International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2018; 6(4): 1530-1536

Received: 06-05-2018
Accepted: 09-06-2018

Ranjitha J
Dept. of Post-Harvest Technology, College of Horticulture, Bagalkot, Karnataka, India

Bhuvaneshwari G
Dept. of Post-Harvest Technology, College of Horticulture, Bagalkot, Karnataka, India

Deepa Terdal
Dept. of Post-Harvest Technology, College of Horticulture, Bagalkot, Karnataka, India

Vasanth M Ganiger
University of Horticultural Sciences, Bagalkot, Karnataka, India

Correspondence
Ranjitha J
Dept. of Post-Harvest Technology, College of Horticulture, Bagalkot, Karnataka, India

Physico-chemical and sensory characteristics of pomegranate peel powder enriched defatted soy flour fortified cookies

Ranjitha J, Bhuvaneshwari G, Deepa Terdal and Vasanth M Ganiger

Abstract
The study on utilization of pomegranate peel powder (PPP) and defatted soybean flour (DSF) in cookies was undertaken to upgrade the nutritional quality as well as protein deficiency and assess the acceptability. The cookies were prepared from composite flours by incorporating 2.5 and 5 g of pomegranate peel powder with corresponding 25 and 30 g of pomegranate peel powder into refined wheat flour (RWF). The cookies were analyzed for their physical properties, chemical composition and sensory properties. The spread ratio, width and thickness of the cookies decreased from 1.39 to 1.36, 3.71 to 3.28 and 2.66 to 2.41cm with the increase of PPP and DSF in the blends. With the increase in the concentration of PPP and DSF, there was an increase in protein content and decrease in Carbohydrate and calorific value was observed. The Protein content of the cookies supplemented with 5% PPP and 30% DSF was the highest (8.62%). The cookies supplemented with PPP and DSF up to 5% and 30% level were of acceptable sensory quality.

Keywords: Pomegranate peel powder (PPP), defatted soybean flour (DSF), refined wheat flour (RWF)

Introduction
Pomegranate (*Punica granatum* L.) is an ancient favorite table-fruit of the tropical and subtropical regions of the world, belonging to the family Punicaceae. India is the world leading country in pomegranate production is 13.45 lakh tones from an area of 1.93 lakh hectares with a productivity of 11.39 tonnes/ha (NHB data base). Bhagwa variety among all the varieties grown in India is easily available on commercial scale. Pomegranate peels are characterized by an interior network of membranes comprising almost 26-30 per cent of the total fruit weight and are characterized by substantial amounts of phenolic compounds, including flavonoids (anthocyanins, catechins, and other complex flavonoids) and hydrolyzable tannins (punicalin, pedunculagin, punicalagin, galic and ellagic acid). These compounds are concentrated in pomegranate peel and juice which account for 92 per cent of the antioxidant activity associated with the fruit. Gallic acid, ellagic acid and punicalagin, in addition to their free radical scavenging properties, also posses antibacterial activities against intestinal flora, particularly enteric pathogens i.e., *Escherichia coli*, *Salmonella spp*. *Shigella spp.*, as well as *Vibrio cholera* (Negi *et al*., 2003) [17].

Fruits and vegetable processing in India generates substantial quantities of waste and these wastes of fruits are an abundant source of antioxidant and polyphenols among those pomegranate (*Punica granatum* L.) peel, a byproduct of juice processing industries was reported to contain a series of bioactive compounds (tannins, flavonoids and other phenolic compounds), minerals and fibres for a wide range of dietary requirements (Mirdehghan and Rahemi, 2007) [16]. Recycling byproducts or processing waste is of great importance from environmental point of view as well as the health benefits derived from the extracted bioactive compounds. This product may be used as such or after further value addition. Solid and liquid waste recycling is emerging as one of the important areas in research for achieving efficiency in utilization of all the raw material or inputs so as to reduce the cost of production.

The soybean (*Glycine max*) a grain legume, is one of the richest and cheapest sources of plant protein that can be used to improve the diet of millions of people, especially the poor and low income earners in developing countries because it produces the greatest amount of protein used as food by man (Liu, 2000) [15].

Functional foods are the food components that benefits health beyond the basic nutrition. Conventional foods, enriched or enhanced foods, dietary supplements and fortified foods are some of the examples of functional foods. These substances provide essential nutrients often beyond quantities necessary for normal maintenance, growth, development and other biologically active component that impart desirable physiological effects (Drozen and Harrison, 1998) [9]. Baking Industry is considered to be one of the major segments of food processing in India. Baked products have popularities in the populace because of their availability, ready to eat convenience and reasonably good shelf life (Vijaya kumar, 2013) [31]. Cookies are different from other baked products like bread and cakes because of their low moisture content which ensures less chance of microbial spoilage to provide a longer shelf life, making large scale production and distribution possible (Dhankar, 2013) [8].

