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Ganeshan Tharshini
Department of Foods and Nutrition, CCS Haryana Agricultural University, Hisar, Haryana, India

Veenu Sangwan
Department of Foods and Nutrition, CCS Haryana Agricultural University, Hisar, Haryana, India

Suman
Department of Foods and Nutrition, CCS Haryana Agricultural University, Hisar, Haryana, India

Correspondence
Veenu Sangwan
Department of Foods and Nutrition, CCS Haryana Agricultural University, Hisar, Haryana, India

Organoleptic and chemical characteristics of soybean and pomegranate peel powder supplemented cakes

Ganeshan Tharshini, Veenu Sangwan and Suman

Abstract
The present study delineates information pertaining to the organoleptic evaluation and chemical characteristics of wheat flour cake supplemented with soybean flour and pomegranate peel powder. The overall acceptability score of control (100 per cent wheat flour) cake was 7.40 and that of cakes made of wheat, soybean flour and pomegranate peel powder at 85:10:5, 82.5:10:7.5 and 80:10:10 level of substitutions had overall acceptability mean scores of 7.80, 7.74 and 7.96 which fell in the category 'liked very much'. The protein and fat contents of Type I cake were 11.23 and 23.72 per cent, respectively which were significantly higher than that of control cake. As the level of substitution with pomegranate peel powder increased there was a significant ($P \leq 0.05$) increase in the crude fibre and ash content of all types of value added cakes from 2.23 to 3.03 and 1.81 to 2.15 per cent, respectively. Total dietary fibre content of control cake was 7.51 per cent, which was significantly lower than that of Type I (8.29 per cent), Type II (8.67 per cent) and Type III (9.07 per cent) cakes. Soluble and insoluble dietary fibre content of all types of cakes were significantly ($P \leq 0.05$) higher than that of control cake. Similarly the calcium, phosphorus, iron, zinc and magnesium content of control was significantly ($P \leq 0.05$) lower than that of Type I, II and III cakes. The starch and protein digestibility was 50.63 mg maltose released/g meal and 73.24 per cent, respectively in the 100 per cent wheat flour cake which was significantly ($p \leq 0.05$) higher than that of value added cakes.

Keywords: pomegranate peel powder, soybean, wheat flour, organoleptic, cake

Introduction
Pomegranate is a low maintenance crop of the arid and semi arid regions and can thrive under all types of climate stresses. It is known for its high nutritional and neutraceutical fruit value and is very popular fruit crop among the growers and consumers worldwide. Maharashtra, Karnataka, Gujarat, Rajasthan, Uttar Pradesh, Andhra Pradesh and Tamil Nadu dominate its production in India (Dhinesh and Ramasamy, 2016) [5]. Pomegranate fruit is consumed after removal of its peel which is then usually discarded as a waste product. Utilization of pomegranate peel by converting it into powder form is one of the alternative ways of utilizing this nutritious fruit waste material which is mostly discarded or given to animals for feeding. This alternative use of pomegranate peel powder can be of importance to environmentalists also, as its use in food processing industries can prove to be a solution for controlling increasing biological wastes. It has been reported that pomegranate peel possess anti- bacterial properties besides being a rich source of Vitamin C, various polyphenols phenolic punicalagins, gallic acid, catechin, flavones, flavonones and anthocyanidins and thus its utilization can provide various health benefits (Singh *et al* 2002) [17]. Supplementation of bakery products like cake, which are very popular among children and are a rich source of energy and protein, with soybean and pomegranate peel powder will further help in improving the nutritional and chemical qualities of developed cake. Keeping in view that development of value added products from diverse raw ingredients is receiving the prime focus of food processing industries and researchers, the present study was planned to exploit the feasibility of development of value added cake from different ratios of wheat flour, soybean flour and pomegranate peel powder.

Materials and Methods
Procurement of raw material
Grains of wheat (*Triticum aestivum*, WH-1142) used in the study were procured in a single lot from the Wheat and Barley Section, Department of Genetics and Plant Breeding, CCS Haryana Agricultural University, Hisar.
Pomegranate was procured in bulk from the fruit market of Hisar. Soybean (*Glycine max*)

flour along with other ingredients required for the development of baked products was purchased from the local market of Hisar.

