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Nutritional, Organoleptic and Keeping Quality of Wheat-Soybean Cookies Supplemented with Pomegranate Peel Powder

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A B S T R A C T

The present study highlights the potential for utilization of pomegranate peel powder to increase the nutritional, organoleptic and keeping quality of wheat and soybean based cookies. Soybean flour ratio was kept constant (10 per cent) while wheat flour was substituted by pomegranate peel powder at 5, 7.5 and 10 per cent levels in cookies. All the developed cookies were organoleptically acceptable. Protein and fat contents in control cookies were 8.89 and 20.34 per cent, respectively which significantly (P≤0.05) increased to 10.79 and 21.72 per cent, respectively in Type I cookies. It was found that crude fibre (4.21 per cent) and ash (2.28 per cent) were highest in Type III cookies. Total dietary fibre content of control cookies was 8.43 per cent and that of Type I, Type II and Type III cookies was 9.21, 9.53 and 9.88 per cent, respectively which were significantly (P≤0.05) higher than that of control. The soybean flour and pomegranate peel powder supplemented cookies possessed significantly (p≤0.05) higher calcium, phosphorus, iron, zinc and magnesium contents than control cookies. The cookies were organoleptically acceptable upto 90 days in air tight containers at room temperature.

Introduction

Value addition is receiving the prime focus among food scientists and researchers not only to increase the alternative uses of cereals, millets and pulses but also to enhance the nutritive value and health potential of developed products. Soybean (*Glycine max*) is an important source of dietary protein (about 40%) of good nutritional quality and a high oil content (about 20%) together with numerous beneficial nutrients, bioactive factors and phytochemicals which make it the crop of choice for improving the diets of millions of people in the developing countries (Ali, 2010; Sangwan and Dahiya, 2013). It has potential to offer unique health benefits like cholesterol reduction, preventing cardiovascular diseases, cancer, diabetes, controlling blood sugar levels and regulation of menopause. Pomegranate (*Punicagranatum*) is a popular fruit in India and is known for medicinal benefits.

For thousands of years, many cultures have believed that pomegranate is high in natural antioxidants and has beneficiary effects on health, fertility and longevity (Jain *et al.*,

2014). Pomegranate peel is a nutrient rich by-product and possesses apparent wound healing properties, immune modulatory activity, antibacterial activity, anti-atherosclerotic and anti-oxidative capacities (Ibrahium, 2010; Akhtar *et al.,* 2015). Intelligent utilization of pomegranate peel powder and peel extracts has been successfully experienced in various food preparations including edible oils, bakery products, jellies and meat and meat products and yoghurt (Naveena *et al.,* 2008; Kanatt *et al.,* 2010; Devatkal *et al.,* 2012; Altunkaya *et al.,* 2013; El-Batawy, 2014). The supplementation of wheat based bakery products with both soybean and pomegranate peel powder will help in improving their amino acid pattern and nutritional value and will make available functional foods. The present study was undertaken to assess the effect of supplementation, of wheat-soybean cookies, with pomegranate peel powder on their nutritional, organoleptic and keeping quality.

Materials and Methods

Procurement and processing of raw material

The wheat grains (WH-1142) were cleaned and ground in an electric grinder (Cyclotec, M/s Tecator, Hoganas, Sweden) and flour obtained was sieved through a 60 mesh sieve and packed in airtight plastic containers for further use.

The pomegranate fruits were washed thoroughly, peeled and the fruit peels were cut into small pieces and dried in open air under shade. Dried peel was converted into fine powder form and packed in airtight plastic container for further use Soybean (*Glycine max*) flour along with other ingredients required for the development of baked products was purchased from the local market of Hisar.

Preparation of cookies

Method

Wheat flour, soybean flour and pomegranate peel powder were sieved together.

Butter and sugar were creamed. Ammonium bicarbonate and baking soda were added and mixed well with creamed butter and sugar. Egg was added to the creamed mixture and mixed.

In the above mixture sieved flour was added and dough was prepared. Dough was placed for conditioning for 30 minutes in refrigerator. The dough was kneaded again and rolled into sheet and molded to round shape and placed in baking trays.

