to 7.9 of control, but showed significantly ( $p \leq 0.05$ ) lower scores for flavor, texture, taste and overall acceptability i.e. 7.45, 7.55, 7.35 and 7.55 against 9.95, 7.95, 8.0 and 7.93 of control respectively. The samples were found to be moderately acceptable. The D2 samples showed significantly lower scores than the D1 treatment with an overall acceptability score of 6.38 which was liked slightly indicating the loss in sensory attributes with increased levels of supplementation with drumstick leaves. Mittal (2011) reported that *dalia* was most acceptable at 1:1 ratio of oats and sorghum scoring 8.17 for overall acceptability and was liked even more than the control.

#### *Vegetable Poha*

Five samples of vegetable *poha* were prepared using rice flakes as control and for test samples, rice flakes were supplemented with spinach leaves and drumstick leaves, both at 25% and 40% levels. The mean scores of acceptability trials of vegetable *poha* by expert panel of judges using nine-point Hedonic Rating scale are presented in Table 2 and Fig. 4. The data revealed that the highest scores for all the sensory parameters were obtained by S2 (40% SL) with an overall acceptability score of 8.02 and was liked very much. The mean scores of color of D1 were non-significantly higher than the control i.e. 7.75 as against 7.65 of control. Similar trend was also observed for other parameters except overall acceptability where D1 scored 7.55 against 7.65 of control and both were liked moderately. The scores of all the sensory

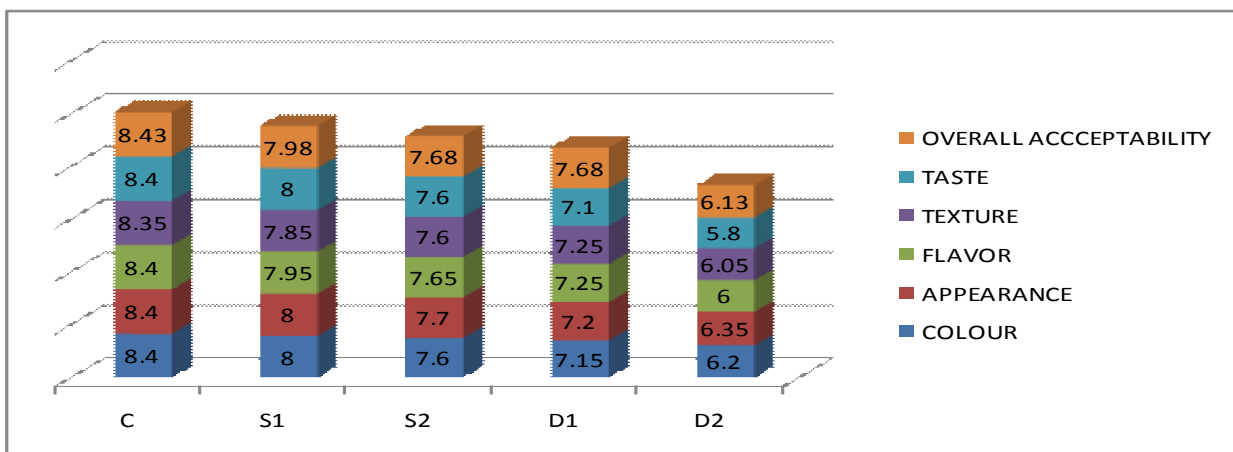


Fig. 1: Organoleptic scores for *missi Roti*

Table 1: Organoleptic scores for value added salty products (Mean $\pm$ SE)