Processing of wheat grains and pomegranate peel

The wheat grains 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.

Preparation of Cake

Ingredients

Supplementation level (%)	Wheat flour (g)	Soybean flour (g)	Pomegranate peel powder(g)	Butter (g)	Sugar (g)	Egg (No.)	Baking powder (tsp)	Vanilla essence
100 % WF	100	-	-	100	100	3	1	Few drops
Type I (WF:SBF:PPP::85:10:5)	85	10	5	100	100	3	1	Few drops
Type II (WF:SBF:PPP::82.5:10:7.5)	82.5	10	7.5	100	100	3	1	Few drops
Type III (WF:SBF:PPP::80:10:10)	80	10	10	100	100	3	1	Few drops

WF = Wheat flour, SBF = Soybean flour and PPP = Pomegranate peel powder

Method

- Wheat flour, soybean flour, pomegranate peel powder and baking powder were sieved twice.
- Creamed sugar and butter together till light and fluffy.
- Beat eggs separately and mixed well in sugar and butter mixture.
- Vanilla essence was also added.
- Sieved flour was added and folded in above mixture and batter was prepared.
- The batter was poured in greased pan and baked, in preheated oven, at 160^0C for 35-40 minutes.

Organoleptic evaluation of cake

Cake 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 cake

Moisture content and ash was determined by employing the standard method of analysis (AOAC 2000) [1]. Crude protein was estimated by standard method of analysis (AOAC 2000) [1], using KEL PLUS Automatic Nitrogen Estimation System. Crude fat and fibre were estimated by employing the standard method of analysis (AOAC 2000) [1] using the Automatic SOCS plus Solvent Extraction System and Automatic Fibra plus system, respectively. Total, soluble and insoluble dietary fiber constituents were determined by the enzymatic method given by Furda (1981) [7]. Calcium, iron, zinc and magnesium in acid digested samples were determined by Atomic Absorption Spectrophotometer according to the method of Lindsey and Norwell (1969) [9]. Phosphorus was determined colorimetrically by using the method of Chen *et al.* (1956) [6]. *In vitro* starch digestibility was assessed by the method of Singh *et al.* (1982) [18]. *In vitro* protein digestibility was determined by the modified method of Mertz *et al.* (1983) [11].

Statistical analysis

Mean, standard error and CD (critical difference) were calculated for analysis of data (Sheoran & Pannu 1999) [16].

Results and discussion

Organoleptic acceptability of cake

The data on organoleptic acceptability of cake is presented in Table 1. The colour score of the 100 per cent wheat flour cake was 7.50 and was found in the category of ‘liked very much’. The colour score of cakes developed from wheat flour supplemented with soybean flour and pomegranate peel powder at 85:10:5 and 82.5:10:7.5 level of substitution was 7.80 and at 80:10:10 level of substitution it was 8.00, which fell in the category of ‘liked very much’. Appearance score of 100 per cent wheat flour cake was 7.30 which fell in the category of ‘liked moderately’. The appearance score of cake prepared from 85:10:5 level of supplementation (wheat flour, soybean flour and pomegranate peel powder) was 7.70 (liked very much), and at 82.5:10:7.5 level it was 7.65 (liked very much) and at 80:10:10 level of substitution it was 7.90 (liked very much). The score for the aroma of the 100 per cent wheat flour cake was 7.60 (liked very much). The aroma score of cakes supplemented with soybean flour and pomegranate peel powder was 7.80, 7.60 and 7.80 (liked very much) at 85:10:5, 82.5:10:7.5 and 80:10:10 level of substitution, respectively. The textural score of the 100 per cent wheat flour cake was 7.30 and was in the category of ‘liked moderately’. The textural score of the supplemented cake increased significantly ($P \leq 0.05$) from 7.80 (liked very much) to 8.00 (liked very much) at 85:10:5, 82.5:10:7.5 and 80:10:10 level of supplementation with soybean flour and pomegranate peel powder. Texture is generally related to the smoothness or roughness of the baked product and is an important attribute for assessing the freshness of the product. The mean score of taste of 100 per cent wheat flour cake was 7.30 (liked moderately) which significantly ($P<0.05$) increased to 7.90 and 8.10 at 85:10:5 and 80:10:10 level of substitution of wheat flour with soybean flour and pomegranate peel powder. Mean scores of taste at 85:10:5 and 82.5:10:7.5 levels of supplementation fell in the category of ‘liked very much’. The overall acceptability score of 100 per cent wheat flour cake was 7.40 (liked moderately) whereas cakes made of wheat, soybean flour and pomegranate peel powder at 85:10:5, 82.5:10:7.5 and 80:10:10 level of substitutions had overall acceptability mean scores of 7.80, 7.74 and 7.96 which fell in the category ‘liked very much’. Rana (2015) also reported that value added cakes developed from multigrain (wheat-sorghum-soybean- mung bean) and medicinal plant like marwa were organoleptically acceptable by the judges. Mehder (2013) [10] also developed organoleptically acceptable baked product ie pan bread supplemented with one per cent pomegranate peel while Altunkaya*et al*. (2013) reported that 2.5 per cent pomegranate peel supplemented bread had a good acceptance in the subjective evaluation (>5) whereas 10 per cent supplementation scored the lowest. Vaijapurkar *et al*. (2015) [20] also reported that value added biscuits prepared from wheat flour, pearl millet flour and 3 per cent pomegranate peel powder was the most accepted variation.

