Effect of pre-treatments on quality parameters of *Nelumbo nucifera* root powder

ABSTRACT

Nelumbo nucifera ~~*roots*~~, commonly known as lotus roots ~~root~~ have an abundance of potential for utilization in many food applications because they have so many medicinal, physiological and health advantages**.** This research was conducted to study the effect of different pretreatments namely on quality parameters of lotus root powder. All treatments were blanched for 3 minutes and dried at 55°C except control. The physical characteristics such as yield, moisture, bulk density and water holding capacity for lotus root powder were found to be 16.500 % to 26.515 %, 7.780 % to 9.470 %, 0.571 (ml/g) to 0.775 (ml/g) and 22.762 (%) to 28.995 (%) however the chemical characteristics of lotus root power such as pH (6.623 to 7.472), crude protein (8.718 % to 12.000 %), crude fat (3.288 % to 4.315 %) and crude fiber (16.790 % to 21.110 %) respectably was recorded. Lotus root powder has high bulk density resulting in easy to dispensability. Similarly due to presence of good amount of crude fibre and water holding capacity lotus root powder possess great potential for processing industries and can be added, substituted, or replaced in different varieties of foods.

Keywords: *Lotus root, blanching, powder, quality,parameters, food*

1. INTRODUCTION

Lotus root (*Nelumbo nucifera* belongs to the family of Nelumbonaceae) is a very popular food native to some tropical Asian countries and Australia. Its physical characteristics include – yellowish white to yellowish brown color, smooth surface with longitudinal striations and brown patches along with nodes and internodes [14]. Lotus root often used as vegetable for its hard and crispy texture, special aroma and mouth feel. Lotus root is full of nutrition; it contains an abundant amount of protein, amino acids, dietary fiber, starch, and Vitamin-C, Vitamin B_1 & B_2 and has some tremendous health benefits. Lotus root is a rich source of fibre with complex carbohydrates, which helps lower the blood glucose level and is also good for weight loss seekers [15]. Lotus root extracts increase the nutritional value of food due to their potential benefits for human health [10, 13]. Hence, addition of root extract in daily food diet can enhance nutritional quality and therapeutic value of food products. Some of the components of lotus root possess functional properties such as the aqueous solubility, swelling, water binding, foaming, gelation, and emulsifying capacity [19] which could make it a good fat mimetic in food products. Moreover, varieties of the components of the lotus root exhibit multiple nutritional and medicinal benefits. It is a good source of dietary fibers, proteins, and sugars [20]. Lotus root powder possesses anti-diarrhea, anti-inflammatory, antioxidant, antipyretic and hypoglycemic activities [5]. Lotus root powder is another usual product which is consumed as breakfast, fast food and traditional confectionery and food additives by Asian people. However, the consumption of lotus root powder as the above form is limited. Due to rich in starch and abundant functional components, health-benefit staple foods can be the important development way for lotus root powder. However, there is less information about the application of lotus root powder in staple foods. It is often used to make dishes such as salads, pickled vegetables, stir-fried foods and confections.

2. MATERIALS AND METHODS

2.1 Experimental site

The experimental work of **"Effect of pre-treatments on quality parameters of *Nelumbo nucifera* root powder"** was conducted at the Post Harvest Technology Laboratory, Department of Post Harvest Technology, College of Horticulture, Banda University of Agriculture and Technology, District Banda (U.P.) India. The main campus of the University is located at Banda, between Latitudes 24º 53′ and 25º 55′ N and Longitudes 80º 07′ and 81º 34′ E. The climate of Banda district is characterized by a hot summer and a pleasant winter.

2.2 EXPERIMENTAL MATERIAL

The Lotus root local cultivars were collected from "Fruit and vegetable mandi" Banda (U.P.) and used for experimentation. The shorted diseased, damaged and off type lotus root were discarded. The selected lotus root was thoroughly washed with tap water to remove dirt and dust particle adhering to the surface of lotus root and were allowed for surface drying.

2.3 EXPERIMENTAL DETAILS

The experiment was comprised of 09 treatments. The details of various treatments are presented below:

Treatment	Treatment detail
LR-1	Unblanched lotus roots dried at 55°C
LR-2	Steam blanching of lotus roots for 3 minutes and dried at 55°C
LR-3	Microwave blanching of lotus roots for 3 minutes and dried at 55°C
LR-4	Hot water blanching of lotus roots for 3 minutes and dried at 55°C
LR-5	Blanching of lotus roots with 0.25% KMS for 3 minutes and dried at 55°C

LR-6	Blanching of lotus roots with 0.5% KMS for 3 minutes and dried at 55°C
LR-7	Blanching of lotus roots with 0.1% $NaHCO_3$ for 3 minutes and dried at 55°C
LR-8	Blanching of lotus roots with 0.2% $NaHCO_3$ for 3 minutes and dried at 55°C
LR-9	Blanching of lotus roots with 0.3% $NaHCO_3$ for 3 minutes and dried at 55°C

2.4 PREPARATION OF LOTUS ROOT POWER

The fresh lotus root was washed under running tap water. Outer layer of root was peeled and cut into small equal pieces and was spread on stainless steel tray lined with filter paper. To evaporate the excessive moisture, it was dried in the cabinet dryer at 55°C for 14 hours, according to [4]. The dried pieces were ground in electric grinder to obtain fine powder which was stored in air tight containers till its further use in product development and analysis.