Levels	Colour	Appearance	Flavor	Texture	Taste	Overall acceptability
<b>MISSI ROTI</b>						
C	8.45 $\pm$ 0.11	8.400.11	8.400.11	8.350.11	8.400.11	8.430.11
S1	8.000.10	8.000.13	7.950.14	7.850.11	8.000.13	7.980.11
S2	7.600.21	7.700.18	7.650.20	7.600.17	7.600.20	7.680.17
D1	7.150.15	7.200.16	7.250.20	7.250.14	7.100.20	7.680.14
D2	6.200.31	6.350.24	6.00.30	6.050.27	5.800.29	6.130.24
F-ratio	20.32**	21.76**	20.83**	25.99**	27.24**	28.61**
CD(5%)	0.538	0.477	0.562	0.476	0.542	0.453
<b>KABULI CHANNA</b>						
C	8.450.14	8.40.17	8.450.14	8.40.17	8.450.14	8.450.14
S1	8.30.16	8.30.16	8.30.16	8.250.18	8.30.16	8.30.16
S2	7.850.17	7.850.17	7.850.17	7.850.17	7.850.17	7.850.17
D1	7.50.24	7.450.22	7.450.22	7.40.21	7.450.17	7.40.21
D2	6.40.26	6.40.26	6.20.17	6.150.18	6.00.18	6.180.16
F-ratio	17.29**	16.55**	26.64**	24.85**	36.17**	29.57**
CD(5%)	0.553	0.560	0.490	0.510	0.459	0.472
<b>DALIA</b>						
C	7.900.14	7.900.14	7.950.15	7.950.14	8.000.15	7.930.14
S1	8.250.12	8.250.12	8.250.12	8.200.14	8.350.13	8.300.13
S2	8.100.12	8.100.12	8.100.12	8.050.11	8.100.12	8.080.12
D1	7.850.13	7.700.16	7.450.14	7.550.14	7.350.13	7.550.13
D2	7.050.21	6.950.21	6.450.15	6.700.16	6.100.14	6.380.10
F-ratio	9.57**	10.55**	27.82**	19.09**	44.94**	39.21**
CD(5%)	0.422	0.440	0.389	0.388	0.380	0.343
<b>VEGETABLE POHA</b>						
C	7.650.21	7.70.22	7.650.18	7.650.20	7.550.20	7.650.19
S1	7.90.07	7.950.05	7.950.05	7.90.07	7.90.07	0.05
S2	8.10.07	8.00.07	8.00.00	8.00.07	8.00.07	0.03
D1	7.750.12	7.650.13	7.650.15	7.60.15	7.40.15	7.550.14
D2	6.60.15	6.50.19	6.40.17	6.40.17	5.950.25	6.250.16
F-ratio	18.68**	17.47**	24.63**	20.68**	25.65**	29.88**
CD(5%)	0.380	0.411	0.370	0.397	0.458	0.363

\*\*significant at 5% level.

