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Nutritional Composition and Sensory Characteristics of *Sev* Supplemented with Spinach Leaves Powder

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ABSTRACT

Backgroud: The study was conducted to evaluate the nutrient composition of *sev* prepared from spinach leaves powder.

Methods: Sensory evaluation of developed products was carried out using 9-point hedonic Scale. The samples were further analysed for moisture, ash, crude fat, crude protein and crude fiber, total, soluble and insoluble dietary fiber, total minerals and antioxidant activity and β-carotene content using standard methods.

Result: The supplementation resulted in a significant (P=0.05) increase in ash, crude fat and crude fiber while crude protein decreased. The supplemented product had crude fat ranging from 27.17-29.35 g; crude fibre 3.45-4.45 g and ash 3.34-4.58 g/100 g at different levels of incorporation as against 26.34, 2.85and 3.02 g/100 g respectively in control product. Significant increase was observed in mineral content also. The supplemented products had iron, calcium, zinc and phosphorus ranging from 5.01-7.23, 73.98-98.34, 2.21-3.13 and 306.12-323.22/100 g on dry matter basis. Antioxidant activity and β-carotene content also increased in supplemented *sev*. This therefore suggests that *sev* supplemented with spinach leaves powder could have more market penetration if awareness is highly created.

Key words: Awareness, Nutrient composition, Sensory evaluation, Supplementation.

INTRODUCTION

Green leafy vegetables occupy an important place among the food crops as these provide a large amount of many vitamins and minerals for humans. They are good rich source of carotene, ascorbic acid, riboflavin, folic acid and minerals like calcium, iron and phosphorous (Sheela *et al.,* 2004). NNMB survey (2006) also reported that consumption of green leafy vegetables to be only 37 per cent of recommended dietary intake. Besides this, the green leafy vegetables are highly seasonal and are available in plenty at a particular season of the year. Abundantly supply during the season results in spoilage of large quantities. Preservations of these green leafy vegetables can prevent large wastage as well as make them available throughout the year. There are number of household processing technique which can be used for improving the shelf life of green leafy vegetables.

Green leafy vegetables are available only for a short period but these can be dried and stored for use during lean season (Joshi and Mathur, 2010). Dehydrated leaves can be used for the development of various recipes. These products if incorporated in the diet can help to reduce the risk of iron and vitamin A deficiency. In India, the consumption of green leafy vegetables is very low and is much below the recommended allowances. Therefore, the majority of the Indians do not get sufficient vitamins and minerals present in leafy vegetables. Over 30 per cent of the world's population are anaemic. Iron deficiency also compromises the immune system and is associated with limited cognitive development in children. Among pre-school children worldwide, 23 per cent suffer from iron deficiency anaemia (WHO 2013). In India, 79 per cent of children between 6 to 35 months and women between 15 to 49 years of age are anaemic (Krishnaswamy 2009). The most sustainable approaches to increase the micronutrient status of populations are food based strategies, which include food production, dietary diversification and food fortification/ supplementation. The food based approach for combating micronutrient malnutrition, is difficult and of a long duration, although its effect is predicted to be long lasting (Singh *et al.* 2014; Gupta *et al.* 2015; Singh *et al.* 2018).

Food based strategies are one of the means that are used for combating vitamin A and iron deficiencies in developing countries. The benefits of such food based strategies are manifold- cost effective, sustainable, culturally acceptable, income-generating, feasible to implement and availability of various micronutrient-rich foods for improving the micronutrient status of not only individuals but also for the community (Pritwani and Mathur 2015; Gupta and Verma 2016; Singh *et al.* 2018).

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The nutritive value of staple food can be enhanced through a mutual complementation of their restrictive micronutrients with value added ingredients. Green leafy vegetables and legumes are among the value added ingredients and multi-cultural components used ubiquitously in Indian cuisine. Green leafy vegetables and legumes are rich source of protein, micronutrients and dietary fibre (Galla *et al*. 2017; Longvah *et al*. 2017; Singh *et al*. 2018).

Thus, this study aimed to evaluate the effect of the supplementation of spinach leaves powder on the proximate composition, mineral content, antioxidant activity and sensory properties of *sev.*

MATERIALS AND METHODS

The present study was conducted in the Department of Foods and Nutrition, COHS, CCS Haryana Agricultural University, Hisar.

Procurement of materials

Grain samples of a wheat variety (WH-1105) and a bengal gram variety (HC-1) were procured from the Department of Genetics and Plant Breeding, CCS Haryana Agricultural University, Hisar. The grain samples were cleaned, bengal gram seeds were dehulled and ground into flour. The ground samples were stored in plastic container till further use.