In the present experiment, different levels of pomegranate peel powder and defatted soybean flour inco rporated to study physico-chemical quality of nutri-enriched cookies.

Materials and Methods

Plant Material

The experiment was conducted in the Dept. of Post-Harvest Technology, College of Horticulture, Bagalkot. Pomegranate fruits of variety Bagwa were procured from farmer's field kaladgi, Bagalkot District. Soybean flour procured from ahmed shopping centre Bangalore. Other ingredients were procured from the local market, Bagalkot.

Productions of pomegranate peel powder

1. **Pre-treatment:** After separation of peel and other waste parts, the peel was cut into pieces by using stainless steel knife and then pre-treated with 2% salt solution for 10 minutes, drained off salt water and washed again with tap water and drained off water peels were spread on stainless steel tray and dried under ceiling fan o remove surface water. These peels were taken for drying.
2. **Process of dehydration to get the pomegranate peel powder:** After pretreatment fresh pomegranate peel was placed in a tray drier at 65 ºC for 10 hr to obtain dried peel. The dried pomegranate peel was crushed by food grinder in to powder form to completely pass through 0.5 mm size sieve. Pomegranate peel powder was packed in HDPE for further chemical analysis and for fortification in cookies with wheat flour.

Standard formulation for preparation of cookies

The standard formula of cookies (Table 1) was used for the preparation of pomegranate peel powder and defatted soybean flour fortified cookies. Only the main ingredient refined wheat flour was replaced with the pomegranate peel powder at 2.5% and 5%, soybean flour at 25% and 30% level.

Treatment details

Table 1: Recipe for pomegranate peel powder and defatted soybean flour fortified cookies

Treatments	Pomegranate peel powder (PPP)	Defatted soybean flour(DSF)	Other Ingredients				
			Maida (g)	Butter (g)	Sugar (g)	Baking powder (g)	Milk powder (g)
T_1 (control)	0%	0%	100	50	50	2	5
T_2	2.5%	25%	72.5	50	50	2	5
T_3	5%	25%	70	50	50	2	5
T_7	5%	30%	65	50	50	2	5

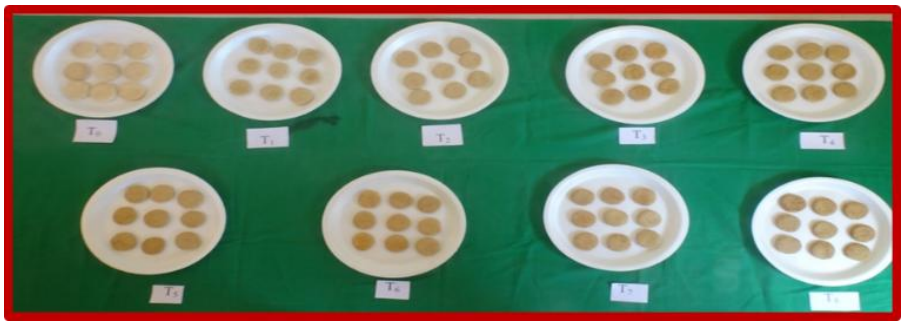

Plate 1: Nutri-enriched cookies fortified with pomegranate peel powder and defatted soybean flour