Table 1: Mean scores of sensory characteristics of cake

Products	Colour	Appearance	Aroma	Texture	Taste	Overall acceptability
100% WF	7.50±0.22	7.30 ±0.26	7.60±0.22	7.30±0.30	7.30±0.26	7.40 ±0.21
Type I (WF:SBF:PPP::85:10:5)	7.80±0.20	7.70±0.16	7.80±0.13	7.80±0.20	7.90±0.19	7.80±0.14
Type II (WF:SBF:PPP::82.5:10:7.5)	7.80±0.20	7.65±0.15	7.60±0.22	7.80±0.20	7.85±0.26	7.74±0.19
Type III (WF:SBF:PPP::80:10:10)	8.00±0.21	7.90±0.18	7.80±0.25	8.00±0.21	8.10±0.31	7.96±0.22

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

Nutritional composition of cake

Proximate composition

The data pertaining to proximate composition of cake is presented in Fig.1 and Table 2.

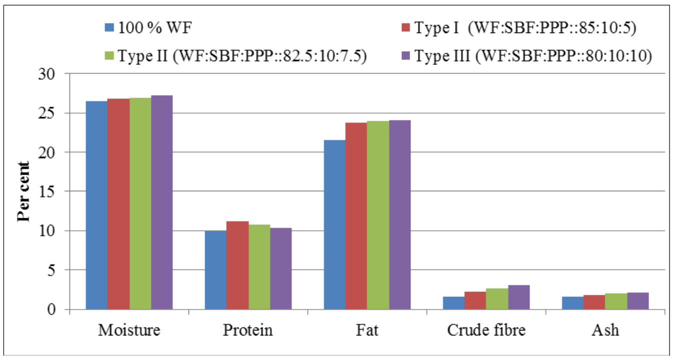

Fig 1: Proximate composition of cake (% on dry matter basis)

Moisture content of 100 per cent wheat flour cake was 26.51 per cent while the moisture content of supplemented cakes *viz.* Type I, Type II and Type III was 26.80, 26.95 and 27.25 per cent, respectively. The protein and fat contents in 100 per cent wheat flour cake were 9.92 and 21.53 per cent, respectively. The protein and fat contents of Type I cake were 11.23 and 23.72 per cent, respectively which were significantly (P≤0.05) higher than that of 100 per cent wheat flour cake. Similarly protein content of Type II (10.79 per cent) cake was significantly (P≤0.05) higher than that of 100 per cent wheat flour cake. The protein content of Type I cake was significantly (P≤0.05) higher than that of Type III cake. Fat content of Type II and III cakes were 23.95 and 24.05 per cent, respectively which were significantly (P≤0.05) higher than that of 100 per cent wheat flour cake. The crude fibre and ash contents in 100 per cent wheat flour cake were 1.60 and 1.65 per cent, respectively which significantly (P≤0.05) increased on supplementation with soybean (10 per cent) and increase in level of supplementation with pomegranate peel powder (from 5 to 10 per cent). However it was observed that as the level of substitution with pomegranate peel powder increased there was a significant (P≤0.05) increase in the crude fibre and ash content of all types of value added cakes from 2.23 to 3.03 and 1.81 to 2.15 per cent, respectively. These results are in agreement with those of earlier workers (Sangwan & Dahiya 2013; Ismail *et al*. 2014; Pandey & Sangwan 2016; Pandey & Sangwan 2018, Tharshini *et al.*, 2018) [12, 13, 15, 8, 19], who found that proximate composition of value added products were higher than that of control products developed from 100 per cent wheat flour.

