

Original Research Article

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Development of Value Added Products using Potato Flour for Nutritional and Health Benefits

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ABSTRACT

Protein Energy Malnutrition continues to be a major health burden in developing countries and the most important risk factor for illnesses and death especially among young children. Increasing potato production with inadequate, expensive and unevenly distributed refrigerated storage facilities in the country has resulted in frequent gluts in the market causing economic loss to the farmers and wastage of precious foods. Keeping in mind the best utilization of potatoes, flour was prepared from variety Kufri Pukhraj by washing, peeling, slicing, blanching, dipping in 10% salt solution and then in 0.05% potassium metabisulfite, tray dried and ground to fine powder. It was used for preparing value added products like *burfi*, *mathi*, *seviyan*, *panjiri* and *halwa* and was organoleptically evaluated using nine point hedonic rating scale. Accepted level of potato flour in different products like *burfi* was 20%, *mathi* 25%, *seviyan* 30%, *panjiri* 40% and *halwa* 50%. Overall acceptability scores of the products was 8.38 in *burfi*, 8.08 in *mathi*, 8.36 in *seviyan*, 8.2 in *panjiri* and 8.04 in *halwa*. Nutritional evaluation of the developed products was also done by using standard methods. Products were found highly nutritious and these can be easily supplemented to eradicate malnutrition among the children. *Burfi* provides 13.88g protein, 4.56mg iron and 48.67mg calcium. *Mathi* provides protein 9.20g, iron 1.75mg and 17.46mg calcium /100g of the product. *Seviyan* provides 11.23g protein, 4.96mg iron and 43.96 mg calcium. *Panjiri* provides protein 13.16g, iron 3.26mg, calcium 29.38mg. *Halwa* provides protein 11.51g, iron 4.99mg and calcium 34.94mg /100g of the product. Microbial testing of potato flour revealed that the potato flour can be kept safely in polyethylene bags for three months without any spoilage. Highly acceptable products were popularized among the self help groups by giving them lectures and demonstrations for nutritional and health benefits of children.

Keywords

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Storage

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Introduction

PEM continues to be a major health burden in developing countries and the most important risk factor for illnesses and death especially

among young children [1]. The World Health Organization estimates that about 60% of all deaths, occurring among children aged less than five years in developing countries could be attributed to malnutrition [2]. Potato is the

most important tuber crop of the world and most important vegetable food crop in India which occupies the third place in the global production [3]. There are few national data for children's development but our conservative estimate is that more than 200 million children under 5 years of age in developing countries are not developing to their full potential [4]. As a result, by 2010 developing countries in Asia produced nearly 50% more potatoes than Europe and a higher percentage (46%) of worldwide output than in all the industrialized countries (41%) combined [5].

Potatoes (*Solanum tuberosum* L.) are one of the most important staple crops for human consumption, together with wheat, rice and corn. About 328.87 million tonnes of potato are produced in the world over an area of about 19.13 million hectare. In India area under production is 1930.91 ha with a production of 42478.65 tonnes and yield of potatoes is 22.7 kg per ha as per govt. of India [6]. In Punjab area under production is 85.14 ha with a production of 2129.79 tonnes and yield of potato is 25.01kg per ha as per govt. of Punjab [7]. This record production has led to several post harvest problems, storage being the major one. Increasing potato production with inadequate, expensive and unevenly distributed refrigerated storage facilities in the country has resulted in frequent gluts in the market causing economic loss to the farmers and wastage of precious foods.

The processing of potatoes would contribute to reduction of post harvest losses and pressure on cold storage [8]. Presently, the global potato sector is undergoing major changes. Currently, more quantities of potatoes are currently processed into value-added products to meet the demand especially of the fast food and convenience food industries [9]. Under the existing circumstances, processing of the bulky perishable potatoes into various processed

products is a viable option which can help extend the storage life, solve the storage problem, cater to the consumer preference belonging to different age groups and social strata and serve as a means to increase the supply in off seasons thus maximizing potato utilization [10].

