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Development of Buckwheat Cookies Supplemented with Wheat Flour

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Abstract. The present study was conducted to develop buckwheat cookies supplemented with wheat flour. Buckwheat and wheat flour were examined for their proximate composition. Buckwheat flour contained 11.6% moisture, 15.79% crude protein, 1.81% crude fat, 1.83% ash, 0.70% crude fibre content and 68.27% NFE, while wheat flour contained moisture content 13.12%, crude fibre content 1.93%, crude fat 1.42%, crude protein content 12.53%, ash content 1.57% and 69.43% NFE, respectively. Wheat flour was incorporated into buckwheat flour at 10, 20, 30, 40 and 50% ratio to make composite flour and the developed cookies were analysed for quality evaluation. Supplementation of wheat flour significantly influenced the proximate and mineral composition of buckwheat flour based cookies. Moisture contents, crude fibre contents and NFE (Nitrogen Free Extract) increased, whereas crude fat, crude protein and ash contents decreased. Mineral contents (Fe, Ca, K, Zn and Mg) of developed buckwheat cookies decreased with increase in wheat flour supplementation levels. Sensory characteristics of supplemented cookies increased with increase in supplementation levels of wheat flour and were acceptable by judges in terms of test, colour, texture and overall acceptability. Cookies developed from C 50% C supplementation level of wheat flour got maximum scored points while C_0 control C_0 was found to be more nutritious and gluten free having more crude protein and mineral contents when compared to supplemented cookies.

Keywords: buckwheat cookies, chemical quality, sensory quality, wheat flour

Introduction

Cookies and biscuits are very vital bakery products. Both are liked and eaten by all age groups especially school going kids who need more energy like proteins per unit body weight when compared to adults (Shahzad *et al*., 2006). These are ideal for availability of essential nutrients. The term cookies comes from the Dutch word koekje (little cake) and the name biscuit is the Latin word which means biscoctum (Macrae *et al*., 1993). Cookies and biscuits are different from other bakery items such as cakes and bread because these contain lower moisture contents as compared to other bakery foods and are relatively free from microbial spoilage and have longer shelf life (Wade, 1988). Cookies are prepared by supplementing different low priced sources like pulses and legumes flour with wheat flour (Akubor and Onimawo, 2003). In supplementation, proteins giving constituent for biscuits should have sweet flavour, high protein efficiency ratio and low water absorption capacity. It should neither have negative influence on the dough spread ratio and texture nor cause any significant changes in the consistency of dough (Lorenz, 1983). The challenge of selecting the best-suited protein source has made the baking factory to examine such components that assign desirable functional and nutritional characteristics to the baked items (Tyagi *et al*., 2007). Common buckwheat *Fagopyrum esculentum* Moench (sweet buckwheat) is a broad leafy herbaceous crop that belongs to the family Polygonaceae. Its seeds structurally and chemically resemble that of wheat grains; therefore, it is considered as pseudo cereal. It originated from East Asia and then shifted into European countries in the 15th century. The cultivation of this miracle crop has spread to many other countries of the world such as The United States of America, Canada, China, Latin America and Africa, with an

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annual production of about one million tonnes (Eggum *et al*., 1980; Pomeranz and Robbins, 1972).

There are various species of buckwheat grown throughout the world, but only nine of them have nutritional and agricultural value (Krkoskova and Mrazova, 2005). Mostly, two types of buckwheat (Common buckwheat and Tartary buckwheat) are used as a source of food throughout the world. These two species of buckwheat are cultivated in mountainous regions of Pakistan, mostly in Gilgit-Baltistan at the area of 948 hectares with an annual production of 1798 metric tonnes (SSR, 2007). Because of high nutritional and medicinal value, its production has been increased in recent years. Being gluten free, it has medicinal value and is used in gluten free food preparation for those who have gluten allergy (celiac patients) (Bonafaccia *et al*., 2003). It is naturally gluten free and contains various kinds of essential nutrients including easily digestible protein, starch, essential minerals (Zn, Fe, K, Ca, Mg, Mn, and Cu), amino acids (lysine) and rutin. It is low in saturated fat, sodium, and cholesterol (Bonafaccia *et al*., 2003). Common buckwheat that is mostly consumed can be compared to other species because it is sweet in taste and easy to dehul unlike tartary buckwheat that has bitter taste and is small in seed size with tough seed coating hence, it is hard to dehull (Jiang *et al*., 2007). Buckwheat is an excellent source of micronutrients like potassium, manganese, copper, iron, and zinc (Ikeda and Yamashita, 1994). In contrast with cereals, buckwheat contained more crude protein, high in lysine content and gluten free that makes it important from medicinal and nutritional viewpoint. Therefore, it is used to prepare an alternate gluten free food for celiac patients (Javornik and Kreft, 1984; Eggum, 1980). Buckwheat foodstuffs are considered as a good nutritional and medicinal value food (Bonafaccia and Kreft, 1998; Mazza, 1989). It has been reported that there is high concentration of amino acid in buckwheat (Kato *et al*., 2001; Liu *et al*., 2001).