Spinach leaves (*Spinacia oleracea* L.) were procured in a single lot from local market of Hisar. Healthy mature and disease-free leaves were selected and washed under running tap water followed by distilled water. Excess water was wiped off with muslin cloth. Then the leaves were dried in the shade for 6 to 8 h to remove excess moisture followed by oven drying at 40-45°C till complete drying. The dried leaves were ground in an electric grinder to obtain a fine powder. The ground powder was stored in low density polyethylene (LDPE) bags for further use.

Preparation of *Sev*

The spinach, chickpea and wheat flour incorporated *sev* were prepared by replacing the main cereal used in basic recipe by spinach and chickpea flour. Five combinations were used for preparation of *sev.* The standard recipe of *sev* was taken as control. *Sev* were organoleptically evaluated by a panel of semi trained judges using 9 point hedonic scale. It was observed that *sev* were found acceptable up to 10 per cent level of incorporation of spinach leaves powder. The acceptable *sev* were selected for further nutritional analysis.

Nutritional evaluation

The samples of *sev* were evaluated for proximate composition (AOAC, 2000) total minerals such as Iron, calcium, zinc and phosphorus were estimated by the method of Lindsey and Norwell, 1969, Dietary fibre by Furda (1981), antioxidant activity by Prieto *et al*., 1999 and β-carotene content by AOAC 2000.

RESULTS AND DISCUSSION

Sensory evaluation

Mean scores of sensory characteristics (colour, appearance, aroma, texture, taste and overall acceptability) of micronutrient rich *sev* are presented in the Table 1.

The prepared *sev* were subjected to sensory evaluation with respect to colour, appearance, flavour, taste, texture and over all acceptability by a semi trained panel of ten judges using 9-point hedonics scale. Overall acceptability scores of *sev* made from bengal gram flour (control) and four types of composite flour *i.e*. Type-I, Type-II, Type-III and Type-IV were ranged from 7.82, 7.92, 7.50, 7.22 and 7.13, respectively. Whereas it was noticed that *sev* made from Type-V composite flour got lowest overall acceptability scores (5.90) which fell in the category of 'neither liked nor

Control: Bengal gram flour (100%).
Type-I: Wheat flour:Bengal gram flour: Spinach leaves powder (48:48:4).
Type-II: Wheat flour:Bengal gram flour: Spinach leaves powder (47:47:6).
Type-III: Wheat flour:Bengal gram flour: Spinach leaves powder (46:46:8).
Type-IV: Wheat flour:Bengal gram flour: Spinach leaves powder (45:45:10).
Type-V: Wheat flour:Bengal gram flour: Spinach leaves powder (44:44:12).

Table 1: Mean scores of organoleptic characteristics of *sev.*

Types of *Sev*	Colour	Appearance	Aroma	Texture	Taste	Overall acceptability
Control	8.10±0.16	8.20±0.14	7.00±0.02	7.90±0.07	7.90±0.15	7.82±0.08
Type-I	7.90±0.04	8.00±0.11	7.80±0.15	8.00±0.04	7.90±0.12	7.92±0.03
Type-II	7.20±0.07	7.30±0.09	7.40±0.15	7.70±0.18	7.90±0.07	7.50±0.02
Type-III	7.20±0.11	7.10±0.14	7.00±0.02	7.10±0.10	7.70±0.08	7.22±0.07
Type-IV	7.11±0.15	7.01±0.06	7.00±0.08	7.02±0.03	7.50±0.04	7.13±0.16
Type-V	5.10±0.08	5.90±0.07	6.20±0.11	6.40±0.03	5.90±0.14	5.90±0.03
CD(P=0.05)	0.36	0.37	0.28	0.27	0.35	0.24

Values are mean ±SE of ten panelists.

Control: BGF (100%); Type-I: WF: BGF: SP (48:48:4); Type-II: WF: BGF: SP (47:47:6); Type-III: WF: BGF: SP (46:46:8); Type-IV: WF: BGF: SP (45:45:10); Type-V: WF:BGF:SP (44:44:12); WF: Wheat flour; GF: Bengal gram flour; SP: Spinach powder.

disliked'. Acceptability of *sev* was found to be reduced with increasing in the incorporation level of spinach powder in wheat and bengal gram flour blend.

Nutritional evaluation of *sev*

Proximate composition

The data in respect of proximate composition of *sev* are presented in Table 2.

Control *sev* made from 100 per cent bengal gram flour exhibited 2.58 per cent moisture, 26.34 per cent crude fat, 2.85 per cent crude fibre and 3.02 per cent ash contents which were found to be significantly improved with incorporation of spinach powder at 4, 6, 8 and 10 per cent level in wheat- bengal gram flour blends. While control *sev* contained 19.98 per cent crude protein which was significantly decreased with addition of wheat flour and spinach powder in bengal gram flour. As bengal gram flour made *sev* served as control. Control *sev* contained 19.98 per cent crude protein followed by 14.21 per cent for Type-I, 15.86 per cent for Type-II, 16.80 per cent for Type-III and 17.26 per cent for Type-IV composite flour based *sev*.