Baking was done, in preheated oven, at 160°C for about 25 minutes or till brown colour.

Organoleptic evaluation of cookies

Cookies were subjected to sensory evaluation with respect to color, appearance, aroma, texture, taste and overall acceptability by a panel of 10 semi trained judges, using 9 point hedonic scale.

Nutritional evaluation of pomegranate peel powder and cookies

Moisture content, ash, crude fat, protein and fibre was determined by employing the standard method of analysis (AOAC, 2000). Total, soluble and insoluble dietary fiber constituents were determined by the enzymatic method given by Furda (1981). Calcium, iron, zinc and magnesium in acid digested samples were determined by Atomic Absorption Spectrophotometer according to the method of Lindsey and Norwell (1969). Phosphorus was determined colorimetrically by using the method of Chen *et al.,* (1956).

Shelf life studies of cookies supplemented with pomegranate peel powder

Organoleptic evaluation and fat acidity

The fat acidity was determined by the standard method of analysis (AOAC, 2000).

Statistical analysis

Mean, standard error and CD (critical difference) were calculated for analysis of data (Sheoran and Pannu, 1999).

Results and Discussion

Organoleptic acceptability of cookies

The data on organoleptic acceptability of cookies is presented in Table 1. The colour score of the control cookies was 8.00 (liked very much) while that of soybean flour and pomegranate peel powder supplemented cookies were 7.90 (liked very much) at 85:10:5.0, 7.70 (liked very much) at 82.5:10:7.5 and 7.90 (liked very much) at 80:10:10 levels of substitution of wheat flour with soybean flour and pomegranate peel powder. The appearance scores of cookies prepared from wheat flour supplemented with soybean flour and pomegranate peel powder were 8.00, 7.50 and 7.90 in Type I, II and III cookies, respectively and also fell in the category' liked very much'. The aroma scores of wheat flour cookies supplemented with soybean flour and pomegranate peel powder were 8.00 (liked very much) at 85:10:5 level of supplementation while at 85:10:5 level of substitution, it was 8.10 and 8.00 at 80:10:10 level of supplementation. The textural score of the control cookies was 7.80 and was in the category of 'liked very much'. With the incorporation of soybean flour and pomegranate peel powder there was a non-significant increase in the mean scores of texture. Cookies prepared from wheat flour supplemented with soybean flour and pomegranate peel powder at 85:10:5, 82.5:10:7.5 and 80:10:10 level of incorporation had texture score of 7.90, 8.10 and 8.20, respectively which were found in the category of 'liked very much'. The score for the taste of the control cookies was 7.70 (liked very much) while the mean scores of taste in Type I, II and III cookies was 8.05, 7.75 and 7.85, respectively. The scores were in the category of 'liked very much'. The control cookies obtained 7.90 mean score for overall acceptability which was in the category 'liked very much'. Mean scores of overall acceptability in cookies supplemented with soybean flour and pomegranate peel powder were 7.97, 7.83 and 7.85 at 85:10:5, 82.5:10:7.5 and 80:10:10 level of supplementation, respectively which fell in the category 'liked very much'. All types of cookies were organoleptically acceptable and their overall acceptability scores were in the category 'liked very much'. The results of the present study are in the agreement with those of Mahmoodi (2008), Ndife *et al.*, (2011) and Dhore (2011) who also reported that overall acceptability of control biscuits and supplemented biscuits fell in the category of 'liked very much'.

Nutritional composition of cookies

Protein and fat contents in control cookies were 8.89 and 20.34 per cent, respectively which significantly ($P \leq 0.05$) increased to 10.79 and 21.72 per cent, respectively in Type I cookies (Table 2). The protein and fat contents were 10.45 and 21.90 per cent and 10.13 and 22.11 per cent in Type II and Type III cookies, respectively, which were also significantly ($P \leq 0.05$) higher than that of control cookies. Crude fibre and ash contents in control cookies were 1.02 and 1.23 per cent, respectively which significantly ($P \leq 0.05$) increased to 2.18 and 2.00 per cent in Type I cookies, respectively.