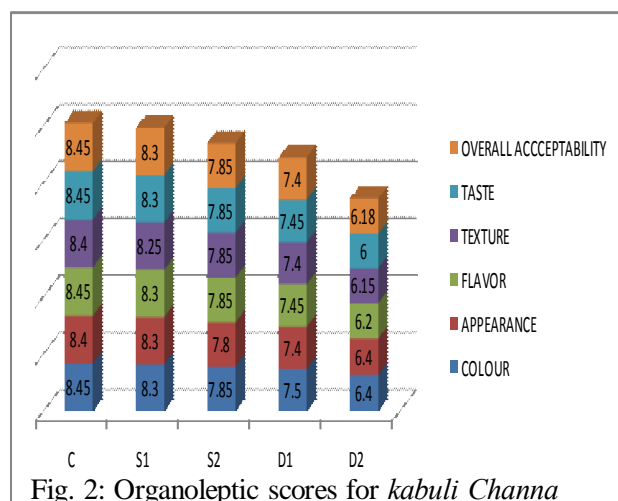


Fig. 2: Organoleptic scores for *kabuli Channa*

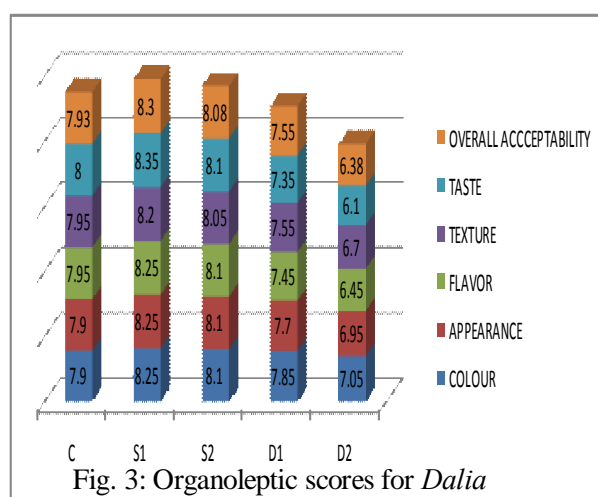
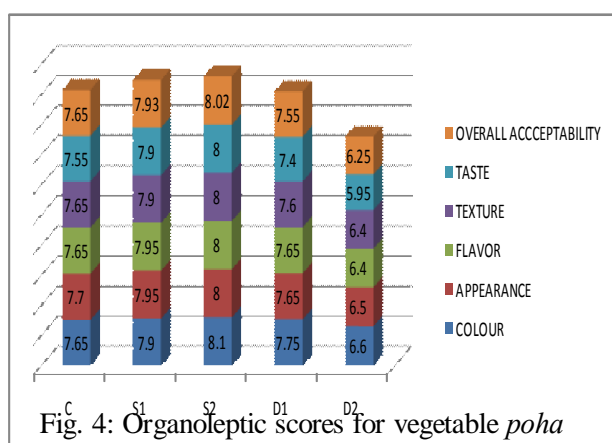


Fig. 3: Organoleptic scores for *Dalia*

Table 2: Proximate composition of developed products (on dry matter basis)

Treatment	Moisture (%)	Protein (%)	Fat (%)	Fiber (%)	Ash (%)	CarboHydrate (%)	Energy (kcal)
<b>MISSI ROTI</b>							
C	2.50±0.20	7.500.40	6.35	1.400.09	2.340.03	80	407
S1	2.750.15	7.600.30	6.550.05	1.470.04	2.440.03	79	406
D1	2.900.20	8.150.30	6.450.05	1.760.5	2.480.01	78	404
F-ratio	-	-	-	9.9**	-	-	-
CD%	NS	NS	NS	0.27	NS	-	-
<b>KABULI CHANNA</b>							
C	3.40.21	17.770.27	15.60.21	2.05	2.770.03	58	445
S1	3.450.11	18.460.48	16.050.11	3.150.01	2.850.02	56	442
D1	3.700.14	19.000.07	16.600.07	4.230.03	3.450.02	53	437
F-ratio	-	-	-	881.42**	111.97**	-	-
CD%	NS	NS	NS	0.17	0.16	-	-
<b>DALIA</b>							
C	3.550.11	9.630.01	5.900.14	2.750.11	2.770.04	75	393
S1	3.950.11	9.450.25	5.900.07	3.200.07	2.830.01	75	390
D1	4.200.07	9.850.04	6.150.04	3.250.04	2.890.01	74	389
F-ratio	-	-	-	-	-	-	-
CD%	NS	NS	NS	NS	NS	-	-
<b>VEGETABLE POHA</b>							
C	2.500.14	5.650.11	6.900.14	1.050.11	1.700.07	82	414
S1	2.700.14	5.850.04	7.050.18	1.400.07	1.750.04	81	412
D1	2.800.21	5.950.10	6.600.14	1.800.07	1.750.11	81	406
F-ratio	-	-	-	9.94**	-	-	-
CD%	NS	NS	NS	0.54	NS	-	-

\*\*significant at 5% level.



attributes of D1 were found to be comparable to the control. Increased level of supplementation with drumstick leaves resulted in lower scores for all the parameters and was found to be slightly liked with an overall acceptability score of 6.25. Nambiar *et al* (2003) also developed *Poha* by supplementation with dehydrated drumstick leaves and 5g/100g level was

found to be acceptable.

#### Nutritional Composition of Drumstick Leaves Incorporated Recipes

##### *Missi roti*

The moisture content of *Missi roti* ranged from 2.5 for control to 2.90 for drumstick leaves supplemented D1 treatment (25% DL) with non-significant difference. The protein content of the control was found to be 7.50% while that of S1 and D1 treatment was 7.6% and 8.15% respectively. The fat content ranged from 6.35 % for control to 6.55% for S1 treatment. The fiber content of *Missi roti* ranged between 1.40 for control to 1.76% for D1 treatment. The difference in the fiber content of S1 and D1 was found to be statistically significant ( $p \geq 0.05$ ). The ash content of *Missi roti* ranged from 2.34% for control to 2.48 for D1 treatment, while the difference was non-significant. The carbohydrate content of the control and the test samples were found to be comparable with values of 80g, 79g and 78g per 100 g for control, S1 and D1 treatments respectively. The energy content