Processing of potatoes into storable potato flour can be one of the best means to ameliorate the problem. Potato flour can be used for preparation of different value added products like soup, biscuits, breads, tikki etc. So, the potato processing industry is primarily concerned with the quality and yield of flour to match the challenge of increased production [11]. Therefore considering nutritional importance and huge production of potato as food, this is an attempt to developing the potato flour based products for improving nutritional status among vulnerable group.

Materials and Methods

Potatoes of variety 'KufriPukhraj' were procured from Punjab Agricultural University seed farm Ladhawal Ludhiana. The potatoes were washed to remove adhering dirt, potatoes were peeled, sliced and blanched in boiling distilled water for 4 min, dipped in 10% salt solution and 0.05% KMS (Potassium Metabisulphite) for 15min to avoid browning, then dried in hot air oven at $60\pm5^{\circ}\text{C}$ for 9hr. The dried slices of potatoes were grounded to fine powder and sieved. Cereals like wheat flour, refined wheat flour, semolina and pulses like bengal gram flour were purchased from local market of Ludhiana.

Preparation of potato flour

Preparation of products

Various proportions of raw ingredients for different recipes were tried. Five value added products *burfi*, *mathi*, *seviyan*, *panjiri*, *halwa*

were developed from different combinations of potato flour with other cereal and pulses at different levels (Fig. 1).

The organoleptic evaluation was done to select the most acceptable level of potato flour used in the development of value added products.

The panel of judges including faculty of Department of Food and Nutrition were provided with score card of Hedonic Rating Scale to score the test samples for their color, flavor, texture, taste and overall acceptability.

These products were prepared using standardised recipes with addition of potato flour at different percentages. Proportion of ingredients which was liked best was selected for the development of final products.

The following products were developed in different ratios and following the methods as indicated below.

Burfi (80:20)

Add desi ghee (60g) in a thick pan, add bengal gram flour (80g) and cook on slow fire till light brown colour. Add potato flour (20g) in it mix thoroughly cook for few min. Remove from fire, add powder sugar (70g) and mix well. Grease a try and spread the mixture over it. Keep it for some time at cool place. Garnish with dry fruits and cut into pieces before serving.

Mathi (75:25)

Add potato flour (25g), salt (3g), ajwain (3 g) to (75g) refined wheat flour. Add fat (20g) to the flour as shortening and mix thoroughly. Knead it into stiff dough. Divide the dough into small ball. Roll the balls into the shape of *mathi*. Prick the rolled *mathi* with knife so that it remains flat even after frying. Deep fry the *mathi* till golden brown colour.

Seviyan (70:30)

Mix bengal gram flour (70g), potato flour (30g), red chilli (2.5g) and salt (3g) nicely. Add 50 ml water, mix well. Fill the mixture in *seviyan* making machine. Heat the oil; rotate the machine over the oil. Fry the *seviyan* till brown colour.

Panjiri(60:40)

Heat desi ghee (25g) in thick pan and roast wheat flour (60g) on slow fire. Add potato flour (40g) mix well and roast for 2 minute. Add powder sugar (35g), cook for 2-3 minute.

Halwa (50:50)

Dry roast the bengal gram flour (50g) till golden brown colour. Add potato flour (50g), cook for 2-3 min then add ghee (20g) in it. Make the syrup of jaggery (100g) and water (300ml), add syrup in bengal gram flour and mix well.

All the value added products using potato flour were accepted in 20-50% level of potato flour.

Proximate composition

The potato flour and their value added products were analyzed for moisture, protein, fat, fiber and total ash contents employing standard methods [12]. A factor of 6.25 was used to convert nitrogen into crude protein.

Mineral content

Iron and calcium content of the potato flour and their products was determined by using the standard methods [12].

Statistical analysis

From the data obtained the mean values and standard error for each sample was calculated.

The significant difference between the organoleptic scores and nutritional composition of the samples were tested. Samples was accepted at the $p<0.05$ level.

