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Effect of addition of Lotus stem powder on nutritional, phytochemical and antioxidant properties of sev

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Abstract
Lotus stem is highly nutritious, possessed antioxidant and anti inflammatory activities and prevent anaemia, PEM and osteoporosis. This study was aimed to utilize Lotus stem powder for the development of nutrients rich sev. LSP supplemented sev were developed by incorporating 10, 15, 20, 25 and 30 per cent of LSP and these were evaluated for sensory parameters, proximate composition, total and *in vitro* bio- accessible minerals and antioxidants. In terms of sensory parameters, LSP supplemented sev were adjudged between 'liked moderately' to 'liked very much' (Figure-2) and were acceptable by the judges. The contents of moisture, crude protein, crude fat, crude fibre, ash, total carbohydrates, total calcium, iron and zinc of best acceptable type-IV sev were 5.58, 13.05, 20.71, 2.97, 4.42, 53.27, 61.38, 5.67 and 3.06 per cent. Phytochemical (total phenolic content and total flavonoids content) and antioxidant capacity were also increased in supplemented sev. Results indicated that lotus stem powder can be successfully incorporated up to 25 per cent for the development of nutrient rich sev without compromising the sensory acceptability. LSP supplemented sev had significantly (P<0.05) higher contents of fiber, calcium and iron than that of control sev.

Keywords: Nutrient rich, lotus stem, *in vitro*

Introduction
Lotus stem powder (LSP) have been considered nutritious as these are packed with high amounts of nutrients. The high amounts of lipid in seeds indicated their goodness in energy. Lotus stem is moderate in calories and rich in dietary fibre with complex carbohydrates which helps in lowering the blood glucose level and is recommended for pregnant women and people with chronic complains of constipation and also good for weight loss seekers (Ogle *et al*. 2001). Shad *et al.* (2011) [13, 16] reported the lotus stem flour proximate composition (g/100 g flour) as ash (1.10±0.66), the total nitrogen (1.36±0.04) total protein (8.48±0.25), total sugar (19.08±0.01) and free amino acids (0.78±0.035). Park *et al.* (2009) investigated that lotus stem cultivars (Inchisa, Muan, Garam, and Chungyang) had high amounts of bioactive compounds: total phenols between 7.95±0.8 and 4.21±0.3 mg of gallic acid equivalents (GAE)/g dry weight, ascorbic acid between 15.8±1.1 and 22.3±1.7 mg/g DW.
Gupta and Dubey (2013) [7] evaluated the nutrient composition of lotus stem *ladoo*, *puri* and noodles with the incorporation of 40 per cent of lotus stem powder. In *ladoo* crude protein was 7.84g, fat 11.85g, crude fibre 6.29g, carbohydrates 50.58g and iron 15.08mg/100g. Lotus stem *puri* had protein 4.25g, fat 34.06g, fibre 5.54g, carbohydrates 48.55g and iron 12.97mg/100g. Lotus stem noodles at 40 per cent level of incorporation contained protein 6.4g, fat 17.85g, fibre 6.04g, carbohydrates 40.54g and iron 14.99mg/100g. In general, they are essential for growth, brain development and immune system. Additionally, LSP play a major role in preventing and treating anaemia because of the highest amount of iron hence being a key source of iron for vegetarians when consumed with vitamin C rich foods Dungarwal, (2019) [5]. Sev is a fried snack and quite popular among children who have been witnessed most malnourished. Generally it is made up of bengal gram flour mixed with spices and fried in oil. It is a high energy snack as it is fried however, with the supplementation of LSP it may also become rich in of iron and calcium and may be the best snacks for malnourished children. Keeping in view the above facts, efforts have been made to prepare LSP supplemented sev and to evaluate their sensory and nutritional properties.

