TECHNOSCIENCE ARTICLE

Effect of Potato Peels Powder Incorporation on Quality Characteristics of Biscuits

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Abstract

Potato peels are an excellent source of dietary fiber, minerals, vitamins, and antioxidants and they represent a nutritionally rich food ingredient that could potentially add value for the bakery industry. In the present study, the impact of potato peels powder at different replacing levels (0, 4, 6, and 8 %) on chemical, sensory, and physical characteristics of biscuits were assessed. Sensory evaluation results demonstrated that samples with an 8% incorporation level registered the highest score of 8.3 for overall acceptability followed by control 8.1 and statistically at each other. The results revealed that the addition of potato peels powder in biscuits making increased moisture, ash content while protein, carbohydrate, and energy contents gradually decreased. Total dietary fiber increased by 0.30% to 3.74%. The thickness and diameter of substituted biscuits decreased, whereas weight increased with increasing levels of incorporation.

Introduction:

A Dietary fiber (DF) is defined as 'the polysaccharides and residue of plant materials which are resistant to hydrolysis (digestion) by human digestive enzymes' as per the Association of Official Analytical Chemist (AOAC). It promotes beneficial physiological effects including laxation, and/or blood cholesterol attenuation, and/or blood glucose attenuation (AACC, 2001). Potato (*Solanum tuberosum* L.) is one of the major crops in the world with an annual production of 3, 67,096 tons in 2013 according to the Food and Agriculture Organization (Statistics Division, 2015). Potato is popularly known as "The king of the vegetable", has emanated as the fourth most important major food crop in India after rice, wheat, and maize. Indian vegetable basket is insufficient without potato. Processing of potatoes (largely for the production chips, papad, French fries, and other dehydrated products) has presented a steady increase during the last decade, exceeding considerably the amount of the vegetable consumed as fresh (Oreopoulou & Tzia, 1971). As a result, a considerable quantity of potato peels waste is generated. The peels which are the major part of processing waste, represent a severe disposal problem to the potato industry, especially since the wet peels are susceptible to rapid microbial spoilage. On the other hand, potato peels contain an array of nutritional and pharmacologically interesting components like phenolic compounds, glycoalkaloids, and cell wall

polysaccharides, which may be used as dietary fiber and natural antioxidant, a precursor of steroids hormones (Schieber *et al.*, 2009). Because the potato peels are an excellent source of dietary fiber, minerals, vitamins, and antioxidants and they represent a nutritionally rich food ingredient that could potentially add value for the bakery industry. Hence, the present study was carried out to evaluate the effect of potato peels powder incorporation on the chemical, sensory, physical and functional characteristics of biscuits.

Methodology:

Control biscuits were prepared by using the rubbing method as given by (Kamaliya & Kamalia, 2002). The following ingredients wheat flour, baking soda, milk powder, sugar, and shortening (Table-1) were purchased from the local market. Potato peels were obtained from the hostel mess of our University. Potatoes were washed thoroughly in running tap water to free them adhering soil particles and placed in a basket to drain out surface water for 15-20 minutes. Potato tubers were peeled manually with a stainless-steel knife of 2 mm size and trimming was also done. Then peels were dried at 60°C in a hot air oven for 6 hours (Sharoba *et al.*, 2013).

The thickness and diameter of the biscuit were assessed by vernier calipers (AACC, 1967). The weight of biscuits was measured as an average value of six individual biscuits with the help of an electrical weighing balance

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(Bala *et al.*, 2015). The percentage of spread factor was calculated by the formula given by (Silky *et al.*, 2014). Sensory evaluation was performed at a nine-point hedonic scale. Protein, fat, ash, moisture, and Total dietary fiber of the biscuit were determined as per (AOAC, 1990). Carbohydrates and energy content were estimated by the difference method.

The data were subjected to ANOVA and mean scores were separated using Duncan's multiple range test by SPSS version 16.0.

Results and Discussion:

Sensory evaluation: the effect potato peels supplementation on color attributes of biscuits are presented in Table 2. The surface color of biscuits containing 8% potato peels had the highest score (8.6) as compared to the control sample (8.1). However, no significant changes observed up to a 6% level of incorporation. Other studies conducted by Elhassaneen *et al.* (2016) have reported that potato peels powder imparted a dark brown color to the crackers, this might have given the scorers an impression of an over baked sample, thus affected their likings. The formulation PPB8% exhibited a significantly ($p=0.05$) higher score of 8.4 for taste followed by PPB6% (7.90), control (7.30), and PPB4% (7.10). The treatment PPB8% scored significantly highest value 8.6 for pleasant flavor followed by the control sample. The data depicted in Figure 1 indicated that the sample with 8% potato peel powder having the most acceptable texture and scored 8.63 followed by the control sample, PPB6%, and PPB4% (7.7, 7.5, and 7.03 respectively). In a similar study by Aslam *et al.*, (2014) studied the effect of mango peels powder at different levels (5, 10, 15%) of biscuits on sensory properties were analyzed. The results showed that biscuits had an acceptable texture of up to 10% mango peels powder. The hardness of the higher supplemented biscuit increased relatively as compared to the control biscuits due to higher water holding capacity. As evident from Table-2 and Fig.-1 the combination PPB8% registered the highest score of 8.3 for overall acceptability followed by control 8.1 and statistically at per each other. Khalil *et al.* (2015) carried out a research in which the biscuit could be made with substitution of oat bran up to 10% with acceptable sensory character.