Plate 2: Sensory evaluation of nutri-enriched cookies

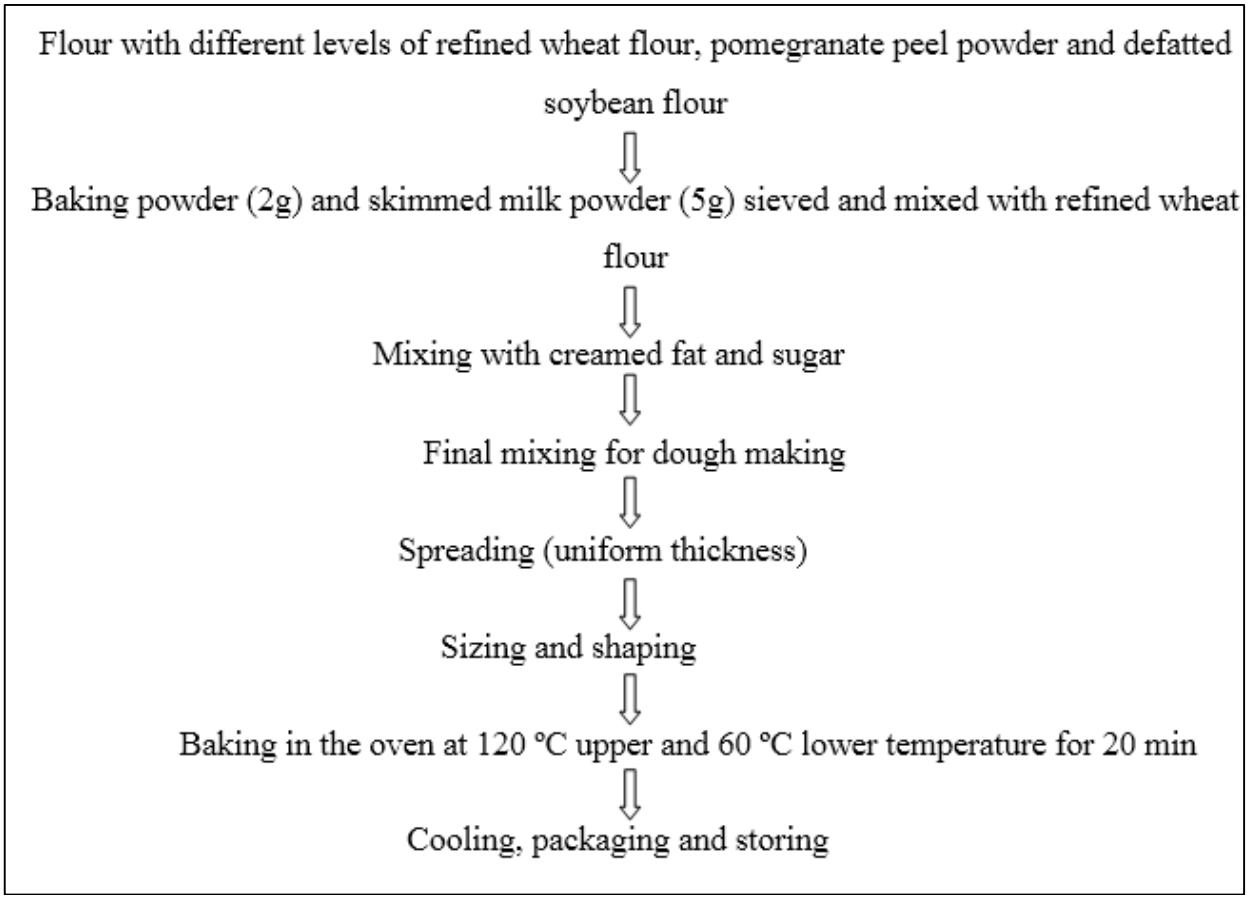

Fig 1: Flow chart for preparation of cookies

Observations Recorded

Thickness (cm)

Thickness of biscuits was measured by stacking six cookies on top of one another and taking average thickness of biscuits in (cm).

Width (cm)

Width of cookies was measured by stacking six cookies edge to edge with the help of scale and again the width of six cookies was re-measured rotating those by 90º. The average value for width was expressed in cm.

Spread ratio

Spread ratio was calculated as the ratio of average value of width (w) to the average value of thickness of cookies.

Protein (%)

Determination of protein content was carried out by micro kjeldhal method which consists of wet digestion, distillation and titration. The protein content was determined by weighing 0.2g of nutri-enriched cookies and transfer to a 250 ml Kjeldahl flask, care to see that no portion of the sample clings to the neck of the flask. To this 1 to 2 g of catalyst mixture (potassium sulphate 100 g and copper sulphate 20 g) and 10 ml of concentrated H_2SO_4 was added. Flask was placed on the stand in the digestion chamber and continue the process of digestion until the colour of the digest is pale green. The digestion mixture was cooled by adding 30 ml of water. After digestion, distillation was carried out by using 40% NaOH and 20% boric acid using methyl orange as an indicator and titrated against 0.1 N H_2SO_4. The protein content was calculated as follows:

$$\text{Nitrogen (\%)} = \frac{14.01 \text{ x ml titrate value of sample x N of } H_2SO_4 \text{ x } 100}{\text{Sample weight (g) x1000}}$$

Protein content was obtained by converting nitrogen to protein by using conversion factor of 6.25

Protein (%) = 6.25 x Nitrogen (%)

Carbohydrate (%)

Carbohydrate content was calculated by differential method (Anon, 1980) [3].

Carbohydrate (g/100 g) =100–[Protein (%) + Fat (%) +Ash (%) + fibre (%) + Moisture (%)].