Ingredients

Supplementation Level (%)	Wheat flour (g)	Soybean flour (g)	Pomegranate peel powder(g)	Butter (g)	Sugar (g)	Egg (No.)	Baking powder (tsp)	Ammonium bicarbonate
Control(100%WF)	100	-	-	50	50	1/2	½	a pinch
Type I (WF:SBF:PPP::85:10:5)	85	10	5	50	50	1/2	1/2	a pinch
Type II (WF:SBF:PPP::82.5:10:7.5)	82.5	10	7.5	50	50	1/2	1/2	a pinch
Type III (WF:SBF:PPP::80:10:10)	80	10	10	50	50	1/2	1/2	a pinch

WF = Wheat Flour, SBF = Soybean Flour and PPP = Pomegranate Peel Powder

Table.1 Mean scores of sensory characteristics of cookies

Cookies	Colour	Appearance	Aroma	Texture	Taste	Overall acceptability
Control (100% WF)	8.00±0.15	8.10±0.18	7.90±0.10	7.80±0.20	7.70±0.26	7.90±0.13
Type I (WF:SBF:PPP::85:10:5)	7.90±0.18	8.00±0.21	8.00±0.15	7.90±0.18	8.05±0.19	7.97±0.13
Type II (WF:SBF:PPP::82.5:10:7.5)	7.70±0.26	7.50±0.27	8.10±0.18	8.10±0.18	7.75±0.20	7.83±0.14
Type III (WF:SBF:PPP::80:10:10)	7.90±0.23	7.90±0.23	8.00±0.20	8.20±0.21	7.85±0.24	7.85±0.17

Values are mean ± SE of ten observations
WF = Wheat Flour, SBF = Soybean Flour and PPP = Pomegranate Peel Powder

Table.2 Proximate composition of cookies (% on dry matter basis)

Cookies	Nutrients				
	Moisture	Protein	Fat	Crude fibre	Ash
Control (100% WF)	3.25±0.022	8.89±0.17	20.34±0.05	1.02±0.01	1.23±0.03
Type I (WF:SBF:PPP::85:10:5)	3.32±0.01	10.79±0.15	21.72±0.04	2.18±0.04	2.00±0.04
Type II (WF:SBF:PPP::82.5:10:7.5)	3.38±0.01	10.45±0.16	21.90±0.01	3.53±0.02	2.14±0.01
Type III (WF:SBF:PPP::80:10:10)	3.44±0.02	10.13±0.15	22.11±0.02	4.21±0.02	2.28±0.03
CD (P≤0.05)	0.04	0.52	0.11	0.10	0.11

Values are mean ± SE of three independent determinations
WF = Wheat Flour, SBF = Soybean Flour and PPP = Pomegranate Peel Powder

Table.3 Dietary fibre content of cookies (% on dry matter basis)

Cookies	Total Dietary Fibre	Soluble Dietary Fibre	Insoluble Dietary Fibre
Control (100% WF)	8.43±0.03	1.85±0.02	6.58±0.02
Type I (WF:SBF:PPP::85:10:5)	9.21±0.03	2.15±0.01	7.06±0.02
Type II (WF:SBF:PPP::82.5:10:7.5)	9.53±0.01	2.35±0.02	7.18±0.02
Type III (WF:SBF:PPP::80:10:10)	9.88±0.03	2.53±0.02	7.35±0.02
CD (P≤0.05)	0.10	0.06	0.08

Values are mean ± SE of three independent determinations
WF = Wheat Flour, SBF = Soybean Flour and PPP = Pomegranate Peel Powder

Table.4 Total minerals of cookies (mg/100g on dry matter basis)

Cookies	Calcium	Phosphorus	Iron	Zinc	Magnesium
Control (100% WF)	49.98±0.94	168.75±5.61	2.84±0.04	1.16±0.02	72.22±3.66
Type I (WF:SBF:PPP::85:10:5)	61.07±1.33	218.75±3.54	3.47±0.02	1.29± 0.01	88.72±0.71
Type II (WF:SBF:PPP::82.5:10:7.5)	62.16±0.47	213.54±3.34	3.41±0.03	1.24± 0.01	89.64±1.34
Type III (WF:SBF:PPP::80:10:10)	63.25±0.42	186.54±4.29	3.37±0.02	1.21±0.02	90.75 ±0.19
CD (P≤0.05)	2.62	6.35	0.25	0.02	2.45

