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Original Research Article

Nutritional Evaluation of Value Added Products Using Potato Flour

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ABSTRACT

Five value added products namely *dhokla*, *vadae*, *idli*, *tikki* and pancake were developed using potato flour evaluated on sensory parameters using nine point hedonic rating scale. Accepted level of potato flour in the developed products was 20-50 per cent. Highest overall acceptability score was obtained for pancake with addition of potato flour. Significant increase (p<0.05) in protein, fat, fibre and ash content of *dhokla*, *vadae*, *idli* and *tikki* was found with addition of potato flour. Micronutrient content increased significantly (p< 0.05) with incorporation of potato flour in all five products. The developed value added products using potato flour could be recommended for malnourished children, pregnant and lactating mothers under supplementary feeding program run by government and non- government agencies.

Keywords: nutritional evaluation, potato flour, sensory evaluation, value added products.

INTRODUCTION

The infants and pre-school children are most vulnerable to growth retardation due to wide prevalence of malnutrition particularly under-nutrition (Isanaka et al 2009). Protein energy malnutrition is the major health burden in developing countries and the most important risk factor for illnesses and death especially among young children (Muller and Krawinkel 2005). The World Health Organization estimates that about 60 per cent of all deaths, occurring among children aged less than five years in developing countries could be attributed to malnutrition (Faruque *et al* 2008). There are more than 200 million children under 5 years of age in developing countries are not developing to their full potential (McGregor *et al* 2007). In India, about 20 per cent of children under five are wasted, 43 per cent underweight and 48 per cent stunted. In terms of numbers, about 54 million under five children are underweight which constitutes about 37 percent of the total underweight children in the world (UNICEF 2011).

Potatoes (*Solanum tuberosum* L.) are one of the most important staple crops for human consumption, together with wheat, rice and corn. India occupies the third place in the global production (FAO 2012). About 328.87 million tonnes of potato are produced in the world over an area of about 19.13 million hectare. India has ample production of potatoes with average yield of 22.7 kg per hectare of Indian soil. Punjab has average yield of potato as 25.01 kg per hectare (Anonymous 2013). A higher potato production with inadequate, expensive and unevenly distributed storage facilities has resulted in wastage of potatoes and economic loss to the farmers. So

processing of potatoes is an important element to prevent post harvest losses and provide a better shelf life and nutrient quality. There is a need to process potatoes into value-added products (Mishra *et al* 2012). Processing 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 (Avula 2005). According to estimations 25 per cent of the potatoes, which are spoiled due to several reasons may be saved by processing potatoes into various value added products and their preservation (Raj *et al* 2011). Moreover, potato is rich in carbohydrates, proteins with an amino acid pattern well matched to human requirements, phosphorus, iron, calcium, vitamin C, B_1 and B_2 and has high protein calorie ratio (Gopalan *et al* 2010). 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

Procurement of raw material: Potatoes of variety 'Kufri Pukhraj' were procured from Punjab Agricultural University seed farm Ladhowal 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±5ºC for 8-9hr. The dried slices of potatoes were grounded to fine powder and sieved. Cereals like wheat flour, refined wheat flour and pulses like Bengal gram flour were purchased from local market of Ludhiana in a single lot.

Development of value added products: Five value added products namely *dhokla, vadae, idli, tikki,* pancakes were developed from different combinations of potato flour at different levels with other cereal and pulses. The sensory evaluation was carried out 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 (Larmond 1970).

The following value added products were prepared using standardised recipes with addition of potato flour at different percentage of potato flour. The blending ratio of raw ingredient with and potato flour is shown in brackets.