Present experiment was therefore conducted to develope buckwheat cookies supplemented with wheat flour to determine the level of buckwheat and to evaluate the gluten free biscuits for patients.

Materials and Methods

The present research work was carried out at (PCSIR) Pakistan Council of Scientific and Industrial Research Laboratories, Skardu during 2012-2013.

Collection of raw materials. Common buckwheat (sweet) *Fagopyrum esculentum* and wheat flour were selected for the development of buckwheat cookies. Whole buckwheat was procured from District Ghancha Baltistan while wheat flour, sugar, industrial fat and other ingredients used in cookies preparation were purchased from local market and brought to PCSIR (Pakistan Council of Scientific and Industrial Research) Laboratory, Skardu. Dehulling and milling of buck wheat was conducted to obtain flour. The hulls were removed through blower to obtain dehulled buckwheat. The dehulled grains were milled by using laboratory mill. The flour was sealed in polyethylene bags and stored in refrigerator for further use.

Preparation of buckwheat cookies. according to the official method of AACC (2000) different % level (10, 20, 30, 40, and 50) of wheat flour were prepared for buckwheat. The recipe used to prepare buckwheat cookies is shown in Table 1.

Proximate composition. Proximate composition includes moisture, crude protein, crude fat, crude fibre, ash and nitrogen free extract. Moisture occurred by oven dehydration method at 105 °C up to constant weight. Crude protein was evaluated by using Kjeldhal method and crude fat extracted by ether extraction method using Soxhlet apparatus. Crude fibre was known through acid digestion and alkali digestion method. Ash content was determined in muffle furnace at 550 °C for 6 h. For all these determinations powdered and oven dried samples were used in triplicate in accordance with standard procedures. NFE was calculated by difference (AACC, 2000).

Mineral estimation. The developed buckwheat cookies were analysed for minerals (Ca, Fe, Zn, K and Mg) through wet digestion. Iron, calcium, magnesium and zinc contents were calculated by using atomic absorption spectrophotometer, while potassium was estimated by

Table 1. Ingredients used in cookies preparation

Ingredients	Weight (g)
Flour	500
Sugar	250
Industrial fat	250
Baking powder	6.50
Salt	0.040
Egg	1

the use of flame photometer; according to the recommended method of AACC (2000).

Minerals (Fe, Zn, Ca and Mn) were calculated in cookies. About 1 g of finely ground sample was kept in digestion tube and 10 mL concentrated nitric acid was added and kept at room temperature overnight. Then the mixture was treated with 4 mL concentrated perchloric acid and sample was kept on magnetic hot plate for digestion. The process was completed in about 1-2 h. The sample was then allowed to cool down to room temperature, transferred to 200 mL volume flask and filtered by using filter paper. The volume of sample in flask was made up to 100 mL with distilled water and absorbance was estimated through atomic absorption spectrophotometer (Model GBC 932 PLUS, UK).

Sensory evaluation. Supplemented buckwheat cookies were sensory evaluated in terms of taste, colour, texture and overall acceptability by presenting developed cookies to a panel of six judges using 9 points hedonic scale as recommended by Larmond (1977).

Statistical analysis. The data achieved from different treatments were statistically evaluated in MSTAT-C software using completely randomized design (CRD) and least significant difference (LSD) test (at 5% level of significance) to separate means according to the method described by Steel and Torrie (1997).