Values are mean ± SE of three independent determinations
WF = Wheat Flour, SBF = Soybean Flour and PPP = Pomegranate Peel Powder

Table.5 Effect of storage period on mean scores of sensory characteristics of cookies

Supplementation Level (%)	Storage period (days)							
	0	15	30	45	60	75	90	Mean
Colour								
Control (100% WF)	8.00±0.15	7.80±0.25	7.70±0.25	7.60±0.16	7.60±0.16	7.50±0.22	7.10±0.23	7.61±0.28
Type I (WF:SBF:PPP::85:10:5)	7.90±0.18	7.90±0.18	7.50±0.20	7.40±0.31	7.40±0.37	7.30±0.26	6.70±0.21	7.44±0.41
Type II (WF:SBF:PPP::82.5:10:7.5)	7.70±0.26	7.60±0.31	7.50±0.22	7.40±0.34	7.30±0.15	7.00±0.21	6.70±0.3	7.31±0.35
Type III (WF:SBF:PPP::80:10:10)	7.90±0.23	7.70±0.213	7.30±0.37	7.20±0.17	7.20±0.26	7.00±0.21	6.80±0.25	7.30±0.38
Mean	7.88	7.75	7.50	7.40	7.38	7.20	6.82	
Appearance								
Control (100% WF)	8.10±0.18	7.80±0.25	7.60±0.16	7.60±0.16	7.40±0.16	7.40±0.22	6.80±0.25	7.53±0.40
Type I (WF:SBF:PPP::85:10:5)	8.00±0.21	7.80±0.20	7.50±0.17	7.40± 0.31	7.30±0.25	7.25±0.17	6.60±0.22	7.41±0.45
Type II (WF:SBF:PPP::82.5:10:7.5)	7.60±0.27	7.50±0.27	7.40±0.34	7.20±0.20	7.20±0.20	7.10±0.18	6.70±0.21	7.24±0.29
Type III (WF:SBF:PPP::80:10:10)	7.90±0.23	7.60±0.22	7.20±0.33	7.20±0.20	7.20±0.20	7.20±0.21	6.80±0.25	7.30±0.35
Mean	7.90	7.68	7.42	7.35	7.38	7.24	6.72	
Aroma								
Control (100% WF)	7.90±0.10	7.75±0.29	7.60±0.16	7.50±0.31	7.30±0.30	7.20±0.25	6.70±0.30	7.42±0.39
Type I (WF:SBF:PPP::85:10:5)	8.00±0.15	7.75±0.33	7.70±0.21	7.55±0.19	7.50± 0.17	7.10±0.23	6.70±0.30	7.47±0.44
Type II (WF:SBF:PPP::82.5:10:7.5)	8.10±0.18	7.70±0.26	7.50±0.22	7.50±0.22	7.45±0.30	7.10±0.23	6.70±0.30	7.44±0.44
Type III (WF:SBF:PPP::80:10:10)	8.20±0.20	7.80±0.20	7.40±0.16	7.35±0.30	7.20±0.20	7.00±0.3	6.50±0.34	7.35±0.55
Mean	8.05	7.75	7.55	7.48	7.39	7.10	6.65	
Texture								
Control (100% WF)	7.80±0.20	7.70±0.30	7.60±0.16	7.50±0.22	7.40±0.221	7.40±0.221	6.30±0.26	7.39±0.50
Type I (WF:SBF:PPP::85:10:5)	7.90±0.18	7.70±0.34	7.60±0.27	7.50±0.17	7.50±0.17	7.20±0.20	6.30±0.34	7.39±0.52
Type II (WF:SBF:PPP::82.5:10:7.5)	8.10± 0.18	7.50±0.22	7.40±0.31	7.40±0.31	7.40±0.22	7.00±0.21	6.40±0.27	7.31±0.52
Type III (WF:SBF:PPP::80:10:10)	8.00±0.21	7.70±0.21	7.60±0.27	7.15±0.29	7.10±0.23	7.10±0.28	6.30±0.34	7.28±0.55
Mean	7.95	7.65	7.55	7.39	7.35	7.18	6.32	
Taste								
Control (100% WF)	7.70±0.26	7.60±0.16	7.60±0.27	7.40±0.16	7.40± 0.27	7.30±0.26	6.60± 0.27	7.37±0.37
Type I (WF:SBF:PPP::85:10:5)	8.05±0.19	7.90±0.18	7.60±0.37	7.50± 0.17	7.50± 0.17	7.30±0.21	6.40± 0.31	7.46±0.53
Type II (WF:SBF:PPP::82.5:10:7.5)	7.75±0.20	7.70±0.26	7.40±0.31	7.30±0.30	7.20±0.20	7.00±0.21	6.70± 0.34	7.29±0.37
Type III (WF:SBF:PPP::80:10:10)	7.85±0.24	7.60±0.22	7.40±0.22	7.20±0.39	7.20±0.29	7.00±0.29	6.40±0.31	7.24±0.46
Mean	7.84	7.70	7.50	7.35	7.33	7.15	6.53	
Overall Acceptability								
Control (100% WF)	7.90± 0.13	7.73±0.26	7.58± 0.15	7.50± 0.24	7.44± 0.15	7.40± 0.23	6.70±0.24	7.46±0.38
Type I (WF:SBF:PPP::85:10:5)	7.97±0.13	7.78±0.19	7.61±0.29	7.50±0.17	7.44±0.23	7.24 ±0.21	6.54±0.25	7.44±0.46
Type II (WF:SBF:PPP::82.5:10:7.5)	7.83±0.14	7.58±0.23	7.45±0.29	7.36±0.17	7.34±0.27	7.04±0.19	6.64±0.26	7.32±0.38
Type III (WF:SBF:PPP::80:10:10)	7.85±0.17	7.66±0.19	7.34±0.19	7.24±0.32	7.22±0.21	7.06±0.25	6.56±0.28	7.28±0.42
Mean	7.89	7.69	7.50	7.40	7.36	7.18	6.61	