Dietary fibre

The data pertaining to dietary fibre content of cake is presented in Table 3. Total dietary fibre content of 100 per cent wheat flour cake was 7.51 per cent, which was significantly (P≤0.05) lower than that of Type I (8.29 per cent), Type II (8.67 per cent) and Type III (9.07 per cent) cakes. Similarly soluble dietary fibre content of all types of cakes i.e. Type I (1.64 per cent), Type II (1.84 per cent) and Type III (2.04 per cent) cakes was significantly (P≤0.05) higher than that of 100 per cent wheat flour cake (1.25 per cent). Insoluble dietary fibre content of 100 per cent wheat flour cake was 6.27 per cent, which was also significantly (P≤0.05) lower than that of all types of value added cakes having 6.64 to 7.03 per cent insoluble fibre. Total dietary fibre, soluble dietary fibre and insoluble dietary fibre contents of Type I, II and III cakes increased due to incorporation of soybean (10 per cent) and with the increment in supplementation of pomegranate peel powder from 5 to 10 per cent. The results of present study corroborated with those of Chaudhary (2011) and Chandel (2014). The differences in dietary fibre contents of different types of value added baked products were due to differences in level of incorporation pomegranate peel powder while soybean flour was kept constant at 10 per cent level.

Total minerals

The result of total mineral content of cake is presented in Table 4. The 100 per cent wheat flour cake had 60.04, 139.58, 2.90, 1.20 and 72.28 mg/100g of calcium, phosphorus, iron, zinc and magnesium, respectively which were significantly (P≤0.05) lower than Type I, II and III cakes. Type I cake contained 76.62, 177.08, 3.56, 1.38 and 84.31 mg/100g of calcium, phosphorus, iron, zinc and magnesium, respectively and Type II and III cake contained 77.85, 164.58, 3.53, 1.33 and 85.39 mg/100g and 78.92, 147.92, 3.49, 1.27 and 86.41 mg/100g of calcium, phosphorus, iron, zinc and magnesium, respectively.

Table 2: Proximate composition of cake (% on dry matter basis)

Products	Nutrients				
	Moisture	Protein	Fat	Crude fibre	Ash
Cake					
100 % WF	26.51±0.35	9.92±0.14	21.53±0.22	1.60±0.06	1.65±0.02
Type I (WF:SBF:PPP::85:10:5)	26.80±0.02	11.23±0.15	23.72±0.16	2.23±0.03	1.81±0.01
Type II (WF:SBF:PPP::82.5:10:7.5)	26.95±0.37	10.79±0.15	23.95±0.13	2.63±0.03	2.01± 0.01
Type III (WF:SBF:PPP::80:10:10)	27.25±0.14	10.35±0.15	24.05±0.21	3.03±0.03	2.15±0.02
CD (P≤0.05)	NS	0.51	0.67	0.16	0.05

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

Total mineral contents of value added cakes were significantly (P≤0.05) higher than that of 100 per cent wheat flour cake due to addition of soybean flour (10 per cent). However, as the level of pomegranate peel powder increased from 5 to 10 per cent a decreasing trend was observed in phosphorus, iron and zinc contents of different types (Type I, II and III) of value added cakes. A non-significant decrease and increase was observed in the iron and magnesium contents of cakes, respectively, as the level of substitution with pomegranate peel powder increased. The increase in mineral contents of value added baked 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.