of control was found to be 407 Kcal/100g and that of S1 and D1 treatments was observed to be 406 and 404 Kcal per 100 g respectively. Singhi (2007) also reported the ash and energy content of *missa paratha* as 2.42 % and 466 Kcal/100g respectively. The iron content of S1 and D1 treatment of *missi roti* was observed to be 6.80 and 6.65 and that of control was 5.25 mg/100g. The calcium content in *missi roti* was 52.5 mg/100g. The maximum content in S1 treatment was found in *missi roti* (1224 $\mu$ g). The maximum increase in ascorbic acid content was observed in *missi roti*. The phytate content was maximum in *missi roti* 125.5 mg/100g. With addition of 25% drumstick leaves (D1), the phytate content decreased to 111 mg per 100g. The content of polyphenols in *missi roti*, was observed to be 258 mg per 100 g. With supplementation of 25% spinach leaves, this content reduced to 245 mg/100g.

#### *Kabuli channa*

The moisture content of *kabuli channa* was found to be ranging from 3.4 to 3.7 for control and D1 treatments respectively, while the difference was statistically non-significant. The protein content ranged from 17.77 for control to 18.46 and 19.0% for S1 and D1 respectively with non-significant difference. The increase in the protein content was observed to be very small due to the low amounts of protein in spinach leaves and drumstick leaves. The fat content of all the treatments of *kabuli channa* was found to be comparable with values of 15.6% for control and 16.6% for D1 treatment. The crude fiber content in control sample of *kabuli channa* was 2.05% and it significantly ( $p \leq 0.05$ ) increased to 3.15 and 4.23 percent respectively on supplementation with 25% SL and DL. A significantly higher ( $p \leq 0.05$ ) ash content was observed in the D1 treatment as 3.45% as compared to S1 2.85% and control 2.77%. The carbohydrate content of control was found to be 58% followed by 56 and 53% in S1 and D1 respectively. The energy content was observed to be in the range of 437 Kcal/100g for D1 to 445 Kcal/100g for control. Nambiar and Parnami (2008) developed *kabuli channa* with 20g DL/30g raw *channa* and reported the protein and energy content as 6.5g and 155 Kcal per 100g on fresh weight basis. The iron content of drumstick leaves supplemented *kabuli channa* was found to be 8 mg/100g. Calcium content of ranged from 203.5 mg/100g in *kabuli channa*. Supplementation of *kabuli channa* with 25%

drumstick leaves increased the calcium content to 348 mg/100g. There was a significant increase in the  $\beta$ -carotene content of all the preparations on supplementation with 25% SL which ranged from 5 ... .. *kabuli channa*. The D1 treatment also showed minimum increase in ascorbic acid content reported in *kabuli channa* having 2-fold increase. The content of polyphenols in *kabuli channa* was observed to be 297.5 mg per 100 g. With supplementation of 25% spinach leaves, this content reduced to 291.5 mg/100g. *Dalia*

The moisture content of *dalia* ranged between 3.55% for Control and 4.20% for D1 treatment. The protein content of control *dalia* was found to be 9.45%. *Dalia* with 25% Spinach Leaves (S1) had a protein content of 3.20% while D1 treated *dalia* also had a similar protein content of 3.25%. The highest fat content was observed in *dalia* with 25% Drumstick leaves (D1) supplementation i.e. 6.15% which was found to be comparable to S1 and Control with 5.90% each. The D1 treatment had a fiber content of 3.25% followed by S1 and C as 3.2 and 2.75 percent. The total ash content of the samples ranged from 2.77 for control to 2.89 for D1 treatment. The control and S1 treatments had a carbohydrate content of 75% each. The carbohydrate content of *dalia* with 25% drumstick leaves (D1) was found to be 74%. The energy content was found to be ranging from 389-393 Kcal per 100 g for D1 and C respectively. Among the D1 treatments, the minimum  $\beta$ -carotene content was found in in *dalia* (1259.6 $\mu$ g). The D1 treatment also showed minimum increase in ascorbic acid content reported in *dalia* having 2-fold increase. On supplementation with 25% spinach leaves the phytate content of the products decreased to 99.75 per 100 g and with addition of 25% drumstick leaves, the content was found to be 102.3 mg/100g respectively which was lower in comparison to the control.

