



Development and Evaluation of Indian Traditional Sweet ‘Laddoo’ Supplemented with Germinated Pumpkin Seed Flour

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Authors' contributions

This work was carried out in collaboration among all authors. Authors SCS and VR designed the study, wrote the protocol and guided the research work. Author NK managed the analyses of the study, performed the statistical analysis and wrote the first draft of the manuscript. Author VK managed the literature searches. All authors have read and approved the final manuscript.

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ABSTRACT

Aim: The study was planned to evaluate Indian traditional sweet ‘Laddoo’ supplemented with germinated pumpkin seed flour.

Study Design: The traditional recipe was supplemented by replacing the whole wheat flour and bengalgram flour with 10, 20 and 30% of germinated pumpkin seed flour. The developed products were subjected to organoleptic and nutritional evaluation. The results were subjected to statistical analysis using ANOVA.

Place and Duration of Study: The study was carried in Department of Foods & Nutrition and was part of doctoral research work carried out between 2017-19.

Methodology: 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 and available minerals using standard methods.

Results: The supplementation resulted in a significant ($P \leq 0.05$) increase in ash, crude fat, crude protein and crude fiber while total carbohydrates decreased. The supplemented product had crude

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protein ranging from 19.39-25.59 g; crude fibre 2.21 -3.24 g and ash 5.70-8.19 g/100 g at different levels of incorporation as against 16.53, 1.64 and 3.66 g/100 g respectively in control product. Significant increase was observed in mineral content also. The supplemented products had calcium, magnesium, zinc, iron, potassium and phosphorus ranging from 63.47-95.46, 132.63-133.58, 3.58-7.51, 6.49-11.33, 639.53-884.34 and 343.32-356.63 mg/100 g on dry matter basis. The developed products were acceptable to judges.

Conclusion: Incorporation of germinated pumpkin seed flour significantly ($P \leq 0.05$) improved the nutrient and mineral profile of whole wheat flour Bengal flour *Laddoo*. Such developed products can be very useful in combating the macronutrient and micronutrients deficiency problem in population of all age groups.

Keywords: Pumpkin seeds; Indian traditional sweet; laddoo; sensory evaluation; nutrient and mineral composition.

1. INTRODUCTION

Pumpkin belongs to the genus *Cucurbita* and family *Cucurbitaceae*. It is one of the widely grown vegetables, a valuable source of carotenoids. Like other members of *Cucurbitaceae*, pumpkin seeds are located at its central hollow cavity; interspersed in between net like mucilaginous network. The seed content of pumpkin fruit varies from 3.52 to 4.27% [1]. Though the flesh of vegetable has found its way into the Indian diet since time immemorial, the seeds are almost always discarded as waste without acknowledging their nutritive value. After harvesting, the seeds are often used as animal feed; ground up for fertilizer or even discarded. In India, seeds go as waste in cattle feed and only little amounts are eaten after being salted and roasted [2]. The nutritional benefits of pumpkin seeds have aroused the interest of scientists in it as a potential source of micronutrients. Being excellent nutrient source of minerals mainly zinc, phosphorous, magnesium, potassium and selenium; pumpkin seed are known as nutritional powerhouse and can be a great weapon for fighting diseases such as arthritis, inflammation, prostate cancer etc. They can be consumed regularly without causing any side effects on human health and can play important role in food by nutritional aspects [3,4].

Different processing methods have always sought the attention of scientists for improving the nutritional value of products by decreasing antinutrients and improving digestibility. Germination is a commonly employed processing method. Such processing of seeds not only contributes to nutritive value but also affects the functional properties of the flour that in turn affects its utility in product development.