Table 3: Dietary fibre content of cake (% on dry matter basis)

Products	Total Dietary Fibre	Soluble Dietary Fibre	Insoluble Dietary Fibre
Cake			
100 % WF	7.51±0.03	1.25±0.02	6.27±0.01
Type I (WF:SBF:PPP::85:10:5)	8.29±0.03	1.64±0.02	6.64±0.02
Type II (WF:SBF:PPP::82.5:10:7.5)	8.67±0.02	1.84±0.01	6.83±0.01
Type III (WF:SBF:PPP::80:10:10)	9.07±0.02	2.04±0.02	7.03±0.01
CD (P≤0.05)	0.07	0.05	0.03

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

Table 4: Total mineral content of cake (mg/100g, on dry matter basis)

	Total minerals				
Products	**Calcium**	**Phosphorus**	**Iron**	**Zinc**	**Magnesium**
Cake					
100 % WF	60.04±0.88	139.58±4.33	2.90±0.03	1.20±0.01	72.28±0.17
Type I (WF:SBF:PPP::85:10:5)	76.62±0.44	177.08±4.54	3.56±0.02	1.38±0.02	84.31±2.16
Type II (WF:SBF:PPP::82.5:10:7.5)	77.85±0.20	164.58±4.17	3.53±0.04	1.33±0.01	85.39±2.05
Type III (WF:SBF:PPP::80:10:10)	78.92±0.44	147.92±5.51	3.49±0.02	1.27±0.02	86.41±1.90
CD (P≤0.05)	1.99	6.94	0.28	0.04	2.93

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

In-vitro starch and protein digestibility of cake

The results of *in-vitro* starch and protein digestibility of cake is presented in Table 5.

Table 5: *In-vitro* starch and protein digestibility of cake (on dry matter basis)

	***In-vitro* digestibility**	
Products	**Starch digestibility (mg maltose released/g meal)**	**Protein digestibility (%)**
Cake		
100 % WF	50.63±0.34	73.24±0.03
Type I (WF:SBF:PPP::85:10:5)	49.61±0.14	72.44±0.02
Type II (WF:SBF:PPP::82.5:10:7.5)	48.91±0.14	71.90±0.03
Type III (WF:SBF:PPP::80:10:10)	48.21±0.13	71.35±0.02
CD (P≤0.05)	0.84	0.10

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

The starch and protein digestibility was 50.63 mg maltose released/g meal and 73.24 per cent, respectively in the 100 per cent wheat flour cake which was significantly (p≤0.05) higher than that of value added cakes. The starch and protein digestibility was 49.61 mg maltose released/g meal and 72.44 per cent, respectively for Type I cake. Type II cake had starch digestibility of 48.91 mg maltose released/g meal and protein digestibility of 71.90 per cent while Type III cake had starch digestibility of 48.21 mg maltose released/g meal and protein digestibility of 71.35 per cent. There was a significant (p≤0.05) decrease in the starch digestibility of Type I and Type III cakes from 49.61 to 48.21 mg maltose released/g meal as the level of substitution with pomegranate peel powder increased from 5 to 10 per cent. A significant (p≤0.05) decrease also observed in the protein digestibility of supplemented cakes from 72.44 to 71.35 per cent. The differences in the starch and protein digestibility of control and value added baked products might be due to differences in the starch, protein and antinutrient contents of raw flours and pomegranate peel powder used for product development. Moreover the biological utilization of protein is primarily dependent on its digestibility.

Conclusion

From the present study it may be concluded that organoleptically acceptable value added cake could be developed from wheat and soybean flour blends and pomegranate peel powder. Hence, it is recommended that development of value added products from wheat flour, soybean flour and pomegranate peel powders, which are rich in protein, minerals (iron, zinc, calcium, magnesium and phosphorus) and dietary fibre, should receive concerted attention of the researchers. commercialized and promoted to reach the public to eliminate the malnutrition and hidden hunger. Development and utilization of such multigrain and pomegranate peel powders supplemented baked products will increase the alternative uses of cereals and pulses and also promote use of peel which is usually discarded. Promotion of such products will also play an important role in providing more nutrition, especially to children, and that such products can also serve as functional foods with good health potential.

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