2.5 EXPERIMENTAL DESIGN

Analysis was carried out by ANOVA (Analysis of Variance) determinations and expressed as mean value. All the data obtained for the experiment were subjected to OPSTAT (Developed by C.C.S.H.A.U, Hishar) Statistical Software for statistical analysis. Data pertaining to the physical analysis of lotus root powder were carried out by using factorial Completely Randomized Design.

2.6 PARAMETERS STUDIED

2.6.1 Yield (%)

Cabinet drying yield (Y) was evaluated by determination of the product recovery given by the percentage ratio between the total mass of product recovery and the mass of extract fed in the system; and it was calculated according to a following formula based on the dry matter content [5].

$$\text{Yield (\%)} = \frac{Mass\ of\ extract}{Total\ mass} \times 100$$

2.6.2 Moisture (%)

Moisture content was determined as per the method of AOAC method (2005) and calculated as follows:

$$\text{Moisture (\%)} = \frac{Final\ weight - Initial\ weight}{Initial\ weight} \times 100$$

2.6.3 Bulk density (ml/g)

A 50 ml graduated cylinder was filled with 20 g of sample followed by gentle tapping of the cylinder. The volume sample was read directly and results expressed as ml/g [16].

2.6.4 Water holding capacity (g/g)

Weighed quantity (5 g) of sample was transferred to a centrifuge tube (50 mL) and weighed the tube with sample. Then distilled water was added in unmeasured increments till the pasty consistency was achieved. It was followed by centrifugation at 4000 rpm for 10 min. Supernatant if any discarded and the tube was weighed again [9]. Water hydration capacity was measured as ml of water absorbed by per g of material.

$$\text{Water holding capacity (g/g)} = \frac{Final\ weight - Initial\ weight}{Initial\ weight}$$

2.6.5 pH

pH was taken with ELTOP-3030 pH meter prior to pH measurement (Model: pH, 815); the instrument was standardized with the buffer solutions of pH 4, 7 and 9. The pH of the samples was estimated directly [17].

2.6.6 Crude protein (%)

Protein content was determined using [3] method. Percentage of nitrogen and protein calculated by the following equation:

$$(\%)\text{Nitrogen} = \frac{Ts - Tb\ \times \text{Normilaty of acid}\ \times 0.014}{Weight\ of\ sample\ taken} \times 100$$

Where, Ts = Titre volume of the sample (ml), Tb = Titre volume of Blank (ml), 0.014= M eq. of N_2.

% Protein = Nitrogen × 6.25

2.6.7 Crude Fat:

2g of sample was taken into the thimble and the whole weight was recoded (W_1). About 50-60 ml of solvent was taken in the beaker and thimble was placed in the beaker. The temperature of the system maintained near the boiling temperature of the solvent taken. It was left undisturbed for half an hour. At the end of the boiling temperature was increased to 150-200 °C. The condensation was allowed till the solvent in beaker got condensed followed by the reclamation all the solvent in beaker was evaporated the value of fat recorded with following formula and expressed in percent.

$$\text{Crude fat (\%)} = \frac{\text{Weight of ash with thimble} - \text{Weighing the thimble with sample}}{\text{Weight of sample}} \times 100$$

2.6.8 Crude Fiber (%)

Crude fibre contents were estimated by the method given by [3] by using the following formula:

$$\text{Crude fibres (\%)} = \frac{\text{Loss in weight}}{\text{Weight of sample taken}} \times 100$$

3. RESULT AND DISCUSSION

3.1 Physio-chemical properties

This data was represented in Table-1. After pulverizing, lotus root powder's yield was significantly affected by pre-treatment such as steam blanching, microwave blanching, hot water blanching, blanching with potassium metabisulfite *and* blanching with sodium bicarbonate. The value of yield was recorded in 16.500 to 26.515. [18] Reported a slightly higher value of yield of lotus root power.

Moisture content plays a vital role in determining the functional properties and predicting the shelf life of the dried products. The moisture was significantly affected by pre-treatment. The highest moisture percentage was recorded in LR-9 (9.470) then LR-2 (9.410) and LR-4 (9.280) while lowest in LR-1 (7.780). This variation in moisture content between pretreated and untreated samples may be due to pretreatment speeds up moisture diffusion during the drying process. [8] reported similar trends in drying of blanched and unblanched carrot shreds at 40, 50 and 60°C. [11] also demonstrated that the final moisture content of dried carrot pomace was 7.68, 6.64, 5.68, and 4.07% at 60, 65, 70, and 75°C, respectively, during forced convective drying.