Value addition of existing foods with such ingredients is a simple and feasible way of enhancing nutritional values of foods and adds variety to snacking with health [5,6,7]. *Laddoo* is a highly savoured cereal- legume based Indian traditional sweet. Being a favorite with all age groups and across regions in India, it can be a perfect choice as vehicle for value addition [8,9]. The addition of germinated pumpkin seed flour into the whole wheat flour -Bengal gram flour *Laddoo* can further increase the protein quality, dietary fiber as well as mineral content. Keeping all this in view, the present study was carried out with the objective of value addition in Indian traditional sweet 'laddoo' by supplementing with germinated pumpkin seed flour and study the organoleptic acceptability and nutritional composition of developed product.

2. MATERIALS AND METHODS

Present study was carried out in Department of Foods and Nutrition, I.C. College of Home science, Chaudhary Charan Singh Haryana Agricultural University, Hisar. Pumpkins were procured from the local market and seeds were separated from the pulp.

The required ingredients for the preparation of *Laddoo* namely, whole wheat flour, Bengal gram flour ghee, refined sugar were purchased in a single lot from the local market of Hisar.

2.1 Germination

For the purpose of germination, the cleaned and washed seeds were soaked in distilled water for 24 hrs. followed by 48 hours of germination by placing in wet germination sheets. The germinated pumpkin seeds were dried overnight in hot air oven (50°C). The dried germinated seeds were made into flour using electric grinder.

2.2 Product Development

Three types of *Laddoos* were developed (Table 1) by replacing 10, 20 and 30% of whole wheat-Bengal gram flours with germinated pumpkin seed flour as follows:

Supplemented recipe	Level of supplementation
Control	WWF:GF:GPSF::50:50:0
Type-I	WWF:GF:GPSF::45:45:10
Type-II	WWF:GF:GPSF::40:40:20
Type-III	WWF:GF:GPSF::35:35:30

WWF: Whole wheat flour; GF: Gram flour; GPSF: Germinated pumpkin seed flour

2.3 Method

1. Sieved and dry roasted wheat flour and bengal gram flour separately.
2. Melted ghee in a skillet.
3. Added roasted flours along with germinated pumpkin flour and fried in ghee for 2-3 minute.
4. Removed from fire and allowed to cool.
5. Added ground sugar and mixed well.
6. Made balls (*Laddoo*) of even size.
7. Total cooked weight of recipe was recorded.

2.4 Sensory Evaluation

Sensory evaluation of developed germinated pumpkin seed flour supplemented *Laddoo* was carried out by a panel of ten semi-trained judges from I.C College of Home Science, CCS Haryana Agricultural University, Hisar using 9-point hedonic scale. The judges were presented with each product in separate sessions and were requested to rinse their mouths with plain water before each analysis. Observations were made with respect to color, appearance, flavour, taste, texture and overall acceptability on a scale of 1 to 9 representing 'dislike extremely' to 'like extremely'. The scale of 5 represented the neutral score 'neither like nor dislike.' The

unsupplemented *laddoo* was used as control to compare the effect of supplementation.

2.5 Nutritional Evaluation

Moisture, ash, crude fat, crude protein and crude fiber were estimated by employing the standard methods of analysis [10]. The total carbohydrate was calculated by the difference method.

$$\begin{aligned} \text{Total carbohydrate (\%)} \\ &= 100 - [\text{crude protein (\%)} \\ &+ \text{crude fat (\%)} \\ &+ \text{crude fiber (\%)} \\ &+ \text{total ash (\%)}] \end{aligned}$$

Total, soluble and insoluble dietary fiber constituents were determined by the enzymatic method [11]. Total calcium, iron, zinc, potassium and magnesium in acid digested samples were determined using Atomic Absorption Spectrophotometer Model No: Pinnacle 700AA. Phosphorus was determined colorimetrically [12].

2.6 Statistical Analysis

The data obtained were subjected to statistical analysis for analysis of variance in a complete randomized design by OPSTAT software developed by Sheoran and Pannu [13]. Level of significance was set at $P \leq 0.05$. CD (Critical difference) was used to check the significance of results.