Calorific value (Kcal /100 g)

Energy was calculated by differential method (Anon, 1980) [3].

Energy (K.cal) = [Protein (g) x 4 + Fat (g) x 9 + Carbohydrates (g) x 4]

Sensory Evaluation

Sensory evaluation of nutri-enriched was carried out by a semi trained panel consisting of Teachers and Post-Graduate students of College of Horticulture, Bagalkot with the help of nine point hedonic rating scale (1 = dislike extremely, 2 = like only slightly, 3 = dislike moderately, 4 = dislike slightly, 5 = neither like nor dislike, 6 = like slightly, 7 = like moderately, 8 = like very much and 9 = like extremely) for colour and appearance, texture, taste, flavour and overall acceptability (Swaminathan, 1974) [29].

Statistical Analysis

The data on sensory evaluation, quality analysis and storage studies of nutri enriched cookies fortified with pomegranate

peel powder and defatted soybean flour was carried out by using Completely Randomized Design (CRD) analysis. Interpretation of data in accordance with Panse and Sukhatme (1985) [20]. The level of significance used in 'F' and't' test was p=0.01. Critical difference values were calculated whenever 'F' test found significant.

Results and Discussion

Width (cm)

The data on width of nutri-enriched pomegranate peel powder and defatted soybean flour fortified cookie was found to be significantly different among the treatments (Table 5). The maximum width of 3.71 cm was recorded in treatment T_1 (100% RWF) cookies followed by T_2 **(**72.5% RWF +2.5% PPP + 25% DSF: 3.44 cm)) and the minimum width was registered in the treatment T_7 (65% RWF + 5% PPP + 30% DSF: 2.85 cm). This might be due to enhancement of fruits and vegetable powder which significantly decreased the width of cookies. It is attributed to the increase in fibre contents due to addition of pomegranate peel powder which is rich source of fibre. Sharif *et al*. (2009) [23] has observed the same trend in fibre and mineral enriched de-fatted rice bran supplemented cookies. They observed a decreasing trend in width from 44.15 to 36.53 mm with increase in rice bran incorporation. Cookies baked from flours with lipids extracted have smaller diameter than those from un-extracted flours. So it can be inferred that due to smaller fat content (1.21%) in sweet potato flour than soft wheat flour (typically 2%). Other study also reported the effect of orange peel powder incorporation on physical, nutritional and sensorial quality of cookies, in that, the average width of control cookies was 58.4 mm whereas, that of orange peel substituted cookies (5-20%) varied from 56.8 to 52.5 mm (Zaker *et al*., 2016) [32].

Perusal of data from Table 1 reveals on thickness of nutri-enriched cookies and observed significant differences by fortification of different levels of pomegranate peel powder and soybean flour. A decreasing trend in thickness of biscuit was found with the increase in level of pomegranate peel powder substitution. Maximum thickness of 1.39 cm was recorded in treatment T_1 (100% Refined wheat flour *i.e.* Control) and the treatment T_2 (72.5% refined wheat flour+2.5% pomegranate peel powder + 25% defatted soybean flour) and T_3 (70% RWF + 5% PPP + 25% DSF**:** 1.36 cm each) were found to be on par with each other. However, minimum thickness was recorded in the treatment T_7 (65% wheat flour + 5% pomegranate peel powder + 30% soybean flour: 1.33 cm). These results are in close conformity with the findings of Singh *et al*. (2008) [27] who studied the effect of incorporating sweet potato flour with wheat flour on quality characteristics of cookies. The similar findings were observed by Ajila *et al*. (2008) [1] In their study, the authors found decrease in diameter and thickness of biscuits with the addition of 15 and 20% mango peel powder which may be due to dilution of gluten in soft dough biscuits with incorporation of mango peel powder.

Cookie spread represents a ratio of diameter to thickness. The results pertaining to spread ratio of pomegranate peel powder and soybean flour fortified cookies (Table 1) showed no significant differences among the treatments. However, the spread ratio decreased due to different levels of pomegranate peel powder and defatted soybean flour with refined wheat flour. The maximum spread ratio (2.66) was recorded in treatment T_1 (100% RWF) *i.e.* Control. The minimum spread ratio (2.14) was found in T_7 (65% RWF + 5% PPP + 30% DSF). Different views are expressed on the mechanism by which the spread ratio of cookies is reduced when wheat flour is supplemented with non-wheat flour (Giami and Bekebain, 2005; Sudha *et al*., 2006) [11, 28]. It has been established that cookies spread is strongly correlated with the water absorption capacities of flours, since the water absorption capacity of non-wheat powders is presumed to be higher than wheat flour and strong water binding characteristics of fibre may also affect the spread ratio of cookies. Rapid partitioning of free water to hydrophilic sites during mixing increases dough viscosity, thereby limiting the cookies spread (Vieira *et al*., 2007; Legesse and Emire, 2012) [14]. The similar results were observed by Zaker *et al*. (2016) [32] also found that the changes in width and thickness are reflected in spread ratio which was 8.94 mm for control cookies, and further these values was decreased to 7.94 in orange peel powder cookies.