Table-1: Treatment effects on Potato Peels Powder incorporated Biscuits

Ingredients (g)	Control	PPB4%	PPB6%	PPB8%
Refined wheat flour	100	96	94	92
Potato peels (PP)	0	04	06	08
Powdered sugar	12	12	12	12
Vegetable fat	40	40	40	40
Skimmed milk power	05	05	05	05
Ammonium bicarbonate	0.5	0.5	0.5	0.5
Common salt	2.5	2.5	2.5	2.5
Ajwain	1.5	1.5	1.5	1.5
Water	10 ml	10 ml	10 ml	10 ml

Table-2: Mean scores for Sensory Evaluation of Biscuits containing Potato Peels Powder

Treat-ments	Colour	Taste	Texture	Flavor	Overall accept.
Control	8.10±.10 ^a	7.30±.10 ^a	7.46±.15 ^a	7.70±.10 ^a	8.10±.10 ^{ab}
PPB4%	7.93±.05 ^a	7.10±.10 ^a	7.30±.10 ^a	7.03±.15 ^b	7.36±.15 ^c
PPB6%	7.90±.10 ^a	7.90±.10 ^b	7.33±.15 ^a	7.50.40 ^{ab}	7.93±.15 ^b
PPB8%	8.60±.10 ^b	8.43±.15 ^c	8.10±.10 ^b	8.63.05 ^c	8.30±.10 ^a
C.D.	0.166	0.195	0.261	0.507	0.280
SE(m)	0.047	0.055	0.074	0.144	0.079
SE(d)	0.067	0.078	0.105	0.203	0.112
C.V.	1.004	1.247	1.695	3.225	1.735

Mean±SD of 3 replicates. Mean followed by different letters in the same column differs significantly at ($p<0.05$) where, PPB4%= 4% Potato Peels Powder, PPB6%= 6% Potato Peels Powder, PPB8%=8% Potato Peels Powder NS = Non Significant

Figure-1: Graphical representation for the Sensory profile of Biscuits containing different levels of Potato Peels powder

Table-3: Physical Characteristics of Potato Peels incorporated Biscuits

Formula tions	Weight (g)	Thickness (mm)	Diameters (mm)	Spread rt. (D/T)	Spread factor %
Control	9.79±.005 ^a	7.28±.01 ^a	46.53±.25 ^a	6.39 ^a	100 ^a
PPB4%	11.02±.01 ^b	7.29±.01 ^a	44.40±.0 ^b	6.09 ^b	95.30 ^b
PPB6%	11.02±.04 ^b	6.76±.01 ^c	44.70±.01 ^b	6.61 ^c	103.44 ^c
PPB8%	11.90±.17 ^c	6.86±.05 ^d	43.05±.48 ^c	6.25 ^d	97.88 ^d
C.D.	0.201	0.059	0.524		
SE(m)	0.061	0.018	0.158		
SE(d)	0.086	0.025	0.224		
C.V.	0.960	0.437	0.614		

Physical properties: the effect of various levels of potato peels addition on the physical properties of biscuits shown in Table 3. It is clear from results that potato peels incorporated biscuits exhibited significantly ($p=0.05$) higher values for weight with the highest values (11.90 g) obtained from 8%, followed by (11.2 g) from 6% and 4% potato peels biscuits. Sadal *et al.* (2018) reported that the weight of biscuits increased significantly with an increase in the level of the proportion of pineapple pomace powder. The thickness of potato peels substituted biscuits was significantly reduced with the increase in potato peels powder percentage. This is due to the dilution of gluten (Alija *et al.*, 2008). Though no significant ($p<0.05$) changes were observed up to 4% level of incorporation. The diameter was significant ($p<0.05$) reduced by the addition

of potato peels powder. The highest diameter (46.53 mm) was obtained from control biscuits followed by (44.70 mm) from 6% potato peels. A decrease in diameter may be due to the high-water absorption capacity of potato peels powder. Ojha & Thapa, (2017) produced mandarin peel fortified biscuits and the result showed that increased mandarin peel proportion in wheat flour decreased the diameter of the biscuits. From the results given in Table-3, there was no specific trend shown in the spread ratio and spread factor of biscuits. The highest value (6.61) was obtained from 6% biscuits followed by (6.39) from control biscuits for spread ratio. The spread factor of biscuits was ranged from 103.44% at 8%, 97.88% at 6%, and 95.39 at 4% substitution against 100% in control biscuits. Decrease spread ratio and spread factor were attributed to fact that composite flour of wheat and potato peels powder form aggregates with an increased number of hydrophilic sites available for competing, for the limited free water in dough (McWatters, 1978).