3. RESULTS AND DISCUSSION

3.1 Sensory Characteristics

The mean sensory scores for control *Laddoo* i.e. without incorporating pumpkin seed flour were 8.40, 8.40, 8.20, 8.40, 8.50 and 8.34 for colour, appearance, aroma, texture, taste and overall acceptability, respectively and they were 'liked very much' by the panel of semi-trained judges (Table 2).

Table 1. *Laddoo* supplemented with germinated pumpkin seed flour

Ingredients	Control	Type I	Type II	Type III
Whole Wheat flour (g)	75	67.5	60	52.5
Bengal gram flour (g)	75	67.5	60	52.5
Germinated pumpkin seed flour (g)	-	15	30	45
Ghee(clarified butter) (g)	75	75	75	75
Sugar (g)	50	50	50	50
Cooked weight (g)	275	276	277	277

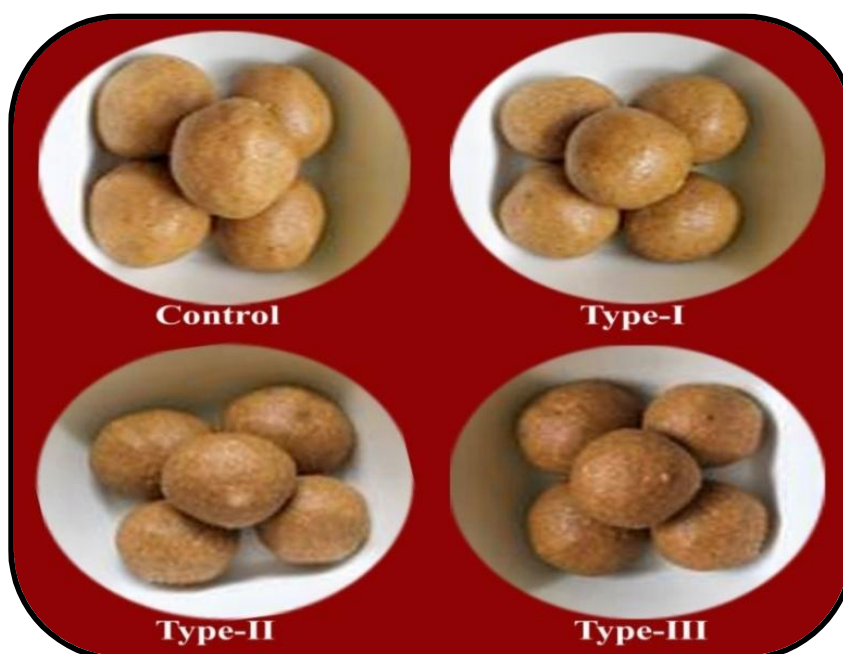


Fig. 1. Developed pumpkin seed flour Laddoo

Type-I and Type-II Laddoo incorporating 10% and 20% germinated pumpkin seed flour had 8.20, 8.30, 8.30, 8.40, 8.50, 8.34 and 8.10, 8.20, 8.00, 8.30, 8.20 and 8.16 mean scores for various sensory characteristics i.e. colour, appearance, aroma, texture, taste and overall acceptability, respectively. Type-I and Type-II Laddoo were categorised as 'liked very much'. The organoleptic evaluation scores for Type-III Laddoo incorporating 30% germinated pumpkin seed flour fell in the category of 'liked moderately'. The overall acceptability of Type III with 30% incorporation was significantly ($P \leq 0.05$) lower than that of Type type I or II. However, no such significant difference was observed in overall acceptability of Type I and Type II with 10 and 20% incorporation. A 20% level of incorporation may therefore be recommended as further increase significantly ($P \leq 0.05$) affected the acceptability score.