Results and Discussion

The product was prepared using different ratios of ingredients in different trials. The samples were analysed for their proximate (crude fat, ash, crude fibre, crude protein, moisture and NFE (nitrogen free extract) contents and mineral composition (iron, zinc, magnesium, calcium and potassium). The developed buckwheat cookies were presented to a panel of six expert judges for estimation of organoleptic characteristics according to 9 point hedonic scale.

Proximate composition of buckwheat flour and wheat flour. Buckwheat (common buckwheat) flour and wheat flour used in the present research work were investigated for their chemical composition. Percentage chemical compositions are presented in Table 2.

The data shows that buckwheat flour contained 11.6% moisture, 15.79% crude protein, 1.81% crude fat, 1.83% ash, 0.70% crude fibre content and 68.27% NFE. These results are in close conformity with the outcomes of Bonafaccia *et al*. (2003), who confirmed that buckwheat flour contained 7.89 to 10% moisture, 10.23 to 17% crude protein, 1.3 to 2.8% ash, 1.1 to 3.5% crude fat, 0.7 to 1.8% crude fibre and 64 to 73% NFE (Bilgicli, 2009; Fessas *et al.* 2008). Buckwheat flour contained 8.5 to 19% of crude protein content depending on the variety, fertilizer and pesticides used that probably affect the overall concentration of buckwheat protein contents (Fornal, 1999). Data shows that wheat flour contained 13.12% moisture, 12.53% crude protein, 1.42% crude fat, 1.93% crude fibre, 1.57% ash content and NFE 69.43%. These outcomes are in close agreement with the study of Wahab (2001), who reported that wheat flour contain 7.38% moisture, 10.40% protein, 2.15% crud fat, 2.80% crude fibre, 1.47% ash and 75.80% NFE. Similar result are also reported in the outcomes of Ahmad *et al*. (2005) who examined that commercially available flour contained 9.95-11.58% moisture, 0.52-0.68%, ash, 0.94-1.51% fat, 10.32-11.58% protein, 0.40-0.60% crude fibre and 74.62-77.74% NFE.

Table 2. Proximate composition of buckwheat flour and wheat flour

Sample type	Moisture	Crude protein	Crude fat	Crude fibre	Ash	NFE
			%			
Buck-wheat flour	11.60	15.79	1.81	0.70	1.83	68.27
Wheat flour	13.12	12.53	1.42	1.93	1.57	69.43

NFE = nitrogen free extract.

Proximate composition of different treatments of developed buckwheat cookies. The products prepared with different formulations were analysed for proximate composition. The data is shown in Table 3.

Moisture content. Analysis of variance showed that supplementation with wheat flour had significant effect on moisture content of common buckwheat flour based cookies. Data reveals that moisture content of supplemented buckwheat cookies increased with increase incorporation of wheat flour. High moisture content of supplemented cookies may be credited to high moisture content of wheat flour in contrast to buckwheat flour. This may be due to relatively higher amount of fibre content in wheat flour than that of common buckwheat flour. The results achieved are in complete confirmation with the finding of Eastwood (1986), who reported that

Table 3. Proximate composition of different treatments of developed buckwheat cookies

Treat-ments	Mois-ture	Crude fat	Crude fibre	Crude protein	Ash content	NFE
C_0	2.88^d	24.44^a	0.72^e	15.87^a	1.70^a	54.39^f
C_1	3.08^c	24.24^b	0.88^d	15.31^b	1.59^{ab}	54.91^e
C_2	3.16^{bc}	24.10^{bc}	1.01^c	14.99^c	1.50^b	55.24^d
C_3	3.27^b	23.96^c	1.16^b	14.67^d	1.33^c	55.61^c
C_4	3.42^a	23.79^d	1.29^a	14.37^e	1.05^d	56.08^b
C_5	3.50^a	23.68^d	1.35^a	13.93^f	0.95^d	56.59^a

C_0 = Control 100% common buckwheat flour; C_1 = 90% buckwheat + 10% wheat flour; C_2 = 80% buckwheat + 20% wheat flour; C_3 = 70% buckwheat + 30% wheat flour; C_4 = 60% buckwheat + 40% wheat flour; C_5 = 50% buckwheat + 50% wheat flour; NFE = nitrogen free extract.

the incorporation of rice bran and wheat in bakery products preparation retain more moisture in developed products because of the existence of cellulose and hemicellulose. Other researchers (Pflaumer *et al*., 1990; French and Hill, 1988) also reported that the incorporation of guar gum and CMC hold more moisture amount in baked products because of their high water holding capacity.