1. *Dhokla* (65:15:20)

   Mix suji (15g), Besan (65g), potato flour (20g), salt 2.5g and curd (100g) in a pan. Mix them properly, add 50ml water in it. Add ½ tsp eno into the mixture, again mix it. Put whole mixture in micro safe pan and cook in microwave for 4 min.
2. *Vadae* (80:20)

   Soak the 80g black gram dal overnight, drain the water. Grind and add 20g potato flour, salt 2.5g. Beat the mixture smoothly till fluffy. Give the shape of tikki; make a hole in the centre and deep fry till golden brown. Serve hot.
3. *Idli* (70:30)

   Mix the suji (70g), potato flour (30g), salt (2.5g) and curd (100g) nicely. Make batter of pouring consistency by adding 50ml water and keep for 10 minutes. Grease the mould, Add eno salt into the mixture, and again mix well. Pour 1 table spoon of batter in each *idli* mould. Steam it for 4 minute in microwave. Take it out from mould after 4 minutes.
4. *Tikki* (35:35:30)

   Soak the rice flakes (35 g) for 5 minute. Boil the channa dal (35 g) and mash it. Mix the rice flakes, channa dal and potato flour (30 g). Add all above

ingredients and water as needed. Heat the oil in karahi. Make tikki from mixture and shallow fry till golden brown colour.

5. Pancake (50:50)

   Mix besan (50g), potato flour (50g), red & green chilli, salt and coriander leaves. Add water (70 ml) and mix well. Heat the oil on non stick tawa. Pour the mixture over tawa and spread with the help of spatula. Cook both the sides till light brown colour.

Proximate composition: Potato flour and their value added products were analyzed for moisture, protein, fat, fiber and total ash contents employing standard methods of AOAC (2000). A factor of 6.25 was used to convert nitrogen into crude protein.

Mineral and vitamin content: Calcium content of the potato flour and their products was determined by the titrimetric method and iron content was estimated by using the AOAC (2000) method. Vitamin C content of potato flour and their products was estimated by AOAC (2000) and Beta- carotene was estimated spectrophotometrically by method of Rao (1967).

Statistical analysis: The data were analyzed by computation of descriptive statistical measures such as mean and standard error of the variables. One way analysis of variance was used to analyze sensory scores and nutritional composition of the samples (Cheema and Sidhu 2004).

RESULTS AND DISCUSSION

Sensory evaluation*:* The data of sensory evaluation of value added products using potato flour is presented in Figure 1. *Dhokla*, *vadae*, *idli*, *tikki* and pancake were acceptable at 20-50% level of potato flour. *Dhokla* with 20 per cent of potato flour obtained highest score with overall acceptability 8.12 which was at par with control. It differed significantly ($p<0.05$) with other levels. *Vadae* with 20 per cent of potato flour obtained highest score with overall acceptability 8.6 with no significant difference with control. *Idli* with 30 per cent of potato flour obtained highest score with overall acceptability 8.24 was at par to control showed significant difference ($p<0.05$) with other levels. *Tikki* with 30 per cent of potato flour obtained highest overall acceptability score which was significantly different ($p<0.05$) with control and other levels. Pancake with 50% of potato flour obtained highest score with overall acceptability 8.66 which was significantly different ($p<0.05$) with control and other levels.

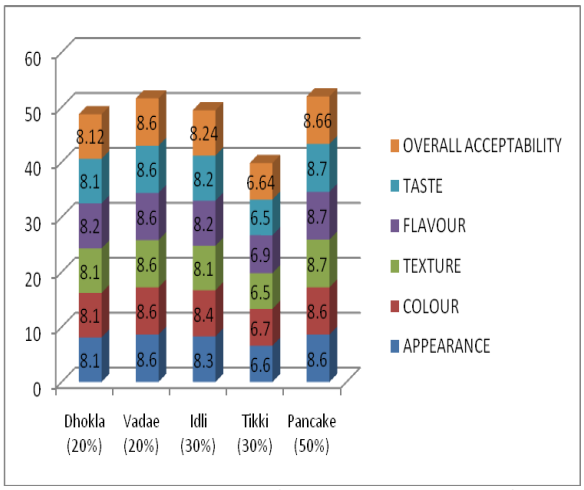

Figure 1 Sensory evaluation of products using potatoes flour

Table 1 Nutrient Composition of potatoes and potato four (g 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
Beta-Carotene (µg)	24 µg	0.88 µg
Vitamin C (mg)	17 mg	9.95 mg
Calcium (mg)	10 mg	19.38 mg
Iron (mg)	0.48 mg	3.82 mg