Table 1: Influence of pomegranate peel powder and defatted soybean flour on Physical characteristics of nutri-enriched cookies

Treatments		Width (cm)	Thickness (cm)	Spread ratio
T_1	: 100% RWF	3.71	1.39	2.66
T_2	: 72.5% RWF + 2.5% PPP + 25% DSF	3.44	1.36	2.51
T_3	: 70% RWF + 5% PPP + 25% DSF	3.16	1.36	2.32
T_7	: 65% RWF + 5% PPP + 30% DSF	2.85	1.33	2.14
Mean		3.28	1.36	2.41
SEm ±		0.042	0.024	0.037
CD at 1%		0.15	0.04	0.14

The above treatments includes the following ingredients in common

Sugar :50	Hydrogenated fat : 50g	
Milk powder :5g	Baking powder : 5g	
RWF: Refined wheat flour	PPP: Pomegranate peel powder	DSF: defatted soybean flour

Total carbohydrate (%) and calorific value (Kcal/100 g)

Significantly lowest total carbohydrate (40.38%) was observed in treatment T_7 (65% refined wheat flour + 5% pomegranate peel powder + 30% defatted soybean flour) and the maximum carbohydrate content (53.76%) was recorded in the treatment T_1 cookies with 100 per cent refined wheat flour (Table 2). The lower values for carbohydrate in T_7 was due to incorporation of pomegranate peel powder and soybean flour where they are dense with other nutrients *viz.*, protein, fat, crude fibre and ash than the T_1 cookies (control). Similarly the carbohydrate content of the WF/SF blends decreased with the increasing concentration of soybean flour (SF). This was in close conformity with Okoye *et al.*, (2008) [19] in wheat and soybean flour blended biscuits and the similar results of decreasing carbohydrate content have been reported by several workers [Ojha and Thapa, 2017) [11] in study of mandarin peel powder fortified biscuits; Hanan and Rasha (2012) [12] in nutritional assessment of wheat biscuits and fortified wheat biscuits with citrus peels powders;

Significantly minimum calorie content of 407.44 Kcal/100 g was recorded in the treatment T_7 (65% Refined wheat flour + 5% pomegranate peel powder + 30% defatted soybean flour fortified cookies) and it was found to be on par with all other treatments except treatment T_1 (418.63 Kcal/100 g) with 100% refined wheat flour cookies (Table 2). Significantly highest calorific value in control may be due more per cent of carbohydrate along with protein and fat. Whereas, low calorific value in pomegranate peel powder and soybean flour might be due more percentage of ash and crude fibre which does not add any calories. So, the cookies of the present study were having low calorific value with high protein and crude fibre. The findings of the present study are well supported by Gamal *et al*. (2012) [10] in nutritional quality of biscuit supplemented with wheat bran and date palm fruits, as the levels of mixture increased the caloric value decreased in biscuits; Dayanand *et al*. (2012) [7] reported in studies on development of high protein-low calorie cookies in that the calorific value of cookies was found to be decrease from 505.73 to 454.23 kcal/100 g with the substitution of Maida with DSF (defatted soyflour) and Sugar with SLP (Stevia leaves powder); Bazilla *et al*. (2012) [4] in carrot pomace powder enriched defatted soyflour fortified biscuits.

Protein Content (%)

Significantly higher protein (8.62%) was found in the treatment T_7 (65% Refined wheat flour + 5% pomegranate peel powder + 30% defatted soybean flour) and the minimum protein content was recorded in the treatment T_1 (3.34%) with 100% refined wheat flour cookies (Table 2). This was due to incorporation of defatted soya flour which is rich in protein (40.2%) as compared to cookies prepared with refined wheat flour alone. Soybean is an excellent source of protein and complement to lysine-limited cereal protein. Addition of soy flour improves the quantity and quality of protein content of the food product, thereby has the great potential in combating with protein energy malnutrition. Similar results of increasing protein content in fruits and vegetable powders fortified cookies have been reported by several workers. Increase in the protein content in the fortified cookies with increase in the levels of fortification was reported by Paul and Bhattacharyya (2015) [21, 22] in study of cookies fortified with juice and pomegranate peel powder. Okoye *et al*. (2008) [19] reported that the biscuits produced from blends with higher concentrations of soybean flour contained more protein than the ones made from blends containing less proportion of soybean flour. The similar results were also reported by Sindhu *et al*. (2016); Chandra and Mishra (2012); Singh *et al*., (2012) [25, 26].