Values are mean ± SE of ten observations; WF = Wheat Flour, SBF = Soybean Flour and PPP = Pomegranate Peel Powder

Table.6 Effect of storage period on fat acidity (mg KOH/100g) of cookies (on dry weight basis)

Supplementation level (%)	Storage period (days)							Mean
	0	15	30	45	60	75	90	
Control (100% WF)	32.34±0.33	36.67±0.57	42.34±0.33	47.67±0.33	52.67±0.67	59.33±1.20	67.67±0.67	48.38±12.53
Type I (WF:SBF:PPP::85:10:5)	36.67±0.89	41.34±0.89	47.34±0.33	52.00±0.22	56.67±1.20	65.67±0.67	72.33±0.89	53.14±12.80
Type II (WF:SBF:PPP::82.5:10:7.5)	35.34±1.20	41.00±0.82	46.34±0.67	51.33±1.20	55.33±1.21	64.33±0.33	71.67±0.58	52.19±13.00
Type III (WF:SBF:PPP::80:10:10)	34.67±0.58	39.67±0.33	45.33±0.58	50.67±0.33	54.67±0.22	63.33±0.33	69.67±0.58	51.14±12.69
Mean	34.75	39.67	45.83	50.42	54.83	63.14	70.33	
CD(P≤0.05)	Period : 0.59		Supplementation level : 0.45			Period × Supplementation level : 1.18		

Values are mean ± SE of three independent determinations
WF = Wheat Flour, SBF = Soybean Flour and PPP = Pomegranate Peel Powder

