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Nutritional quality parameters and acceptability scores of namakpara prepared from lotus stem powder

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Abstract
Medicinal plants have played a major role as a functional food and pharmacological source of active substances. Lotus stem is an aquatic herb with stout creeping yellowish white colored rhizome. It is sweet in taste and can be eaten uncooked, steamed, fried and its powder is used for making poducts. It contains a wide spectrum of vitamins and minerals. Therefore, the present study was undertaken to overcome the ill effects of nutrition related problems with improving the quality of life by using dehydrated lotus stem powder in namakpara. The main aim of the study was to develop value added product like namakpara with the incorporation of namakpara at different levels. The results of sensory appraisal revealed that among different proportion of ingredients used with the combination of 80% wheat flour and 10% of lotus stem powder was most acceptable and received the highest ratings.

Keywords: Lotus stem, namakpara

Introduction
Lotus stem (*Nelumbo nucifera*) also known as Indian lotus belongs to family *Nelumbonaceae*. It is an aquatic herb with stout creeping yellowish white coloured rhizome. In Asia lotus is cultivated for its edible rhizomes, seeds and leaves. It is harvested in autumn or winter and dried for later use. In India lotus plant is developed in all lakes and other water bodies, at high elevation territories of Kashmir, Himalayas, North India and in the lower heights of Kanya Kumari and Southern India. Exterior of lotus stem is covered with a peel that is reddish brown color in appearance. Its buds, flowers, fruits, leaves, stalks, rhizomes and roots are edible and have been used as herbal medicines for treatment of cancer, diarrhea, heart problems, hypertension and insomnia (Subbuti 2007) [5].

Lotus stem is sweet in taste and can be eaten uncooked, steamed, fried and its powder is used for making soups. Tender young lotus stem is used for salads. It has a milled flavour and a crisp texture, so it can also be cooked as vegetable and soaked in syrup or pickled in vinegar (Maki *et al.* 2008) [2]. The Rhizomes of *Nelumbo nucifera* show anti-diabetic and anti-inflammatory effects and its extracts had antipyretic activities which have been attributed to their bioactive components, such as polyphenols and flavonoids (Yang *et al.*, 2016) [7]. Lotus stem extracts are also reported to have high inhibitory activity against glycolytic enzymes such as α amylase that inhibits blood glucose elevation and reduce insulin secretion and hence can be effective in managing type 2-diabetes (Mukherjee, *et al.*, 1997) [3]. Lotus stem extract inhibits the bone resorption and prevent bone metabolic disorders such as osteoporosis (Sang et al., 2011) [4]. lotus stem aqueous extract possess cytoprotective effect. Extract contained polyphenolic compounds, which confer the radical scavenging and antioxidant activities on the extract and therefore protect the cells. The extract prevented the iron-induced oxidative damage (Takefumi *et al.* 2012) [6].

Materials and Methods
In present study, lotus stem was purchased from the market.

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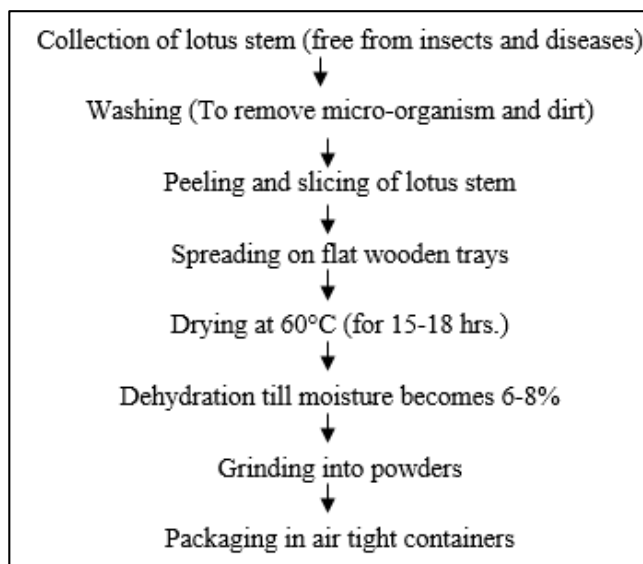Agricultural University, Hisar,
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Fig 1: Flow diagram of preparation of lotus stem powder.