The bulk density was affected by pre-treatment are significant. The highest mean value was found in LR-6 (0.775) while lowest mean value LR-3 (0.571). This increase may be due to treatments as well as increasing the drying temperature. However lower value may be due to the higher moisture content in untreated powders. Bulk density is useful to study the potentiality of flour in complementary food (low bulk density) because we can feed more products with high nutritional density [6].

The water holding capacity was significantly affected by pre-treatment. The highest water holding capacity was recorded in LR-8 (28.995) then LR-7 (28.535) and LR-6 (27.912) while minimum in LR-1 (22.762). This is likely due to the higher fibre content and higher percentage of larger particles present in the lotus root powder. The high water-holding capacity is an important property for the use of lotus root powder as ingredient in breads, cakes etc. Similar result was reported by [22] in mango pulp and peel powder.

Table-1 Effect of pre-treatment on yield (%), Moisture(%), bulk density (ml/g) and water holding capacity(%) of lotus root powder

Treatment	Yield (%)	Moisture (%)	Bulk density (ml/g)	Water holding capacity (%)
LR-1	26.515	7.780	0.667	22.762
LR-2	21.200	9.410	0.724	23.195
LR-3	19.600	8.407	0.571	24.353

LR-4	25.500	9.280	0.745	25.213
LR-5	23.500	8.900	0.757	26.273
LR-6	21.500	8.500	0.775	27.912
LR-7	16.500	9.240	0.699	28.535
LR-8	19.150	8.510	0.714	28.995
LR-9	17.367	9.470	0.682	27.612
C.D. (0.05)	0.294	0.083	0.003	0.001
SEm ±	0.098	0.028	0.001	0.000

These results were presented in Table-2. The pH content was significantly affected by pre-treatment and the maximum pH (LR-7 7.472) whereas, the minimum (LR-2 6.623) was recorded in the powder of lotus root. [1] observed the pH value of 5.22 for Amrapali mango powder dried in a cabinet dryer at 70°C. The pH values play an important role in shelf stability against microbial spoilage. It is directly associated with the concentration of organic acids, and changes in pH may occur during drying due to the removal of water and the degradation of organic acids [7].

The data reveal that significant variation in crude protein content was found in lotus root powder of various pre-treatment. The highest value in LR-1 (12.000) followed by LR-5 (11.815), LR-6 (11.600) then LR-4 (11.345) and lowest in LR-3 (8.718) was recorded. Crude proteins play important roles in human health, are indispensable for growth and development, regulate physiological functions, and maintain pH homeostasis [2]. Thus, the flour protein content can be a factor in their valorization as food ingredients. However, it is important to consider that in starchy products, protein interactions with starch interfere with rheological properties and digestibility [12]. [19] reported the lotus stem flour proximate of crude protein (8.48±0.25).

It is evident from the data that there was significant difference in crude fat in powder prepared from fresh lotus root. The crude fat varied between 3.288 % and 4.315 % among the lotus root powder prepared from different pretreatments. Crude fat increased in lotus root powders due to the elimination of moisture content i.e. increasing concentration of nutrients. [21] reported a slightly lower value of fat (0.4g per 100g) of lotus stem power.

The perusal of data reveals that significant difference in crude fibre was observed in lotus root powder prepared from various pre-treatment and it ranged between 16.790 % and 21.110 %. This high variability may be due to differences in the ripeness and processing conditions of the lotus root. According to [21] observe the crude fibre was 6.47 g less per 100 g in the lotus stem powder.

Table-2 Effect of pre-treatment on pH, crude protein(%), crude fat (ml/g) and crude fiber(%) of lotus root powder

Treatment	pH	Crude protein (%)	Crude fat (%)	Crude fiber (%)
LR-1	6.888	12.000	4.315	21.110
LR-2	6.623	10.132	4.210	16.790
LR-3	6.852	8.718	3.288	16.840
LR-4	7.005	11.345	3.818	17.000
LR-5	6.924	11.815	4.110	20.327
LR-6	7.467	11.600	4.000	20.170
LR-7	7.472	11.200	3.700	19.800
LR-8	7.189	10.800	3.500	19.500
LR-9	7.012	10.600	3.400	19.150
C.D. (0.05)	0.004	1.300	0.593	1.157
SEm ±	0.001	0.434	0.198	0.386

4. CONCLUSION

It was concluded that Lotus root powder prepared from Un-blanched lotus roots dried at 55°C has more potentiality for complimentary food preparation due to presence of high yield, bulk density, water holding capacity, good amount of crude protein, crude fat and crude fibre therefore, can be used as substitute in many foods. Lotus root powder provides many therapeutic, health and functional benefits incorporation levels. Further research can be carried out to see its implication on complimentary food.

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