Storage of potato flour

Potato flour for making value added products were packed in double sealed air tight container. Microbial analysis was carried out for the presence of pathogens for three months at one month interval to ascertain their quality and safety using the media glucose yeast agar [13].

Popularization of the potato products among self help groups

The self help group's members of different villages of Punjab like AyaliKalan, Bains, Lohara, Moga and from local areas of Ludhiana city were participated. Highly acceptable products were popularized among the self help groups by giving them lectures, demonstrations and booklet on potato based recipes for nutritional and health benefits of children.

Results and Discussion

Organoleptic evaluation

Burfi, mathi, seviyan, panjiri and *halwa* were acceptable at 20-50% level of potato flour. *Burfi* with 20% of potato flour obtained highest score with overall acceptability 8.38 showed non-significant difference ($p<0.05$) which was liked very much as compare to control with overall acceptability of 8.26. *Mathi* with 25% of potato flour obtained highest score with overall acceptability 8.08 which was liked very much as compare to control with overall acceptability of 7.8. *Seviyan* with 30% of potato flour obtained highest score with overall acceptability 8.36 showed non-significant difference ($p<0.05$)

which was liked very much as compare to control with overall acceptability of 7.9. *Panjiri* with 40% of potato flour obtained highest score with overall acceptability 8.2 showed non-significant difference ($p<0.05$) which was liked very much as compare to control with overall acceptability of 8.14. *Halwa* with 50% of potato flour obtained highest score with overall acceptability 8.04 which was liked very much as compare to control with overall acceptability of 7.54 which was liked moderately (Fig. 2).

Proximate composition

Nutrient composition of potato four

The proximate composition of potato flour has been presented in the Table 1. The results showed that the moisture content potato flour was found to be 13.07. The protein content was found to be 6.22g whereas in fresh potatoes it was 1.6g/100g and with negligible fat content 1.02, high dietary fiber 4.22 in potato flour in fresh it was 0.4g. Potato flour gives higher amount of energy 327.42 as compare to fresh potatoes i.e. 97 Kcal/100g. Calcium content in fresh potatoes was 10mg whereas in potato flour it was 19.38mg/100g. Iron content in fresh potatoes was 0.48mg whereas in potato flour it was 3.82mg/100g.

Nutrient composition of developed products

The proximate composition of the developed products has been presented in the Table 2. The moisture content of *burfi* ranged from 0.99% for control to 1.34% with substitution of bengal gram flour with potato flour in accepted level (20%). The protein content of the control was found to be 17.08% while the acceptable level was 15.16% while the difference was significant. The fat content ranged from 35.7% for control to 34.75% for accepted level, difference was non-significant. The fiber content of *burfi* ranged between

1.1% for control to 1.80% at 20% level of potato flour. The ash content of *burfi* ranged from 1.2% for control to 1.43% for accepted level, while the difference was significant.

The moisture content of *mathi* ranged from 3.43% for control to 3.93% substitution of refined wheat flour with potato flour in level (25%). The protein content of the control was found to be 6.52% while the accepted level was 6.44%. The fat content ranged from 35.2% for control to 35.93% for accepted level. The fiber content of *mathi* ranged between 0.46 for control to 1.28% for accepted level. The ash content of *mathi* ranged from 1.27% for control to 1.35% for test sample, difference was significant.

The moisture content of *seviyan* ranged from 3.43% for control to 3.57% substitution of bengal gram flour with potato flour in accepted level (30%). The protein content of the control was found to be 9.3% while accepted level was 8.37%. The fat content ranged from 5.6% for control to 4.22% for accepted level. The fiber content of *seviyan* ranged between 1.2 for control to 2.10% for test sample. The ash content of *seviyan* ranged from 1.52% for control to 1.59% for accepted level, while the difference was significant.

The moisture content of *panjiri* ranged from 0.65% for control to 1.35% substitution of wheat flour with potato flour in accepted level (40%). The protein content of the control was found to be 6.6% while the acceptable level was 7.4%.