Namakpara was prepared with different proportions of lotus stem (10%, 15%, 20% and 25%). Sensory evaluation was conducted to evaluate the acceptability of all different proportions of namakpara on the basis of the 9 point hedonic scale by 15 semi-trained panel members to get the most acceptable level from namakpara. Proximate analysis of nutrients of the most acceptable product was done by using standard procedures (AOAC).

Results and Discussion
Mean scores for overall acceptability of namakpara depicted that all types of namakpara fell in the category of "liked very much" to "liked slightly" by the panelists where control namakpara scored 8.05 followed by type III (7.85), type II (7.72), type I (7.55) and type IV (6.85).
Overall acceptability increased as the amount of lotus stem powder was increased to maximum of 20% and decreased overall acceptability when the level of lotus stem powder incorporation was increased to 25%.

Table 1: Consumer acceptability of Namakpara

Type of Namakpara	Sensory characteristics					
	Color	Appearance	Aroma	Texture	Taste	Overall acceptability
Control (WF)	8.05±0.17	7.95±0.13	7.97±0.18	8.00±0.20	8.02±0.18	8.05±0.17
Type-I (WF:LSP::90:10)	7.45±0.26	7.40±0.16	7.42±0.20	7.51±0.22	7.39±0.20	7.55±0.14
Type-II (WF:LSP::85:15)	7.84±0.20	7.26±0.26	7.78±0.36	7.70±0.15	7.58±0.08	7.72±0.10
Type-III (WF:LSP::80:20)	7.81±0.20	7.85±0.21	7.80±0.19	7.80±0.17	7.91±0.15	7.85±0.16
Type-IV (WF:LSP::75:25)	6.00±0.18	6.45±0.16	6.05±0.15	6.25±0.20	6.51±0.19	6.25±0.18

Values are mean ±SE of three independent determinations
WF: Wheat Flour LSP: Lotus Stem Powder

Nutritional analysis of namakpara was done with the control and type III of namakpara with lotus stem powder. The nutrient composition of control namakpara was compared with best acceptable type III namakpara. Significantly higher content of ash, crude fibre, carbohydrates, iron, calcium and magnesium were found in type III namakpara (Tables 2 and 3). Antioxidant activity of namakpara supplemented with lotus stem powder was found to be higher as compared to the control namakpara (table 5).

Table 2: Proximate composition of Namakpara (g/100g, on dry matter basis)

Namakpara	Moisture	Crude Protein	Fat	Ash	Crude Fibre	Carbohydrates
Control (WF 100%)	5.12±0.03	8.93±0.01	19.23±0.23	2.87±0.07	2.47±0.05	66.50±0.21
Type-III (WF:LSP::80:20	5.91±0.20	7.43±0.06	18.13±0.07	3.53±0.06	3.95±0.12	68.26±0.32

Table 3: Total mineral content of Namakpara (g/100g on dry basis)

	Iron	Calcium	Zinc	Magnesium
Control (WF 100%)	7.64±0.14	42.54±0.07	1.63±0.14	71.14±0.088
Type-III (WF:LSP::80:20)	9.81±0.12	58.86±0.27	1.423±0.268	78.36±0.204

Table 4: Total soluble sugars, reducing sugars and non- reducing sugars content of Namakpara (g/100g on dry basis)

	Total soluble sugars	Reducing sugars	Non- reducing sugars
Control (WF 100%)	5.90±0.17	0.36±0.09	5.54±0.17
Type-III (WF:LSP::80:20)	6.67±0.14	0.44±0.01	6.22±0.15

Table 5: Antioxidant activity of Namakpara (g/100g on dry basis)

	Total phenolic content (mg GAE /100g)	Total Flavonoids (mg RE/100g)	Ferric Reducing Antioxidant Power	Antioxidant activity DPPH (mgTE/100g)
Control (WF 100%)	19.16±0.36	23.38±0.15	50.41±0.41	21.76±0.76
Type-III (WF:LSP::80:20)	28.83±0.22	64.86±0.38	103.41±0.72	38.69±0.52

It may be concluded from this research that lotus stem powder can be successfully used in the development of various value added food products without affecting their sensory qualityies. Addition of lotus stem powder has also improves the nutritional profile of namakpara specially the mineral contents. All types of lotus stem supplemented namakpara were liked and acceptable by the panelists.

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