Total minerals

The results of total calcium, iron, zinc and phosphorus contents of *sev* are presented in Table 3.

Control *sev* contained 4.76 mg/100 g of iron content, which was improved with increase in the level of spinach powder. It varied from 5.01 to 7.23 mg/100 g respectively for all the four types of composite flour *sev.* Calcium content of bengal gram *sev* was 39.66 mg/100 g, while it varied from 73.98 to 98.34 mg/100 g, respectively for all the four types of composite flour. Type-IV had significantly higher (98.34 mg/100 g) and Type-I had lower (73.98 mg/100 g) calcium content.

Zinc and phosphorus content of control *sev* were 1.76 and 300.79 mg/100 g, respectively which also found to be increased with increase in the level of incorporation of spinach powder in wheat-bengal gram blends. The valued ranged from 2.21 to 3.13 and 306.12 to 322.23 mg/100 g, respectively. Type-IV *sev* exhibited higher (3.13 mg/100 g) zinc contents. Similarly, phosphorus content was found to be significantly higher (322.23 mg/100g) in Type-IV *sev* and lower (306.12 mg/100 g) in Type-I *sev.*

Dietary fibre

The results of dietary fibre contents of *sev* are presented in Table 4.

Control *sev* exhibited 8.23, 1.58 and 6.65 g/100g, respectively total, soluble and insoluble dietary fibre content. Among the composite flour made *sev,* total, soluble and insoluble dietary fibre content ranged from 8.56 to 10.03, 2.04 to 3.00 and 6.52 to 7.03 g/100 g, respectively, being maximum in Type-IV composite flour made *sev* while minimum in Type-I composite flour made *sev*. The differences were statistically significant among control and supplemented *sev*. Dietary fibre content increased in supplemented *sev* might be due to higher fibre in spinach leaves powder.

Anti-oxidant activity and β-carotene content

The results of anti-oxidant activity and β-carotene contents of *sev* are presented in Table 5

Control *sev* contained 11.67 per cent anti-oxidant activity which found to be further significantly improved on supplementation with spinach leaves powder in all types of supplemented *sev*. Type-I *sev* contained 13.54 per cent anti-oxidant activity followed by Type-II (15.03%), Type-III (16.49%) and Type-IV *sev* (17.55%).

Similarly, β-carotene content of control *sev i.e*. 90.67 µg/100 g was also found to be improved significantly on supplementation with spinach leaves powder. It varied from 155.89 µ g/100 g for Type-I *sev* to 232.76 µ g/100 g for Type-IV *sev*.

Overall acceptability scores in term of colour, appearance, texture, aroma and taste of control *sev* were in the range of 'liked very much'. Acceptability scores decrease with increase the incorporation level of spinach leaves powder. Other workers also reported that biscuits and cookies were found acceptable up to 10 per cent level of incorporation of green leafy vegetables (Drisya 2015; Ajibola *et al*. 2015). Galla *et al.* (2017) also reported that biscuits with 10 per cent spinach leaves powder found acceptable by the panellists.

Table 2: Proximate composition of *sev* supplemented with spinach powder (%, on dry matter basis).

Sev	Moisture*	Crude protein	Crude fat	Crude fibre	Ash
Control (BGF 100%)	2.58±0.04	19.98±0.27	26.34±0.65	2.85±0.07	3.02±0.01
Type-I	2.98±0.05	14.21±0.10	27.17±0.52	3.45±0.02	3.34±0.04
Type-II	3.45±0.05	15.86±0.20	28.65±0.28	3.78±0.01	3.78±0.03
Type-III	3.79±0.23	16.80±0.12	28.98±0.21	4.19±0.08	4.23±0.09
Type-IV	4.23±0.07	17.26±0.23	29.35±0.50	4.45±0.03	4.58±0.08
CD (P=0.05)	0.17	0.56	0.36	0.17	0.22±

*On wet matter basis Values are mean±SE of three independent determinations.

Type-I: WF: BGF: SP (48:48:4); Type-II: WF: BGF: SP (47:47:6); Type-III: WF: BGF: SP (46:46:8); Type-IV: WF: BGF: SP (45:45:10); WF: Wheat flour; BGF: Bengal gram flour; SP: Spinach powder.

Table 3: Total mineral content of *sev* supplemented with spinach powder (mg/100g, on dry matter basis).