The crude fibre and ash contents were 3.53 and 2.14 per cent and 4.21and 2.28 per cent in Type II and Type III cookies, respectively. The supplemented cookies had significantly (P≤0.05) higher contents of moisture, protein, fat, crude fibre and ash as compared to control cookies. It was found that protein content was highest in Type I cookies (10.79 per cent) while fat (22.11 per cent), crude fibre (4.21 per cent) and ash (2.28 per cent) were highest in Type III cookies. It was observed that as the level of substitution with pomegranate peel powder increased there was a significant (P≤0.05) increase in fat, crude fibre and ash contents of value added cookies. The data pertaining to dietary fibre content of cookies is presented in Table 3. Total dietary fibre content of control cookies was 8.43 per cent, and that of Type I, Type II and Type III cookies was 9.21, 9.53 and 9.88 per cent, respectively which were significantly (P≤0.05) higher than that of control. Soluble dietary fibre and insoluble dietary fibre contents of control cookies were 1.85 and 6.58 per cent respectively which also increased significantly (P≤0.05) in value added cookies with the increment in supplementation of wheat flour with soybean flour and pomegranate peel powder at all the levels i.e. 85:10:5 (2.15 and 7.06 per cent, respectively), 82.5:10:7.5 (2.35 and 7.18 per cent, respectively) and 80:10:10 (2.53 and 7.35 per cent, respectively) levels. The nutritional value of supplemented value added products is always higher than control products (Sangwan and Dahiya, 2013; Ismail *et al.*, 2014; Pandey and Sangwan, 2016a).

Total minerals

The result of total mineral contents of cookies is presented in Table 4. The control cookies contained 49.98, 168.75, 2.84, 1.16 and 72.22 mg/100g of calcium, phosphorus, iron, zinc and magnesium, respectively which were significantly (p≤0.05) lower than that of soybean flour and pomegranate peel powder supplemented cookies. Type I cookies possessed 61.07, 218.75, 3.47, 1.29 and 88.72 mg/100g calcium, phosphorus, iron, zinc and magnesium, respectively while Type II cookies contained62.16, 213.54, 3.41, 1.24 and 89.64 mg/100g, calcium, phosphorus, iron, zinc and magnesium, respectively. Type III cookies contained 186.54 and 1.21 mg/100g, phosphorus and zinc, respectively which were significantly (p≤0.05) lower than Type I and Type II cookies. However there was a non-significant difference in the calcium, iron and magnesium contents of all types of cookies at 5 to 10 per cent level of substitution with pomegranate peel powder. Similar findings were also reported by other workers (Pandey and Sangwan, 2016b; Pandey and Sangwan, 2016c) that value added products possessed higher mineral contents compared to control. The increase in mineral contents of value added products might be due to high contents of calcium, phosphorus, magnesium, iron and zinc in

soybean flour as compared to wheat flour and pomegranate peel powder. Moreover pomegranate peel powder also possessed higher calcium and magnesium contents than wheat flour.

Shelf life studies of supplemented cookies

Organoleptic evaluation and fat acidity

Stored products were studied for their sensory characteristics at an interval of 15 days upto acceptability by a panel of 10 semi-trained judges using nine-point Hedonic Scale (Table 5). The score of appearance of all types of cookies was in the category of 'liked moderately' to 'liked very much', upto 90 days of storage. The score of aroma of all types of cookies was in the category of 'liked moderately' to 'liked very much', during three months of storage. The scores of texture of control cookies, Type I, Type II and Type III cookies changed from 7.80 (zero day) to 6.30 (90^{th} day), 7.90 (zero day) to 6.30 (90^{th} day), 8.10(zero day) to 6.40 (90^{th} day) and 8.00 (zero day) to 6.30 (90^{th} day), respectively. All types of cookies were organoleptically acceptable and fell in category of 'liked very much' to 'liked slightly' during three months of storage. However on mean basis all types of cookies were acceptable upto 90 days of storage and fell in the category of 'liked moderately'. The fat acidity of Type I, Type II and Type III cookies increased from 36.67 to 72.33, 35.34 to 71.67 and 34.67 to 69.67 mg KOH/100g, respectively during zero to 90 days of storage (Table 6). At the same time it was also observed that on the mean basis the fat acidity of Type III (51.14 mg KOH/100g) cookies was significantly lower than that of Type II (52.19 mg KOH/100g) and maximum fat acidity content was found in Type I (53.14 mg KOH/100g) cookies. Thus indicating that as the level of supplementation with pomegranate peel powder increased in cookies the fat acidity content decreased. From the present study it can be concluded that there is great scope for utilization of pomegranate peels to develop value added cookies having good shelf life.

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