Table 1: Effect of fortification of pomegranate peel powder and defatted soybean flour on Physical properties of nutri-enriched cookies

Treatments		Protein (%)	Carbohydrate (%)	Calorific value (Kcal / 100 g)
T_1	: 100% RWF	3.34	53.76	418.63
T_2	: 72.5% RWF + 2.5% PPP + 25% DSF	6.90	45.80	407.44
T_3	: 70% RWF + 5% PPP + 25% DSF	7.34	44.38	410.89
T_7	: 65% RWF + 5% PPP + 30% DSF	8.62	40.38	407.44
Mean		6.55	46.08	411.10
SEm ±		0.097	0.230	1.204
CD at 1%		0.41	0.95	4.98

The above treatments includes the following ingredients in common

Sugar :50	Hydrogenated fat : 50g	
Milk powder :5g	Baking powder : 5g	
RWF: Refined wheat flour	PPP: Pomegranate peel powder	DSF: defatted soybean flour

Sensory Evaluation

The evaluation of sensory quality of a product is very important tool for deciding the consumer acceptability. Human elements play an important role in evaluation of organoleptic characters of a product. For a new product, the consumer acceptability needs to be evaluated first at laboratory level. The results of organoleptic evaluation (Fig 2) indicated that the cookies fortified with 65% Refined wheat flour + 5% pomegranate peel powder + 30% defatted soybean flour (T_7) scored better than other treatments for all the four organoleptic parameters except taste. Another recipe of cookies T_2 was on par with T_7. Flavour is the combined perception of taste, odour and mouth feel (Benoit, 2004). It appears that the highly acceptable flavour, colour and texture and overall acceptability might have been achieved in the treatment T_7 (65% RWF + 5% PPP + 30% DSF) and the lower organoleptic scores were recorded in T_3 (70% RWF + 5% PPP + 25% DSF) may be due to astringency flavour of phenolic content reduced the flavor. Similar results were reported by Ismail *et al*. (2014) in pomegranate peel powder supplemented cookies who reported improvement of crude fibre contents in pomegranate peel powder supplemented cookies, might have a featured product hardening property imparting characteristic sensorial score decline. Addition of PoP at 6 per cent level did not manifest any undesirable organoleptic response and the product remained acceptable below 7.5 per cent supplementation. Bazilla *et al*. (2012) [4] observed the mean overall sensory acceptability scores of more than 8.50 for biscuit samples incorporated upto 5% carrot pomace powder indicated the commercial scope for manufacturing good quail vegetarian biscuits with carrot pomace powder and defatted soyflour.

Conclusion

The composition of [T_7: 65% RWF + 5% PPP + 30% DSF] was found nutritionally superior as well as recorded highest score in sensory properties and it can be concluded that the substitution of wheat flour with pomegranate peel powder up to 5 per cent with 30% defatted soybean flour into the formulation of cookies enhanced the Physico-chemical properties as well as sensory properties.