Crude protein content. Significant differences were examined in protein content of buckwheat flour based cookies. Data indicates that protein content of wheat flour supplemented buckwheat cookies decreased with increase in wheat flour incorporation. The mean crude protein content results of test cookies were C_0 (15.87%), C_1 (15.30%), C_2 (14.99%), C_3 (14.67%), C_4 (14.37%) and C_5 (13.93%). The highest mean value (15.87%) was recorded in C_0, while lowest mean value (13.93%) in C_5 (Table 3). High protein content of supplemented cookies may be credited to high protein content of common buckwheat flour contrasted to wheat flour. The outcomes achieved are in confirmation with the results of Baljeet *et al.* (2010) who reported a decrease in crude protein content with increase in a mixture of different flours from cereal, legume, or root crops that is created to satisfy specific functional characteristics and nutrient composition. This work also supported the finding of Dhingra and Jood (2001) who reported a decrease in the crude protein.

Crude fat content. Supplementation of wheat flour significantly influenced the crude fat content of common buckwheat flour based cookies. Data explained that crude fat content of wheat flour supplemented buckwheat cookies decreased with gradual increase in wheat flour incorporation. The mean crude fat content results of test cookies were (24.44%), C_1 (24.24%), C_2 (24.08%), C_3 (23.96%), C_4 (23.79%) and C_5 (23.68%). The highest mean value (24.44%) was recorded in C_0, while lowest mean value (23.68%) in C_5 (Table 3). Higher crude fat content may be credited to high crude fat content of wheat flour contrasted to buckwheat flour. The outcomes of the study are in agreement with the results of Khan *et al.* (2012) who estimated decreasing fat contents in gluten free ready to serve buckwheat product (1.01%), (0.71%), (0.59%), (0.59%) and (0.34%). It is clear that by the addition of buckwheat flour, fat contents also increased.

Crude fibre content. Supplementation of wheat flour significantly affected the crude fibre content of common buckwheat flour based cookies. It is found from the results that crude fibre content of wheat flour supplemented buckwheat cookies increased with gradual increase in wheat flour incorporation. The mean crude fibre content results of test cookies were C_0 (0.72%), C_1 (0.88%), C_2 (1.01%), C_3 (1.16%), C_4 (1.29%) and C_5 (1.35%). The highest mean value (1.35%) was recorded in C_5, while lowest mean value (0.72%) in C_0 (Table 3). High crude fibre content of supplemented biscuits may be credited to higher crude fibre in wheat flour in contrast to buckwheat flour. The present data achieved are in complete confirmation with the findings of Baljeet *et al.* (2010), who observed that incorporation of buckwheat flour had significant effect on crude fibre content. Hooda and Jood (2005) reported similar result on increase in dietary fibre with 10% replacement of wheat flour with fenugreek flour. Our findings also agree with the study of Hamid and Luan (2000) and French and Hill (1988), who found that incorporation of CMC in baked biscuits had significant effect.

Ash content. Supplementation of wheat flour significantly affects the ash content of common buckwheat flour based cookies. From the result it is found that ash content of buckwheat cookies decreased with gradual increase in wheat flour incorporation. The mean ash content results of test buckwheat cookies were C_0 (1.70%), C_1 (1.59%), C_2 (1.50%), C_3 (1.33%), C_4 (1.05%) and C_5 (0.95%). The highest mean value (1.70%) was recorded in C_0, whereas lowest mean value was found in C_5 (0.95%) as shown in Table 3. Decrease in ash content of supplemented buckwheat cookies with the increase in incorporation level of wheat flour is evidently due to the presence of higher ash content in buckwheat flour when compared to wheat flour. The outcomes achieved are contrary to the finding of Rani *et al.* (2008), where the addition of soya bean flour resulted in increased ash content in biscuits developed from wheat flour. Ndife *et al.* (2011), also points out an increase in ash content in whole wheat flour based bread with increase in different supplementation levels of soybean flour. These are contrary to the findings of the present studies.