Sensory analysis is an integral part of any product development study. In a study similar to ours, development and nutritional evaluation of food products supplemented with pumpkin seeds has been reported by Kaur & Sharma [14]. Food products namely Laddoo, Panjeeri and Mathi were developed using standardized recipes with different levels of pumpkin seed flour in raw and roasted form. Sensory analysis revealed that 30% supplementation of pumpkin seed flour (raw and roasted) in all the products was most

acceptable. Bishnoi et al. [15] reported organoleptic acceptability of herbal aonla laddoo containing 6% *satavari* powder to be "Neither liked nor disliked" which was significantly lower than control. The recipe with 4% *satavari* powder had better acceptability and was categorized as 'Liked very much'. In another study, Ghatge et al. [16] developed nutra-laddoo incorporating whole Flaxseed, amaranth and Jaggery. Flaxseed level varied from from 0 to 50%. Using a 9-point hedonic scale, they observed that nutra laddoo prepared with a 30% supplement of Whole Flaxseed obtained higher score (8.0) as compared to other supplementation levels. Jain and Grover reported a mean score of 7.6 for overall acceptability of laddoo with 10% garden cress seed supplementation [17].

3.2 Nutritional Evaluation

Proximate composition of Laddoo supplemented with germinated pumpkin seed flour is presented in Table 3. For value addition in Laddoo, the whole wheat flour and gram flour were replaced by 10, 20 and 30% of germinated pumpkin seed flour. The value addition resulted in a significant ($P \leq 0.05$) increase in all proximate parameters including moisture, ash, crude fat, crude protein and crude fiber. A significant ($P \leq 0.05$) decrease was observed in the total carbohydrate content as level of incorporation increased. Control Laddoo had 3.17% moisture, 3.66% ash, 21.46%

crude fat, 16.53% crude protein, 1.64% crude fiber and 52.30% total carbohydrate. An increased moisture content ranging from 3.42 to 3.69%, ash 5.79 to 8.19% and crude fat 25.87 to 31.52%, crude protein 19.39 to 25.59% and crude fiber 2.21 to 3.24% was observed after value addition. The total carbohydrate content was 51.15, 37.38 and 31.46% for Type-I, Type-II and Type-III *Laddoos*, respectively.

3.3 Total Dietary Fiber

Laddoo with no added pumpkin seed flour (control) had 2.83% soluble, 10.94% insoluble and 13.77% total dietary fiber content. Value addition with germinated pumpkin seed flour, significantly ($P \leq 0.05$) increased the soluble, insoluble and total dietary fiber content. The respective composition of soluble, insoluble and total dietary fiber content of Type-I *Laddoo* was 2.90, 11.33 and 14.24%, for Type-II *Laddoo* it was 2.94, 11.73 and 14.67% and for Type-III *Laddoo* it was 2.99, 12.15 and 15.14% (Table 4)

3.4 Total Mineral Content

A significant ($P \leq 0.05$) improvement was observed in the total mineral profile of *Laddoos*. The calcium content improved from 47.53 mg/100 g (control) to 63.47 mg/100 g (Type-I), 79.59 mg/100 g (Type-II) and 95.46 mg/100 g (Type-III) with an increase of 33.54, 67.45 and 100.84%, respectively (Table 5).

The control *Laddoo* with no value addition had mineral content 131.50 mg/100 g magnesium, 1.52 mg/100 g zinc, 4.56 mg/100 g iron, 517.52 mg/100 g potassium and 330.14 mg/100 g phosphorus. All the total mineral contents were found to improve with value addition. The magnesium content of *Laddoo* was increased to 132.63 mg/100 g (Type-I) and 133.58 mg/100 g (Type-III). Respective mineral composition for zinc, iron, potassium as well as phosphorus was 5.44, 8.50, 761.47 and 349.50 mg/100 g for Type-II *Laddoo*. It was 7.51, 11.33, 884.34 and 356.63 mg/100 g for Type-III *Laddoo*.