The fat content ranged from 25.7% for control to 23.42% for accepted level. The fiber content of *panjiri* ranged between 1.3% for control to 2.4% for accepted level. The ash content of *panjiri* ranged from 0.67% for control to 0.95% for accepted level, while the difference was significant.

The moisture content of *halwa* ranged from 5.76% for control to 7.4% substitution of bengal gram flour with potato flour in accepted level (50%). The protein content of the control was found to be 15.56% while the accepted level was 11.78%, difference was significant. The fat content ranged from 8.95% for control to 8.87% for accepted level, difference was non-significant.

The fiber content of *Halwa* ranged between 1.2 for control to 2.71% for accepted level. The ash content of *Halwa* ranged from 1.46% for control to 1.82% for accepted level, difference was significant.

Mineral content in developed products

The iron content of the developed products has been presented in the Table 3 with addition of potato flour at 20-50% level. The iron content of *burfi* at 20% level of potato flour was 4.56mg/100g, showed non-significant difference. The iron content of *mathi* at 25% of potato flour was observed to be 1.75 and that of control was 1.52mg/100g.

The iron content of control *seviyan* was found to be 3.53mg/100g which increased to 4.96 mg/100g on supplementation with 30% level of potato flour. The iron content of *panjiri* at 40% level were found to be 3.26 mg/100g while *halwa* supplemented with potato flour at level of 50% was found to be 4.99 mg/100g showed non-significant difference.

The results of the calcium content of the developed products as shown in Table 3 indicated that the calcium content of *burfi* at 20% and *mathi* at 25% level of potato flour were found to be 48.67 mg 17.46 mg /100g.

The calcium content of *seviyan* at 30% level of potato flour were found to be 43.96 mg/100g significantly lower than the control that was pulse based.

Table.1 Nutrient composition of potatoes and potato four (Per 100g)

Nutrients	Potatoes	Potato flour
Moisture (g)	74.7 g	13.07 g
Crude Protein(g)	1.6 g	6.22 g
Crude Fat (g)	0.1 g	1.02 g
Crude Fiber (g)	0.4 g	4.22 g
Carbohydrates (g)	22.6 g	73.34 g
Energy (Kcal)	97 Kcal	327.42 Kcal
Calcium (mg)	10 mg	19.38 mg
Iron (mg)	0.48 mg	3.82 mg

Table.2 Proximate composition of developed products (% dry weight basis)

Products	Moisture %	Protein%	Fat%	Fiber%	Ash%
<i>Burfi</i>					
Control	0.99±0.15	17.08±0.34	35.7±0.24	1.1±0.14	1.2±0.32
Accepted	1.34±0.13	15.16±0.4	34.75±0.25	1.80±0.13	1.43±0.3
t-value	32.5**	78.61**	NS	23.16**	12.66**
<i>Mathi</i>					
Control	3.43±0.25	6.52 ±0.20	35.2±0.30	0.46±0.08	1.27±0.2
Accepted	3.93±0.15	6.44±0.15	35.93±0.15	1.28±0.05	1.35±0.2
t-value	24.49**	2.91**	39.51**	65.47**	8.22**
<i>Seviyan</i>					
Control	3.43±06	9.3±0.3	5.6±0.7	1.2±0.13	1.52±0.8
Accepted	3.57±0.5	8.37±0.5	4.22±0.5	2.10±0.17	1.59±0.5
t-value	8.04**	8.61**	36.28**	5.99**	3.59**
<i>Panjiri</i>					
Control	0.65±0.14	6.6 ±0.03	25.7±0.3	1.3±0.2	0.67±0.1
Accepted	1.35±0.14	7.4±0.23	23.42±0.2	2.4±0.2	0.95±0.1
t-value	30.81**	26.45**	81.24**	42.38**	13.95**
<i>Halwa</i>					
Control	5.76±0.12	15.56±0.16	8.95±0.23	1.2±0.21	1.46±0.2
Accepted	7.4±0.10	11.78±0.18	8.87±0.2	2.71±0.22	1.82±0.2
t-value	64.81**	51.81**	NS	22.6**	3.27**