Materials and Methods

Development and sensory evaluation of sev

Lotus stem and other ingredients required for sev preparation were procured in a single lot from local market of Hisar city. The fresh lotus stem was cleaned manually and the damaged, inedible and brownish parts were discarded. The cleaned lotus stem was washed under running tap water to remove dust and dirt. It was rinsed with distilled water and spread over filter paper to remove extra water. Outer layer of stem was peeled with the help of stainless steel peeler, cut into small equal pieces and was spread on tray lined with filter paper. To evaporate the excessive moisture, it was dried in the hot air oven at 50±5°C till constant weight. The dried pieces were ground in electric grinder to obtain fine powder which was stored in Low Density Poly Ethylene (LDPE) bags till its further use in product development and analysis. Other ingredients used were bengal gram flour (75g), ghee, red chilli powder, salt and oil to fry.

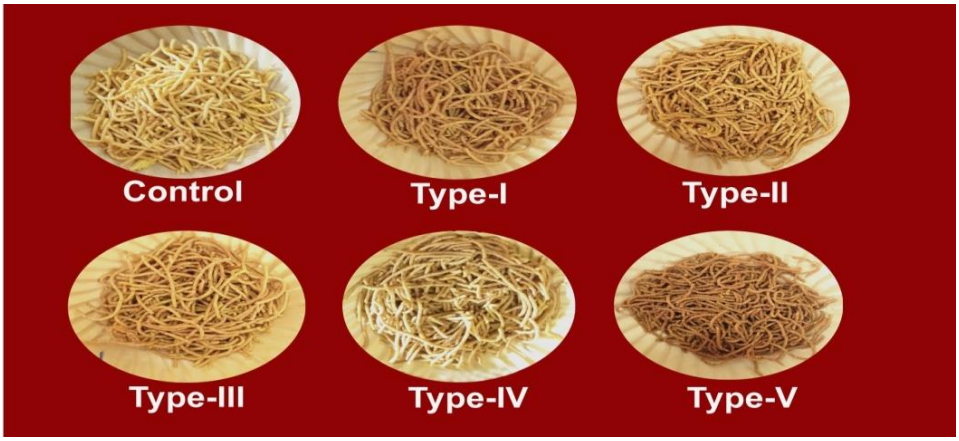

Plate 1: Preparation of lotus stem powder incorporated Sev

Control = Bengal gram flour
Type - I = Bengal gram flour + lotus stem powder (90:10)
Type – II = Bengal gram flour + lotus stem powder (85:15)
Type – III = Bengal gram flour + lotus stem powder (80:20)
Type – IV = Bengal gram flour + lotus stem powder (75:25)
Type – V = Bengal gram flour+ lotus stem powder (70:30)

Developed sev were subjected to organoleptic evaluation by a panel of 20 semi-trained judges from I.C. College of Home Sciences, Chaudhary Charan Singh Haryana Agricultural University, Hisar, Haryana. The judges were asked to rate the product on the basis of texture, aroma, colour, appearance and taste of sev by employing a nine-point hedonic rating scale. Overall acceptability was calculated by summing up and average of sensory parameters. Mean scores for all these characteristics were calculated.

Nutritional Analysis of Sev

Proximate composition i.e. moisture, protein, fat, crude fibre, ash were determined by employing the standard method of AOAC (2010) [1]. The contents of calcium, iron and zinc in acid digested samples explained above were determined by Atomic Absorption Spectrophotometer as per the method explained by Lindsey & Norwell (1969) [12]. Available calcium and zinc were extracted by adopting methodology of Kim & Zemel (1986) [9]. *In vitro* available iron and calcium was extracted according to the procedure explained by Rao & Prabhavathi (1978) [15]. The concentration of total phenol of the methanolic extracts was determined by the Folin–Ciocalteau colorimetric method (Singleton *et al*., 1999) [20]. Flavonoids content in methanolic extracts was determined by aluminium chloride colorimetric method (Zhishen *et al*., 1999) [23]. Total antioxidant capacity of the methanolic extracts was determined by using Ferric Reducing Antioxidant Power (FRAP) Assay (Benzie and Strain, 1996) [2] and modified by (Tadhani *et al*., 2009) [21]. The antioxidant activity of the extracts, on the basis of the scavenging activity of the stable DPPH free radical, was determined by the method followed by Brand-Williams *et al*. (1995) [3] as previously described by Tadhani *et al*. (2009) [21].