Nitrogen free extract (NFE). Supplementation of wheat flour had significant effect on nitrogen free extract contents of common buckwheat flour based cookies. The findings shows that carbohydrate content of buckwheat cookies increased with gradual increase in wheat flour incorporation. The mean carbohydrate content of test cookies were C_0 (54.39%), C_1 (54.91%), C_2 (55.24%), C_3 (55.61%), C_4 (56.08%) and C_5 (56.59%). The highest mean value (56.59%) was observed in C_5, while lowest mean value was found in C_0 (54.39%) as shown in Table 3. Increase in nitrogen free extract (NFE) was observed when the supplementation with wheat flour increased. It might be due to the fact that common buckwheat contains higher crude protein content, ash content and crude fat than that of wheat flour, thus as the supplementation level of common buckwheat decreased, NFE increased. The results achieved are in complete confirmation with the results of Balajeet *et al.* (2010), reporting increase in the NFE content by the addition of buckwheat in wheat supplemented flour.

Mineral composition of different treatments of developed buckwheat cookies. The products prepared with different supplementation levels of wheat flour were analysed for proximate mineral composition. The data is shown in Table 4.

Table 4. Mineral composition of different treatments of developed buckwheat cookies

Treat-ments	Iron	Zinc	Calcium	Potassium	Magnesium
			(mg/100 g)		
C_0	20.35^a	3.36^a	50.89^a	695.33^a	368.33^a
C_1	18.65^b	3.25^b	48.19^b	661.67^b	347.67^b
C_2	17.20^c	3.15^c	46.70^c	634.33^c	337.00^b
C_3	15.77^d	3.09^c	44.95^d	593.67^d	315.00^c
C_4	14.02^e	2.97^d	44.27^e	564.00^e	300.33^d
C_5	12.27^f	2.94^d	43.77^f	535.67^f	281.33^e

C_0 = Control 100% common buckwheat flour; C_1 = 90% buckwheat + 10% wheat flour; C_2 = 80% buckwheat + 20% wheat flour; C_3 = 70% buckwheat + 30% wheat flour; C_4 = 60% buckwheat + 40% wheat flour; C_5 = 50% buckwheat + 50% wheat flour.

Potassium content. Supplementation of wheat flour significantly effect potassium (K) content of common buckwheat flour based cookies. Data disclosed that potassium content of wheat flour supplemented buckwheat cookies decreased with gradual increase of wheat flour incorporation. The mean potassium content results of test cookies were as mg/100 g C_0 (695.33), C_1 (661.67), C_2 (634.33), C_3 (593.67), C_4 (564.00) and C_5 (535.67). The highest mean value (695.33 mg/100 g) was recorded in C_0, while lowest mean value (535.67 mg/100 g) in C_5 (Table 4). High potassium content of supplemented cookies may be credited to high potassium content of buckwheat flour contrasted to wheat buckwheat flour.

Calcium content. Supplementation of wheat flour significantly effect calcium (Ca) content of common buckwheat flour based cookies. Results obtained showed that calcium content of wheat flour supplemented buckwheat cookies decreased with gradual increase of wheat flour incorporation. The mean calcium content results of test cookies were as mg/100 g C_0 (50.89), C_1 (48.19), C_2 (46.70), C_3 (44.95), C_4 (44.27) and C_5 (43.77). The highest mean value (50.89 mg/100 g) was recorded in C_0, while lowest mean value (43.77 mg/100 g) in C_5 (Table 4). Decrease in calcium content of supplemented buckwheat cookies may be credited to high calcium content of buckwheat flour contrasted to wheat flour.

Iron content. Supplementation of wheat flour significantly effect iron (Fe) content of common buckwheat flour based cookies. Results showed that iron content of wheat flour supplemented buckwheat cookies decreased with gradual increase of wheat flour incorporation. The mean iron content results of test cookies were as mg/ 100 g C_0 (20.35), C_1 (18.65), C_2 (17.20), C_3 (15.77), C_4 (14.02) and C_5 (12.27). The highest mean value (20.35 mg/100 g) was recorded in C_0, while lowest mean value (12.27 mg/100 g) in C_5 (Table 4). High iron content of supplemented biscuits may be credited to high iron content of buckwheat flour contrasted to wheat flour. The end results achieved are in complete confirmation with the findings of Khan *et al.* (2012). Kashlan *et al.* (1991) also reported that during baking significant loss of most of minerals such as iron content was found when baked bread was compared to wheat flour.