** Significant at 5% level

Fig.1 Flow chart for preparation of potato flour

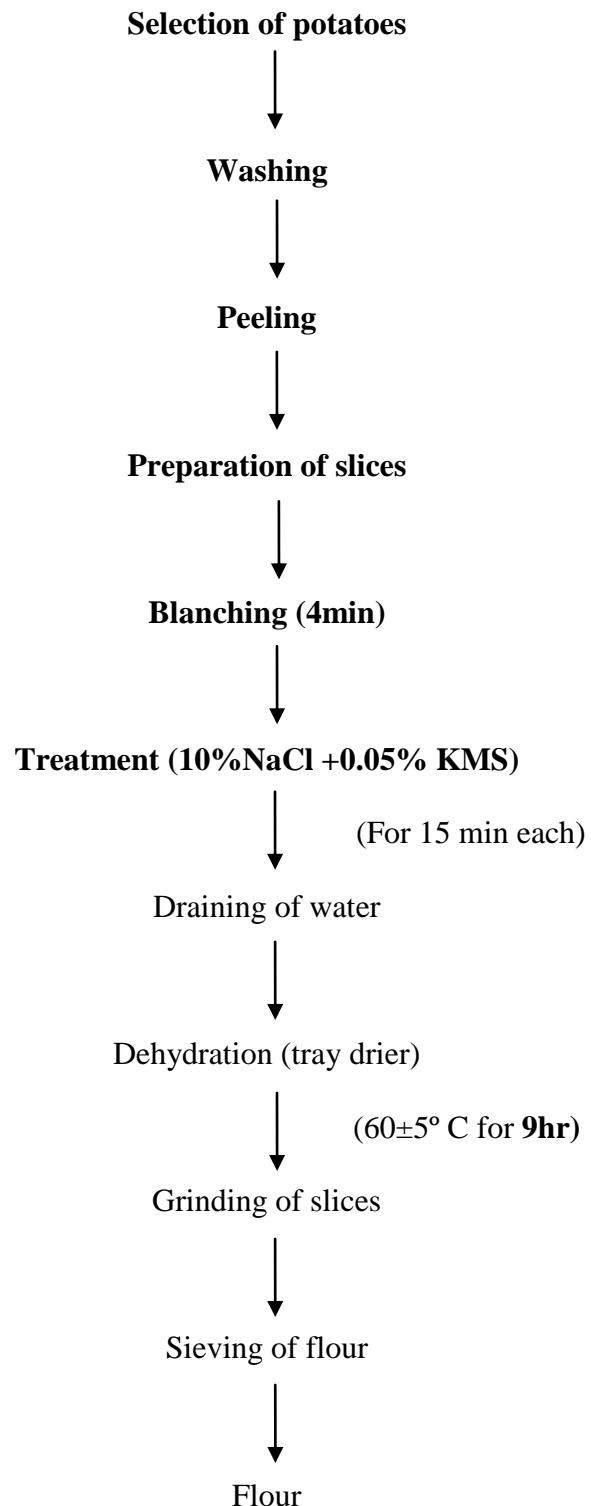
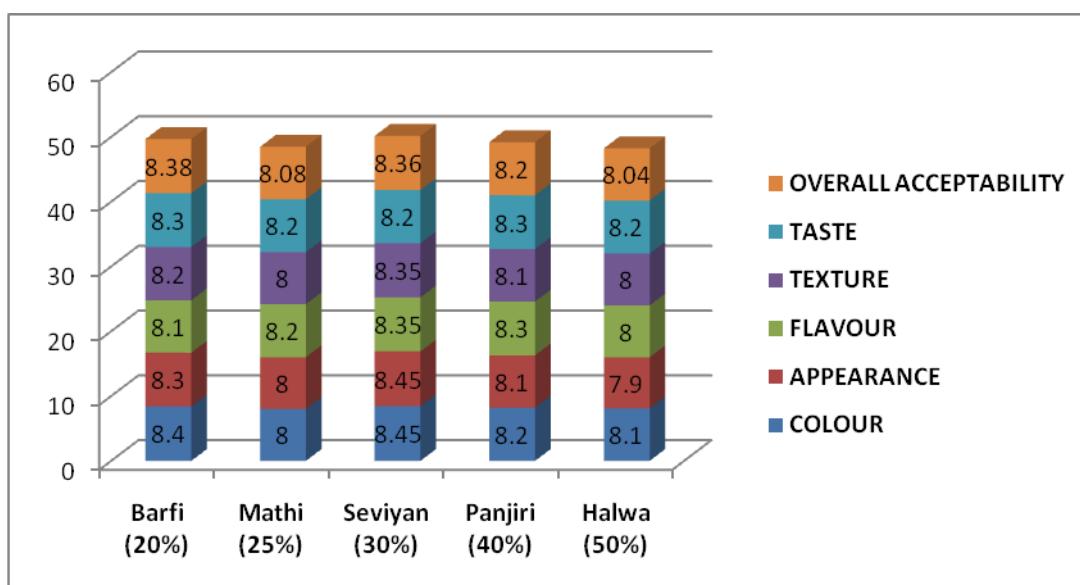