Statistical Analysis

Data of sensory evaluation and nutritional composition of Lotus stem powder supplemented sev were statistically analysed for analysis of variance in a complete randomized design (CRD) by OPSTAT software developed by Sheoran & Pannu (1999) [17].

Results and Discussion

As per the scores given to colour, appearance, aroma, texture and taste, the overall acceptability of control sev was higher than that of LSP supplemented sev. As per the scores of color, appearance, aroma, texture and taste the overall acceptability of control sev was 8.21. hence, these were adjudged as ‘liked very much’. Mean scores of overall acceptability of type-I, type-II, type-III, Type-IV and Type-V cutlets varied from 7.44 to 6.63, being highest for the type-IV sev and lowest for type-V sev. However, all the supplemented sev were adjudged between ‘liked moderately’ to ‘liked very much’ (Figure-2) and were acceptable by the judges. Drying is a common process applied for vegetables, to enhance their sensorial properties and nutritional value. It also improves shelf life, palatability and acceptability of developed products (Jain *et al*. 2016). A pleasant aroma was arised in the dehydrated lotus stem. Sharma and Chaudhary (2001) [19] reported that the *chapati* prepared by them was most acceptable up to 10 per cent incorporation of lotus stem powder in terms of all the sensory parameters. Kumari (2018) [10] reported that *missi roti*

was acceptable up to 10 per cent of lotus stem powder incorporation and Verma and Jain (2012) prepared *mathri* with dehydrated vegetables including lotus stem powder shows higher overall acceptabilityat 7.0 per cent level of incorporation. Kumari and Kumari (2002) [11] prepared *ladoo* and *chapati* with 20 per cent and *mathri* with 15 per cent of lotus stem powder for supplementation to adolescent girls. Chaudhary and Pareek (2010) [4] found that 5 per cent lotus stem powder in *khakare* was most acceptable.

The contents of moisture, crude protein, crude fat, crude fibre, ash and total carbohydrates in sev prepared with 100 per cent bengal gram flour were observed as 5.83, 14.85, 21.57, 1.91, 3.24 and 52.60 respectively, ash and crude fibre were found to be increased significantly ($P \leq 0.05$) after addition of lotus stem powder (Table 1). A non significant difference was observed for moisture, fat and total carbohydrates content between control and LSP supplemented sev. The contents of moisture, crude protein, crude fat, ash, crude fibre and total carbohydrates of type-IV sev were 5.58, 13.05, 20.71, 4.42, 2.97, and 53.27 per cent, respectively. Maximum contents of crude fibre and ash were observed in supplemented sev, whereas the maximum contents of crude protein was found in control sev. The contents of ash and crude fiber were increased significantly after lotus stem powder supplementation. Similarly Gupta (2014) [6] revealed that replacement of 40 per cent lotus stem flour in wheat flour significantly increased the mineral content. The substitution of lotus stem powder for wheat flour to make biscuits showed considerable improvement in calcium and iron content (Yadav and Dunkwal 2014) [22]. Control *ladoo* had significantly lower values for bioavailable calcium and iron as compared to supplemented ones.