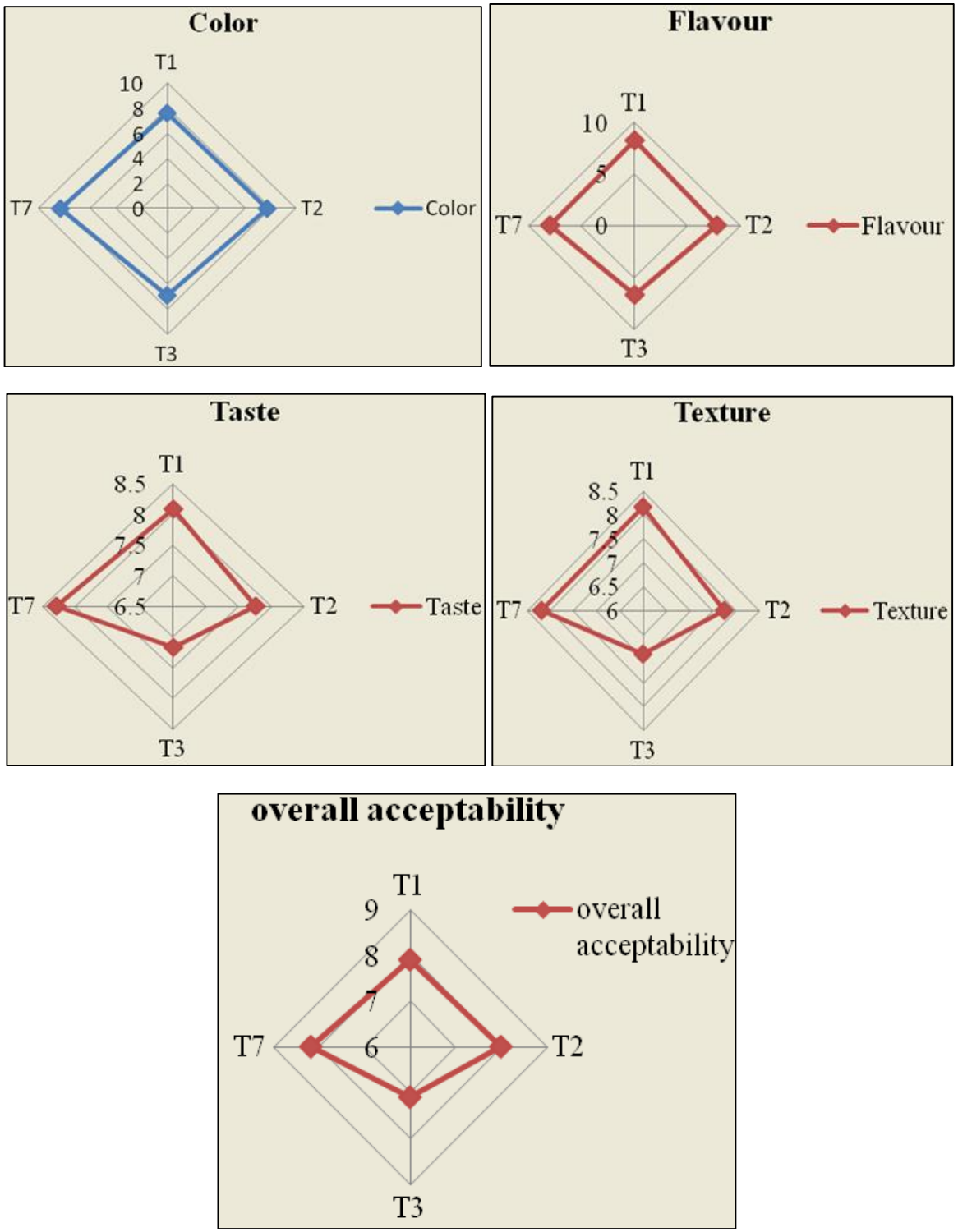

Fig 2: Effect of fortification of pomegranate peel powder and defatted soybean flour on sensory evaluation of nutri-enriched cookies

T_1: 100% RWF
T_2: 72.5% RWF +2.5% PPP + 25% DSF
T_3: 70% RWF + 5% PPP + 25% DSF T_7: 65% RWF + 5% PPP + 30% DSF
*: Score out of 9

References

1. Ajila CM, Leelavathi K, Prasada Rao UJS. Improvement of dietary fiber content and antioxidant properties in soft dough biscuits with the incorporation of mango peel powder. J Cereal Sci. 2008; 48:319-326.
2. Anonymous. Indian Horticulture Database. National Horticulture Board, 2017.
3. Anonymus. Official Methods of Analysis, 13th edition, Association of Official Analytical Chemists, Washington. DC, 1980.
4. Bazilla G, Rama NS, Beena MK. Physico - chemical and sensory characteristics of carrot pomace powder enriched defatted soyflour fortified biscuits. International J. Scientific Res. Publications. 2012; 2(8):2250-3153.
5. Benoit R. Sensory evaluation techniques. Handbook of Food Analysis. 2004; 1:21-39.
6. Chandra R, Mishra N. Development of functional biscuit from soy flour and rice bran. Int. J Agric. Food Sci. 2012; 2(1):14-20.
7. Dayanand P, Pagar NY, Revathy M. Studies on development of high protein-low calorie cookies.