Table 2. Organoleptic acceptability of developed *Laddoo*

Level of incorporation	Color	Appearance	Aroma	Texture	Taste	Overall acceptability
Control	8.40±0.22	8.40±0.22	8.20±0.29	8.40±0.22	8.50±0.17	8.38±0.20
Type-I	8.20±0.25	8.30±0.21	8.30±0.26	8.40±0.16	8.50±0.22	8.34±0.20
Type-II	8.10±0.31	8.20±0.20	8.00±0.30	8.30±0.15	8.20±0.33	8.16±0.24
Type-III	7.50±0.27	7.50±0.27	7.40±0.27	7.70±0.21	6.90±0.41	7.40±0.26
CD ($P \leq 0.05$)	0.76	0.65	0.80	0.55	0.85	0.65

Values are mean ± SE of ten observations

Table 3. Proximate composition of developed *Laddoo* (% dry weight basis)

Types of <i>Laddoo</i>	Moisture*	Ash	Crude fat	Crude protein	Crude fiber	Total carbohydrates
Control	3.17±0.11	3.66±0.04	21.46±0.13	16.53±0.22	1.64±0.03	52.30±0.16
Type-I	3.37±0.10	5.79±0.08	25.87±0.16	19.39±0.18	2.21±0.05	51.15±0.24
Type-II	3.53±0.13	6.63±0.06	30.65±0.19	22.49±0.20	2.84±0.06	37.38±0.16
Type-III	3.69±0.15	8.19±0.07	31.52±0.21	25.59±0.24	3.24±0.08	31.46±0.19
CD ($P \leq 0.05$)	0.41	0.19	1.05	0.69	0.12	0.96

Values are mean ± SE of six independent determinations. *On the fresh weight basis

Table 4. Dietary fiber content of developed *Laddoo* (g/100 g, dry weight basis)

Types of <i>Laddoo</i>	Soluble dietary fiber	Insoluble dietary fiber	Total dietary fiber
Control	2.83±0.03	10.94±0.09	13.77±0.27
Type-I	2.90±0.09	11.33±0.11	14.24±0.29
Type-II	2.94±0.10	11.73±0.13	14.67±0.16
Type-III	2.99±0.14	12.15±0.15	15.14±0.18
CD ($P \leq 0.05$)	0.03	0.08	0.98

Values are mean ± of six independent determinations

Table 5. Total mineral content of developed Laddoo (mg/100 g, dry weight basis)

Types of Laddoo	Calcium	Magnesium	Zinc	Iron	Potassium	Phosphorus
Control	47.53±0.22	131.50±0.21	1.52±0.23	4.56±0.18	517.52±0.21	330.14±0.29
Type-I	63.47±0.23	132.63±0.19	3.58±0.25	6.49±0.25	639.53±0.21	343.32±0.14
Type-II	79.59±0.19	133.41±0.18	5.44±0.16	8.50±0.19	761.47±0.18	349.50±0.21
Type-III	95.46±0.21	133.58±0.20	7.51±0.21	11.33±0.16	884.34±0.19	356.63±0.23
CD (P≤0.05)	0.70	0.64	0.70	0.65	0.64	0.78

Values are mean ± SE of six independent determinations

Table 6. Per cent HCl-extractability mineral content of developed Laddoo (mg/100 g, dry weight basis)

Types of Laddoo	Calcium	Magnesium	Zinc	Iron	Potassium	Phosphorus
Control	51.93±0.11	43.49±0.26	11.50±0.20	9.65±0.13	61.64±0.25	56.42±0.18
Type-I	59.01±0.10	47.43±0.25	13.69±0.13	11.52±0.17	64.59±0.15	58.51±0.22
Type-II	68.75±0.14	51.33±0.22	16.42±0.22	13.38±0.19	66.47±0.16	61.57±0.21
Type-III	77.13±0.15	54.38±0.13	19.67±0.18	15.52±0.15	69.53±0.20	64.47±0.23
CD (P≤0.05)	0.36	0.63	0.19	0.12	0.63	0.69

Values are mean ± SE of six independent determinations

3.5 Percent Hcl-Extractability of Mineral

Value addition with germinated pumpkin seed flour brought significant ($P \leq 0.05$) improvement in mineral per cent HCl-extractability (Table 6). The extractability of calcium was 51.93% (control), 59.01% (Type-I), 68.75% (Type-II) and 77.13% (Type-III) Laddoo. HCl- extractability of magnesium increased from 43.49% (control) to 47.43, 51.33 and 54.38% in Type-I, Type-II and Type-III Laddoo, respectively.