Proximate composition: The proximate composition of potato flour has been presented in the Table 1. 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. Crude fat and crude fibre content in potato flour was 1.02 and 4.22 g respectively which was higher than that present in fresh potatoes. Total energy content provided by potato flour was 327.42 which was higher as compare to that of fresh potatoes. 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. Potato flour gives 0.88mg of beta-carotene and 9.95mg of vitamin C.

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

Products	Protein %	Fat %	Fiber %	Ash %
Dhokla				
Control	9.3±0.7	3.7±0.19	0.95±0.25	1.23±0.4
Accepted	8.6±0.71	3.9±0.28	1.65±0.3	1.56±0.2
t-value	23.61**	12.07**	47.71**	20.68**
Vadae				
Control	9.45±0.12	7.9±0.1	0.9±0.2	2.76±0.2
Accepted	8.80±0.11	6.52±0.1	1.56±0.1	2.43±0.2
t-value	50.51**	74.24**	40.41**	20.57**
Tikki				
Control	9.5±0.057	12.78±0.4	2.72±0.2	3.42±0.4
Accepted	11.06±0.5	14.51±0.4	3.38±0.2	3.78±0.4
t-value	22.47**	6.15**	36.17**	18.65**
Idli				
Control	10.96±0.3	3.57±0.5	0.67±0.6	0.56±0.3
Accepted	10.8±0.3	4.86±0.6	1.73±0.65	0.98±0.2
t-value	26.45**	81.24**	42.38**	13.95**
Pancake				
Control	14.43±0.56	11.38±0.7	1.3±0.46	4.23±0.1
Accepted	10.67±0.54	10.08±0.76	2.48±0.45	4.51±0.1
t-value	51.81**	NS	22.6**	3.27**

** Significant at 5% level

Table 3 Mineral and vitamin content of developed products (fresh weight basis)

Products	Iron (mg/100g)	Calcium (mg/100g)	Vitamin C[#] (mg/100g)	β-carotene[#] (µg/100g)
Dhokla				
Control	4.3±0.3	165.64±0.25	0.19±0.2	67.56±0.78
Accepted	4.5±0.3	161.35±0.24	2.28±0.2	64.17±0.77
t-value	9.73**	94.04**	90.67**	11.32**
Vadae				
Control	2.44±0.3	112.9±0.02	0.29±0.23	66.47±0.04
Accepted	2.54±0.3	99.48±0.02	1.84±0.22	56.32±0.034
t-value	NS	65.57**	10.34**	35.71**
Idli				
Control	1.23±0.5	138.3±0.14	0	0
Accepted	2.37±0.45	142.8±0.15	1.87±0.15	0.12±0.4
t-value	47.59**	213.29**	20.34**	15.12**
Tikki				
Control	5.21±0.04	30.04±0.12	35.67±0.22	78.5±0.04
Accepted	5.86±0.034	26.82±0.15	4.87±0.023	9.08±0.34
t-value	NS	58.92**	65.34**	50.41**
Pancake				
Control	7.04±0.23	52.34±0.4	0.34±0.13	66.76±0.8
Accepted	7.31±0.2	41.69±0.39	6.84±0.12	49.78±0.8
t-value	NS	22.56**	40.93**	28.67**

** Significant at 5% level

The proximate composition of value added products developed using potato flour is summarized in Table 2. The moisture content of *Dhokla* ranged from 3.8% for control to 4.2% in accepted level (20%) with potato flour. The protein content of the control was found to be 9.3% while that of the acceptable level was 8.6%. The fat content ranged from 3.7% for control to 3.9% for accepted level. The fiber content of *dhokla* ranged between 0.95% for control to 1.65% for accepted level. The ash content of *dhokla* ranged from 1.23% for control to 1.56% for accepted level, while the difference was significant. All the parameters were significantly different ($p<0.05$) with that of the control. The moisture content of *Vadae* ranged from 4.86% for control to 4.27% with potato flour in level (20%). The protein content of the control was found to be 9.45% while the accepted level was 8.80%. The fat content ranged from 7.9% for control to 6.52% for accepted level.