Table.3 Mineral content of developed products (on dry weight basis)

Products	Iron(mg/100g)	Calcium (mg/100g)
<i>Burfi</i>		
Control	4.75±0.01	51.59±0.2
Accepted	4.56±0.01	48.67±0.24
t-value	NS	63.1**
<i>Mathi</i>		
Control	1.52±0.02	17.85±0.32
Accepted	1.75±0.02	17.46±0.34
t-value	9.37**	18.97**
<i>Seviyan</i>		
Control	3.53±0.13	47.35±0.23
Accepted	4.96±0.12	43.96±0.22
t-value	65.11**	133.8**
<i>Panjiri</i>		
Control	3.19±0.23	32.57±0.034
Accepted	3.26±0.22	29.38±0.033
t-value	NS	58.92**
<i>Halwa</i>		
Control	4.78±0.34	48.67±0.31
Accepted	4.99±0.23	34.94±0.30
t-value	NS	22.56**

** Significant at 5% level

Fig.2



The calcium content of *panjiri* at 40% level of potato flour was found to be 29.38mg/100g lower than the control i.e. 32.57 mg/100g. The calcium content of *halwa* at 50% level of potato flour were found to be 34.94 mg/100g.

Storage of potato flour

Potato flour for making value added products were packed in double sealed air tight container. Microbial analysis was carried out for total plate count of yeast, mold count for the presence of pathogens for three months at one month interval to ascertain their quality and safety using the media glucose yeast agar. Microbial count in potato flour was at 3 month 1.9×10^4 colony forming unit/g that was under the permissible limit. Microbial testing of potato flour revealed that the flour can be kept safely in polyethylene bags for three months without any spoilage.

Popularization of the potato products among self help groups

Five days training course on “Value Addition of Potatoes” was organised for members of self help group in PAU, Ludhiana in the month of July, 2013. Members of self help groups from different villages of Punjab like AyaliKalan, Bains, Lohara, Moga and members from local areas of Ludhiana city were participated. Highly acceptable fifteen products like *burfi*, *mathi*, *seviyan*, *panjiri*, *halwa* were popularized among the self help groups by giving them lectures, demonstrations and booklet on potato based recipes for nutritional and health benefits of children. Lecture on nutritional value of potato flour, method of making potato flour at domestic level was given by showing charts and booklet on potato for nutritional and health benefits.

It can be concluded from the present study that potato flours is a highly versatile raw material

that can be used in several products. Potato flour can be stored safely with no adverse changes in nutritional value up to three months of storage.

Products developed from potato flour were found highly nutritious in terms of energy, protein, fat, minerals and in vitamins. These developed products could be recommended for feeding children, pregnant and lactating mothers under supplementary feeding program run by government and non-government agencies.

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