Per cent HCl-extractability of zinc increased from 11.50 (control) to 13.69, 16.42 and 19.67 in Type-I, Type-II and Type-III Laddoos, respectively. The extractability of iron increased from 9.65% (control) to 11.52, 13.38 and 15.52%, respectively, at three levels of incorporation. The HCl extractability of potassium increased from 61.64% (control) to 69.53% (Type-III). The HCl extractability of phosphorus increased from 56.42% (control) to 64.47% (Type-III).

Pumpkin seeds have often been explored as rich source of not only protein and ash but also valuable carotenoids and fatty acids. Ardabili *et al.* reported that the pumpkin seeds contained 41.59% oil and 25.4% protein. Moisture, crude fiber, total ash, and carbohydrate contents were 5.2%, 5.34%, 2.49%, and 25.19%, respectively [18]. Similarly, Habib *et al.* described the proximate compositions of the powdered seed as moisture 4.06%, ash 3.80%, crude fiber 2.91%, total lipid 36.70%, total protein 34.56%, total

soluble protein 18.10%, 1.08%, and starch 2.15%. The mineral composition of the seed was phosphorus 0.71%, Magnesium 348.7 ppm, iron 290.0 ppm, copper 70 ppm, zinc 39.9 ppm, and manganese 17.9 ppm [19]. Number of other co-workers have also described potential of pumpkin seeds for developing and innovating nutraceuticals, pharmaceuticals, and cosmeceuticals products for the large range application [20,21].

Laddu is one of the traditional sweet snacks which is popular not only among young children but also liked by people of almost all age group and section across Indian population. Our study reports significantly improved nutritional profile in terms of protein, fibre as well as minerals after supplementation with germinated pumpkin seed flour. Our study is in agreement to work by a number of co-workers who have reported improved nutritional value after value addition of traditional recipe of Laddoo with processed/unprocessed unconventional seeds. Rana and Kaur [8] studied the proximate composition of Laddoo supplemented with 10% garden cress seeds and revealed that the moisture, crude protein, crude fat, ash content of garden cress supplemented Laddoo was 0.92, 14.91, 23.37 and 2.13% which were high as compared to the control Laddoo. Baranwal and Singh [9] developed an iron rich food supplement i.e. niger seed Laddoo. This study showed that the supplement made with two parts of niger seeds and one part of jaggery i.e. 2:1 ratio was

found to be more acceptable. It contained 20.71 g protein, 34 g of fat, 7.83 g crude fibre, 213 mg calcium, 42.61 mg iron, 4.7 g ash per 100 g of Laddoo. Kaur and Sharma [14] evaluated food products (*Laddoo*, *Panjeeri* and *Mathi*) supplemented with raw and roasted pumpkin seeds. The supplemented products were found to have higher protein (8.97 to 12.07%), fat (31.55 to 45.56%), fibre (2.04 to 3.21%), ash (1.69 to 2.55%), iron (2.50 to 3.29 mg/100g) and zinc (1.45 to 2.08 mg/100g) content as compared to the control (0% supplementation). Similar work has been reported by Singh et al. [22] and Kumari et al. [23] also who developed laddoo recipes with *Moringa oleifera* and amaranth seeds, respectively.

4. CONCLUSION

Being a popular product with all age groups, laddoo has the potential to be used as a vehicle for supplementation. Germinated pumpkin seed flour could successfully be incorporated up to 20% level in whole wheat flour- Bengal gram flour *Laddoo*. Supplementation with germinated pumpkin seed flour significantly ($P \leq 0.05$) improved the nutrient and mineral profile of developed *Laddoo*. The developed germinated pumpkin seed flour laddoo can be very useful in combating the macronutrient and micronutrients deficiency problem in population of all age groups. Also this provides a useful alternate to otherwise discarded vegetable by-product.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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