International J Current Res. Review. 2012; 4(23):677-683.
8. Dhankar P. A study on development of coconut based gluten free cookies. Int. J Engg. Sci. Invent. 2013; 2:10-19.
9. Drozen M, Harrison T. Structure function claims for functional foods and Nutraceutical world. J Food Sci. Technol. 1998; 1:18-2.
10. Gamal AE, Salah MA, Mutlaq MA. Nutritional quality of biscuit supplemented with wheat bran and date palm fruits (*Phoenix dactylifera* l.). Food. Nutrition Sciences. 2012; 3:322-328.
11. Giami SY, Bekebain DA. Proximate composition and functional properties of raw and processed full –fat fluted pumpkin (*Telfaria accidentalis*) seed flour. J Sci. Food Agric. 2005; 59:321-325.
12. Hanan MKEY, Rasha MAM. Nutritional assessment of wheat biscuits and fortified wheat biscuits with citrus peels powders. Food and Public Health. 2012; 2(1):55-60.
13. Ismail T, Akhtar S, Riaz M, Ismail M. Effect of pomegranate peel supplementation on nutritional, organoleptic and stability properties of cookies. International J Food Sci. Nutri. 2014, 1-6.
14. Leggese MB, Emire SA. Functional and physicochemical properties of mango seed and kernels and wheat flour and their blends for biscuit production. African J Food Sci. 2012; 3(9):193-203.
15. Liu K. Expanding soybean food utilization. J Food Technol. 2000; 54(7):46-47.
16. Mirdehghan SH, Rahemi M. Seasonal changes of mineral nutrients and phenolics in pomegranate (*Punica granatum* L.) fruit. Sci. Horticulture. 2007; 111:120-127.
17. Negi PS, Jayaprakasha GK, Jena BS. Antioxidant and antimutagenic activities of pomegranate peel extracts. Food Chem. 2003; 80:393-397.
18. Ojha P, Thapa S. Quality evaluation of biscuit incorporated with mandarin peel powder, Sci. Study and Res. Chem. Chemical Eng. Biotech. Food Industry, 2017; 18(1):19-30.
19. Okoye JI, Nkwocha AC, Ogbonnaya AE. Production, proximate composition and consumer acceptability of biscuits from Wheat/Soybean flour blends. Continental J Food Sci. Technol. 2008; 2:6-13.
20. Panse VG, Sukhatme PV. Statistical Mehods for Agriculture Workers, Indian Council of Agriculture research, New Delhi, 1985.
21. Paul P, Bhattacharyya S. Antioxidant profile and sensory evaluation of cookies fortified with juice and peel powder of fresh pomegranate (*Punica granatum).* International J. Agri. Food Sci. 2015; 5(3):85-91.
22. Paul P, Bhattacharyya S. Antioxidant profile and sensory evaluation of cookies fortified with juice and peel powder of fresh pomegranate (*Punica granatum).* International J Agri. Food Sci. 2015; 5(3):85-91.
23. Sharif KM, Butt SM, Anjum FM, Nawaz H. Preparation of fiber and mineral enriched defatted rice bran supplemented cookies. Pakistan. J Nutri. 2009; 8(5):571-577.
24. Sindhu HL, Shweta Saloni, Harshavardhan K, Mounika B, Kalyani D, Pavankumar NS. *Et al*. Development of biscuit incorporated with defatted soya flour and carrot pomace powder. J Environ. Sci. Toxico. Food Technol. 2016; 10(3):27-40.
25. Singh A, Rana I, Sahi NC, Lohani UC, Khan Chand. Optimization of process variables for preparation of apple pomace - black soyflour based biscuits. Int. J. Food Agric. Veterinary Sci. 2012; 2(1):101-106.
26. Singh A, Rana I, Sahi NC, Lohani UC, Khan Chand. Optimization of process variables for preparation of apple pomace - black soyflour based biscuits. Int. J Food Agric. Veterinary Sci. 2012; 2(1):101-106.
27. Singh SCS, Riar SC, Saxena CD. Effect of incorporating sweet potato flour to wheat flour on the quality characteristics of cookies. African J Food Sci. 2008; 2: 65-72.
28. Sudha ML, Srivastava AK, Veterimani R, leelavathi M. Fat replacement in soft dough biscuits: Its implications on dough rehelogy and biscuit quality. J Food Sci. Technol. 2006; 30:35-43.
29. Swaminathan M. Essentials of Food and Nutrition, Ganesh and Co. madras. 1974, 498.
30. Vieira MA, Tramonte R, Podest SRP, Avancini RD, Amboni MC, Amante ER. Physicochemical and sensory characteristics of cookies containing residues from king palm B. V. Processing. Int. J Food Sci. Technol. 2007; 43:1534-1540.
31. Vijayakumar MC, Peter D, Bobde H, John SM. Quality characteristics of cookies prepared from oats and finger millet based composite flour. Engg. Sci. Technol. Int. J. 2013; 3:677-683.
32. Zaker MA, Sawate AR, Patil BM, Sadawarte SK. Studies on effect of orange peel powder incorporation on physical, nutritional and sensorial quality of cookies. Int..J. Eng. Res. Technol. 2016; 5(9):2278-2281.