#### *Vegetable poha*

The proximate composition of control and test samples of *Vegetable poha* is given in Table 2. *Vegetable poha* supplemented with 25% drumstick leaves had 2.8% moisture while control and S1 had 2.5 and 2.7% respectively, while the difference was statistically non-significant. The protein content ranged from 5.65 for control to 5.85 and 5.95% for S1 and D1 respectively with non-significant difference. The increase in the protein content was observed to be very small due to the low amounts of protein in spinach

leaves and drumstick leaves. The fat content of all the treatments of vegetable *poha* was found to be comparable with 6.60% for D1 and 7.05% for S1 treatment. The crude fiber content in control sample of Vegetable *poha* was 1.05% and a significant difference ( $p \leq 0.05$ ) was observed on supplementation with 25% SL and DL which were reported as 1.40 and 1.80 percent respectively. The ash content in the D1 and S1 treatment was observed to be 1.75% both and control 2.77 percent. The carbohydrate content of control was found to be 82.20% followed by 81 and 81% in S1 and D1 respectively. The energy content was observed to be in the range of 406 Kcal/100g for D1 to 413 Kcal/100g for control. Vegetable *poha* had an iron content of 14.35 mg/100g. Calcium content of the vegetable *poha* was 14.2 mg. The  $\beta$ -carotene content of the developed vegetable *poha* was 2.9  $\mu$ g/100g. The increase in the vitamin C content of vegetable *poha* was due to the addition of other ingredients.

### References

- Van den berg, H., Faulks, R.; Granado, H. F.; Hirschberg, J.; Olmedilla, B.; Sandmann, G.; Southon, S. and Stahl, W. (2000). The potential for the improvement of carotenoid levels in foods and the likely systemic effects. *J Sci Fd Agric* 80: 880-912.
- Rajyalakshmi, P.; Venkatalakshmi, K. and Venkatalakshamma, K. (2001). Effect of boiling on beta-carotene content of forest green leafy vegetables by tribals of south India. *J Fd Sci Technol* 38(1): 56-58.
- WHO (2009). Global prevalence of vitamin A deficiency in population at risk 1995-2005. *WHO global database on vitamin A deficiency*: 1-55.
- Kowsalya, S. and Chandrasekhar, U. (2003). Total Carotenoid and Beta Carotene contents of selected stored plant foods. *Ind J Nutr Dietet* 40: 122-28.
- Makkar, H. P. S. and Becker, K. (1996). Nutritional value and antinutritional components of whole and ethanol extracted *Moringa oleifera* leaves. *Animal Feed Sci Technol* 63: 211-28.
- Seshadri, S. and Nambiar, V. (2003). Kanjero (*Digera arvensis*) and drumstick leaves: Nutrient profile and potential for human consumption. *Plants Hum Health Nutr Policy*: 41-56.
- AOAC (2000). Official Methods of Analysis. Association of Official Analytical Chemist, 17<sup>th</sup> ed. Washington DC.
- AOAC (1996). Official Methods of Analysis. Association of Official Analytical Chemist, Washington DC.
- Rangana, S. (1995). *Handbook of analysis and quality control for fruit and vegetable products*. Tata Mc Graw Hill Publishing Company Limited, New Delhi.
- Haug, W. and Lantzsch, H. T. (1983). Sensitive method for rapid determination of phytate in cereals and cereal products. *J Sci Fd Agric* 34:1423.
- Abeza, R. H.; Black, J. T. and Fisher, E. J. (1968). Oxalates determination. Analytical problems encountered with certain plant species. *J Assoc Official Analytical Chemists* 51: 853.
- Singhi, H. (2007). *Nutritional evaluation of value added  $\alpha$ -carotene and iron rich products*. M.Sc. thesis, Punjab Agricultural University Ludhiana.
- Nambiar, V. S. and Parnami, S. (2008). Standardization and organoleptic evaluation of drumstick (*Moringa oleifera*) leaves incorporated into traditional Indian recipes. *Trees Life J* 3(2): 1-7.
- Mittal, S. (2011). *Organoleptic and Nutritional evaluation of gluten free products for celiac disease patients*. M.Sc. thesis, Punjab Agricultural University Ludhiana.