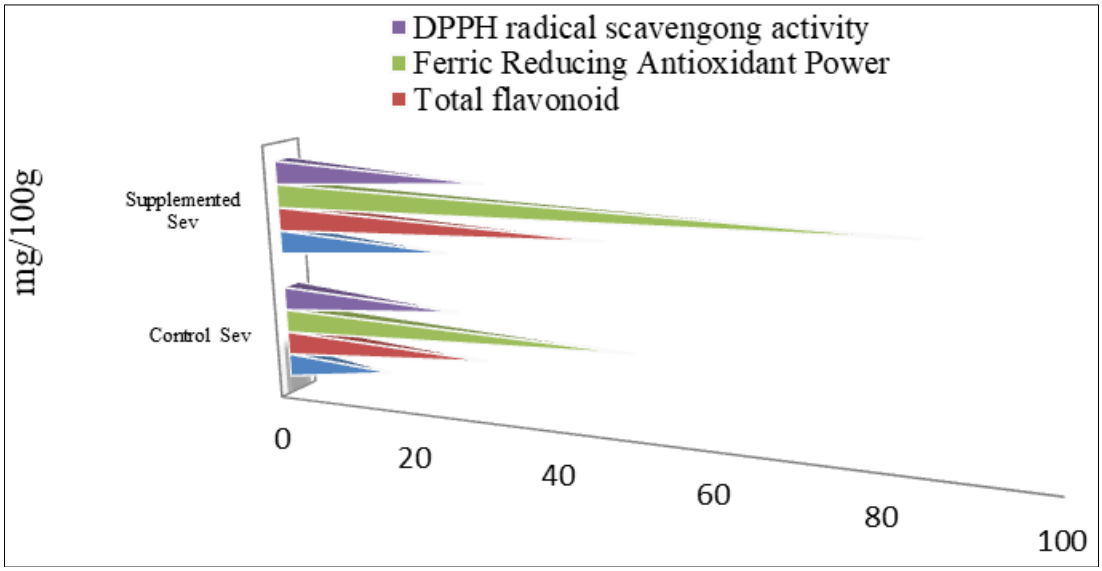

Fig 2: Antioxidant activity of sev products (fresh weight basis)

Total phenolic content and total flavonoids of type IV sev (23.63 mg GAE/100g, 44.97 mg RE/100g, respectively) were significantly higher as compared to control *sev* (14.46 mg GAE/100g, 28.77 mg RE/100g, respectively). Similarly, ferric reducing antioxidant power and the DPPH radical scavenging activity were found significantly higher in supplemented *sev* (82.83 mg TE/100g and 29.17 mg TE/100g, respectively) as compared to control *sev* (48.80 mg TE/100g and 24.90 mg TE/100g, respectively).