Sev	Iron	Calcium	Zinc	Phosphorus
Control (BGF 100%)	4.76±0.02	39.66±0.28	1.76±0.04	300.79±0.85
Type-I	5.01±0.11	73.98±0.15	2.21±0.04	306.12±0.43
Type-II	5.87±0.15	89.56±1.21	2.54±0.05	310.85±0.36
Type-III	6.48±0.12	93.56±2.19	2.98±0.06	316.12±0.50
Type-IV	7.23±0.14	98.34±0.05	3.13±0.02	322.23±0.37
C.D (P=0.05)	0.41	3.86	0.18	1.92

Values are mean±SE of three independent determinations.

Type-I: WF: BGF: SP (48:48:4); Type-II: WF: BGF: SP (47:47:6); Type-III: WF: BGF: SP (46:46:8); Type-IV: WF: BGF: SP (45:45:10); WF: Wheat flour; BGF: Bengal gram flour; SP: Spinach powder.

Table 4: Dietary fibre content of *sev* supplemented with spinach powder (g/100g, on dry matter basis).

Sev	Total dietary fibre	Soluble dietary fibre	Insoluble dietary fibre
Control (BGF 100%)	8.23±0.08	1.58±0.02	6.65±0.09
Type-I	8.56±0.15	2.04±0.03	6.52±0.05
Type-II	9.14±0.16	2.43±0.02	6.71±0.13
Type-III	9.59±0.04	2.78±0.05	6.98±0.22
Type-IV	10.03±0.03	3.00±0.06	7.03±0.12
C.D (P=0.05)	0.38	0.15	0.32

Values are mean±SE of three independent determinations.

Type-I: WF: BGF: SP (48:48:4); Type-II: WF: BGF: SP (47:47:6); Type-III: WF: BGF: SP (46:46:8); Type-IV: WF: BGF: SP (45:45:10); WF: Wheat flour; BGF: Bengal gram flour; SP: Spinach powder.

Table 5: Anti-oxidant activity and β-carotene content of *sev* supplemented with spinach powder (on dry matter basis).

Sev	Anti-oxidant activity (%)	β-carotene (µg/100 g)
Control (BGF 100%)	11.67±0.12	90.67±0.75
Type-I	13.54±0.01	155.89±0.64
Type-II	15.03±0.25	178.65±0.46
Type-III	16.49±0.01	215.67±2.69
Type-IV	17.55±0.11	232.76±2.85
CD (P=0.05)	0.48	5.67

Values are mean±SE of three independent determinations.

Type-I: WF: BGF: SP (48:48:4); Type-II: WF: BGF: SP (47:47:6); Type-III: WF: BGF: SP (46:46:8); Type-IV: WF: BGF: SP (45:45:10); WF: Wheat flour; BGF: Bengal gram flour; SP: Spinach powder.

Moisture, crude fat, crude fibre and ash content significantly increased in spinach powder incorporated *sev* while crude protein content decrease. Control *sev* (100% BGF) contains high amount of protein (19.98). Total iron, calcium, zinc and phosphorus content of supplemented *sev* varied from 5.01 to 7.23, 73.98 to 98.34, 2.21 to 3.13 and 306.12 to 322.23 mg/100 g, respectively. As these contents were found to be improved significantly with increase in the level of incorporation of spinach leaves in wheat-bengal gram flour blends. Pant *et al.* (2012) reported iron content of control *matthi* was 2.1 mg/100 g which increased to 2.3 and 2.5 mg/100 g on supplemented with 25 per cent spinach leaves powder and drumstick leaves powder, respectively.

Total, soluble and insoluble dietary fibre content of control *sev* varied from 8.23, 1.58 and 6.6.5 g/100 g, respectively. In case of supplemented *sev*, Type-IV composite flour made *sev* exhibited maximum contents of total, soluble and insoluble dietary fibre and Type-I composite flour made *sev* contained minimum contents of total, soluble and insoluble dietary fibre content. Singh *et al*. (2007), Pant *et al*. (2012), Verma and Jain (2012) and Singh *et al.* (2018) also reported higher fibre content in traditional products incorporated with cauliflower leaves, moringa leaves and spinach leaves powder.

Anti-oxidant activity and β-carotene content of spinach leaves supplemented *sev* increased due to the addition of spinach powder. Umma Khair *et al*. (2012) also reported higher anti-oxidant activity in spinach leaves powder supplemented products in comparison to control products. Dahiya (2002) and Singh *et al*. (2007) reported higher β-carotene content in *papad* and *matthi* incorporated with fenugreek leaves and bathua leaves powder.

CONCLUSION

The enrichment of *sev* with spinach leaves powder resulted in increase in proximate, mineral, dietary fibre and antioxidant activity and β- carotene contents of the enriched *sev*. *Sev* enriched with spinach leaves powder was acceptable upto 10% levels. The acceptability of *sev* samples with higher incorporation level(s) would only be possible with a lot of awareness creation about the health potentials.

Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the research work.

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