The fiber content of *vadae* ranged between 0.9% for control to 1.56% for accepted level and the ash content of *vadae* ranged from 2.76% for control to 2.43% for test sample. Significant difference ($p<0.05$) was observed between control and treatment levels. The moisture content of *Idli* ranged from 3.32% for control to 4.5% with substitution of semolina with potato flour in accepted level (30%). The protein content of the control was found to be 8.5% while the acceptable level was 7.93%. The fat, fiber and ash content ranged from 3.5% to 2.8%, 1.32% to 2.04% and 0.56% to 0.98% for control and accepted levels respectively. Significant difference ($p<0.05$) was observed between control and acceptable samples. The protein, fat, fiber and ash content of *tikki* was observed as 11.06±0.5, 14.51±0.4, 3.38±0.2 and 3.78±0.4 for accepted levels. All the levels were significantly different ($p<0.05$) with that of the control. The protein content of pancake was observed as 10.67±0.54 which differed significantly ($p<0.05$) with control. The fat, fiber and ash content was 10.08±0.76, 2.48±0.45 and 4.51±0.1 respectively with significant difference ($p<0.05$) as compared to control. Energy, fat and protein content were reported as 430 kcal, 16 % and 14% in corn soy based supplementary food (Amegovu et al 2014). Similar results for proximate composition were reported by Sadana and Chabra (2004).

Mineral and vitamin content: The mineral and vitamin content of developed products is presented in Table 3. The iron content of *dhokla* at 20 per cent acceptable level was observed as 4.5mg/100g. The iron content of *vadae, idli, tikki* and pancake at acceptable level of potato flour was observed as 2.54±0.3, 2.37±0.45, and 5.86±0.034 and 7.31±0.2 mg per 100 respectively. The iron content differed significantly ($p<0.05$) with that of control in *dhokla* and *idli* while non significant difference was observed in other products. The calcium content of *dhokla* at 20% level of potato flour was found to be 161.35 mg/100g. The calcium content of *vadae, idli, tikki* and pancake was observed as 99.48±0.02, 142.8±0.15, and 26.82±0.15 and 41.69±0.39 mg per 100 gm respectively. The values were significantly different ($p<0.05$) with control in all the developed products. The vitamin C content in *dhokla, vadae, idli, tikki* and pancake was observed as 2.28±0.2, 1.84±0.22, 1.87±0.15, and 4.87±0.023 and 6.84±0.12 mg/100 gm respectively. All the values were significantly different ($p<0.05$) from vitamin C content of control. No vitamin C was present in control treatment of *idlii.* Highest β-carotene content was reported in *dhokla* followed by *vadae* and pancake. All the values of β-carotene in accepted levels of the value added products differed significantly ($p<0.05$) with that of the control. Amegovu et al (2014) reported iron content as 12 to 16 mg in supplementary foods. Ghatge (2012) observed iron content as 6.3 n soy based supplementary food.

Popularization of the value added 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. Members of self help groups from different villages of Ludhiana district of Punjab namely Ayali Kalan, Bains, Lohara, Moga and members from local areas of Ludhiana city participated in the training course. Value added products using potato flour were popularized among the self help groups by lectures, demonstrations and distributing booklet on potato based recipes for nutritional and health benefits of children.

CONCLUSION

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 for up to three months at

room temperature. The developed value added products using potato flour could be recommended for malnourished children, pregnant and lactating mothers under supplementary feeding program run by government and non- government agencies.

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