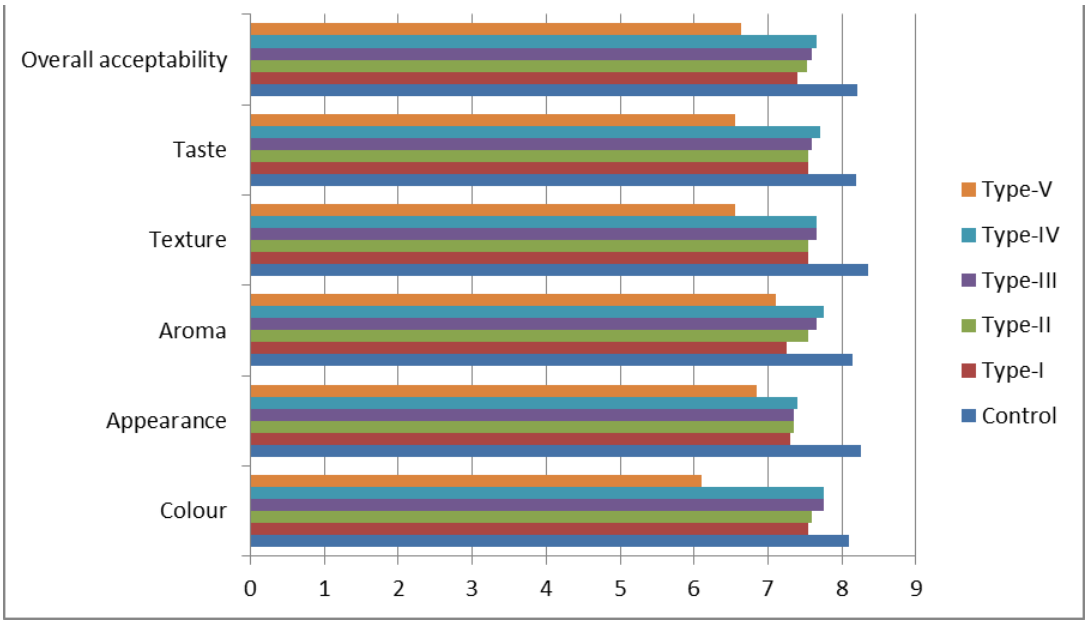

Fig 1: Sensory scores of lotus stem powder supplemented sev

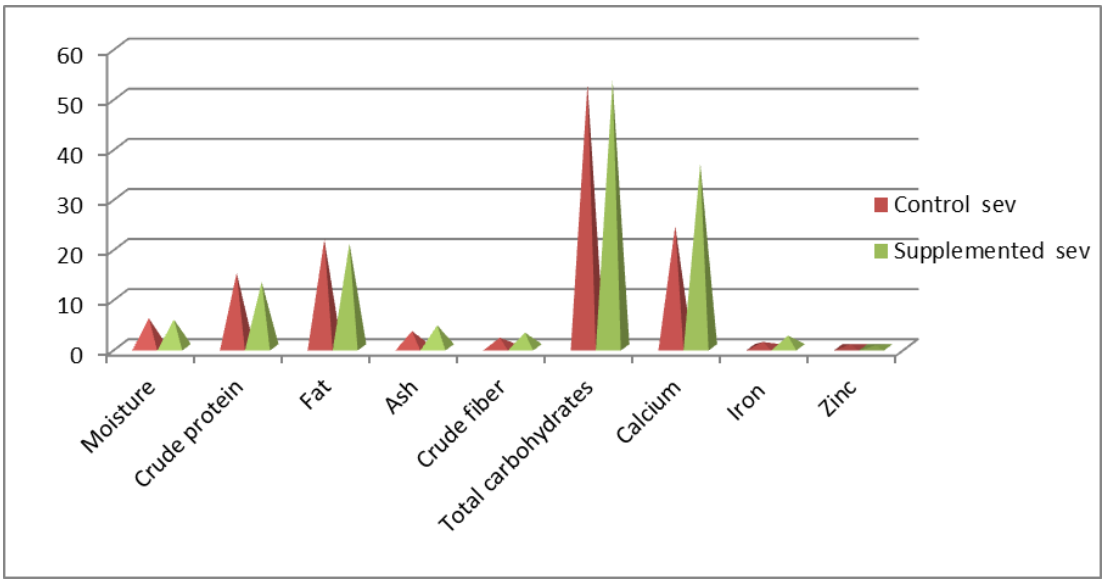

Fig 3: Proximate composition of lotus stem powder supplemented sev (%, on dry weight basis)

Total Calcium, iron and zinc content of control sev was observed as 49.72, 3.74 and 3.76 mg/100g, respectively which were 61.38, 5.67 and 3.06 mg/100g, respectively in LSP supplemented sev. Type-IV sev had significantly (P<0.05) higher contents of total calcium and iron. The per cent availability of calcium, iron and zinc among LSP supplemented sev was 59.72, 41.27 and 14.05 per cent, respectively. Similarly Gupta (2014) [6] revealed that replacement of 40 per cent lotus stem flour in wheat flour significantly increased the mineral content. The substitution of lotus stem powder for wheat flour to make biscuits showed considerable improvement in calcium and iron content (Yadav and Dunkwal 2014) [22]. Control *ladoo* had significantly lower values for bioavailable calcium and iron as compared to supplemented ones.

Conclusion

It may be concluded that lotus stem is more acceptable when incorporated in sev than consumed as such as a salad. Dehydrated lotus stem powder can be successfully incorporated up to 25 per cent for the development of nutrient rich sev without compromising the sensory acceptability. LSP supplemented sev had significantly (P<0.05) higher contents of fiber, calcium and iron than that of control sev. Consumption of lotus stem powder supplemented nutrient rich sev may improve the nutritional status in malnourished children and adolescents as anaemia is the major nutritional problem in India.

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