Table-4: Chemical Composition of Biscuits containing different levels of Potato Peels powder

Treatments	Moisture %	Ash %	Protein %	Fat %	Carbohydrate %	EV (Kcal)
Control						
	3.17±.04 ^a	2.85±.15 ^a	14.12±.01 ^a	6.95±.06	52.91	510.67
PPB4%						
	3.46±.35 ^{ab}	2.96±.07 ^a	13.86±.14 ^a	26.70±.49	53.02	507.82
PPB6%						
	4.28±.54 ^{bc}	3.27±.26 ^{ab}	13.28±.20 ^b	26.59±.12	52.58	502.75
PPB8%						
	4.56±.43 ^c	3.82±.33 ^b	13.20±.15 ^b	26.39±.14	52.03	498.43
C.D.						
	0.752	0.441	0.282	NS		
SE(m)						
	0.227	0.133	0.085	3.357		
SE(d)						
	0.321	0.188	0.121	4.747		
C.V.						
	10.167	7.141	1.085	23.264		

Nutritional analysis: biscuits were formulated with 0, 4, 6 and 8% potato peels powder and subsequently, proximate composition biscuits were determined and the results were presented in Table-4. The lowest moisture content was observed in control biscuits (3.17%). Then the moisture content increased gradually with the incremental addition of potato peels powder. There was a significant difference ($p<0.05$) found in moisture content among control biscuits and all formulations of potato peels powder. Parveen *et al.* (2017) reported that there was an increase in moisture content in biscuits with an increase in the level of carrot and beetroot pomace powder. It was found that the ash content was the highest in the sample containing 8% potato peels powder (3.82%) followed by 6% (3.27%) and then 4%

(2.96%). The least mean value for ash content was obtained from control biscuits. No significant difference ($p=0.05$) was observed in ash content among control biscuits, 4%, and 6% substitution. It was seen that the ash content increased with an increasing level of potato peels powder. It may be due to the higher ash content in potato peels powder than refined wheat flour. The protein content of different biscuits was ranged from 14.12% to 13.20%. The protein content of control biscuits was significantly higher (14.12%) ($p<0.05$) than those of potato peels formulations. There was a significant difference ($p<0.05$) observed among control biscuits PPB6% and PPB8% formulations whereas control biscuits and PPB4% were not significantly ($p<0.05$) different. The fat content in different formulations varied from 26.95% to 26.39%. The control biscuits had maximum fat content 26.95% followed by PPB4% (26.70%), PPB 6% (26.59%) and PPB8% (26.12). A nonsignificant difference was observed between control biscuits and all potato peels formulations.

The carbohydrate content of different biscuits samples was ranged from 53.02% in 4% to 52.91% obtained from control biscuits. The carbohydrate content of potato peels biscuits showed a positive trend of up to 4% potato peels powder supplementation. The carbohydrate content then reduced from 53.02% to 52.58% at 6% and 52.03% obtained at an 8% level of addition.

The energy value of potato peels supplemented biscuits decreased with an increased percentage of substitution. The highest value was obtained in control (510.67 Kcal), followed by PPB4% (507.82Kcal) and PPB6% (502.75 Kcal). Whereas, PPB8% formulation obtained the lowest energy value of 497.43 Kcal.

Total dietary fiber content: the insoluble, soluble, and the total dietary fiber content of various biscuits formulation are presented in Fig. 2 the data showed that the insoluble dietary ranged from 0.21% to 2.72% in the prepared biscuits. With 8% exhibiting the significantly high value (3.72%) followed by 6% (2.16%) and 4% (1.71%), while control biscuits obtained the lowest value of 0.21%. there was a significant difference ($p<0.05$) found among all biscuit's formulations. As can be seen from Table-4 there was a gradual increase in insoluble dietary fiber observed as an increase in the levels of incorporation potato peels powder. This could be attributed to the potato peels contained a significantly higher amount of total dietary fiber as well as insoluble dietary fiber as compared to refined wheat flour. The soluble dietary fiber content of potato peels biscuits showed an increasing trend from 0.087% in control to 1.02% obtained from 8% substituted biscuits. It can be seen that the highest soluble dietary fiber value was obtained from PPB8% followed by PPB6% (0.81%) and PPB4% (0.64%), while the control biscuits gave the lowest value. The total dietary fiber content of different biscuits samples was ranged from 0.30% in control to 3.74%

obtained from an 8% level of substitution.

Conclusively the dehydrated potato peels powder could be incorporated as suitable sources of dietary fiber in a large variety of food products such as biscuits.

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