Zinc content. Supplementation of wheat to common buckwheat flour based cookies had significant ($p<0.005$) effect on zinc (Zn) content. It was observed that zinc content decreased with gradual increase in wheat flour supplementation levels. The mean results of test cookies were as mg/100 g C_0 (3.36), C_1 (3.25), C_2 (3.15), C_3 (3.09), C_4 (2.97) and C_5 (2.94). The highest mean value (3.36 mg/100 g) was recorded in C_0, while lowest mean value (2.94 mg/100 g) was in C_5 (Table 4). Khan *et al.* (2005) and Steadman *et al*. (2001) noticed increase in zinc contents with increase in the addition of buckwheat flour to wheat flour bur contrasting results are observed in the present study.

Magnesium content. Supplementation of wheat flour significantly affected magnesium (Mg) content of common buckwheat flour based cookies. Results revealed that magnesium content of wheat flour supplemented buckwheat cookies decreased with gradual increase in wheat flour supplementation. The mean magnesium content of test cookies were as mg/100 g C_0 (368.33), C_1 (347.67), C_2 (337.00), C_3 (315.00), C_4 (300.33) and C_5 (281.33). The highest mean value (368.33 mg/100 g) was recorded in C_0, while lowest mean value was found (281.33 mg/100 g) in C_5 (Table 4). High magnesium content of supplemented buckwheat cookies may be credited to high magnesium content of buckwheat flour contrasted to wheat flour. When the supplementation level of wheat flour increased and buckwheat concentration decreased then the magnesium contents in cookies also decreased. The results achieved are in complete confirmation with the finding of Khan *et al*. (2012); Ikeda *et al.* (2006) and DeFrancischi *et al*. (1994) who found increase in magnesium content of tartary buckwheat flour than in whole-wheat flour. In the present study decrease in magnesium content was recorded, probably because of the addition of wheat flour to common buckwheat flour.

Sensory/organoleptic evaluation of different treatments of developed buckwheat cookies. The results of sensory/organoleptic evaluation of all treatments of buckwheat cookies are presented in Table 5.

Taste. Supplementation of wheat flour has significant effect on quality score in terms of taste. The minimum scored point (5.26) was recorded in C_0, while maximum point scored (7.54) recorded in C_5 (Table 5). The data shows that with the increase in wheat flour and reduction in buckwheat flour content, taste of developed cookies improved. The results achieved are in close confirmation with the findings of Tyagi *et al.* (2007), who reported the same result when products of biscuit incorporated with mustard flour was evaluated. Eneche (1999) also estimated maximum sensory scores for taste and overall acceptability for the cookies developed from 65% millet flour incorporating with 35% pigeon pea flour.

Colour. Supplementation of wheat flour significantly effect on quality score in terms of colour of common buckwheat flour based cookies. Results showed that quality score of buckwheat cookies increased with gradual increase of wheat flour incorporation. The lowest scored point (5.11) was recorded in C_0, while maximum point scored (8.15) recorded in C_5 (Table 5). The data shows that with the increase in wheat flour supplementation levels and reduction in buckwheat flour content, colour of developed cookies improved. The results achieved are in close confirmation with the findings of Tyagi *et al*. (2007) who reported that maximum colour score of 7.70 was observed of biscuits containing 15% defatted mustard flour. Khouryieh *et al*. (2006) also reported highest score points for colour in noodles formulated with soy flour and whole eggs. Our findings are also similar with the findings of Singh *et al*. (2005), who indicated maximum score points for colour at 15% supplementation of green gram and bengal gram.

Texture. Supplementation of wheat flour significantly ($p<0.005$) effect quality score in terms of texture of common buckwheat flour based cookies. From these results it was observed that with gradual increase of wheat flour incorporation the quality score of buckwheat cookies also increased. The maximum point score (7.84) was recorded in C_5, while lowest point scored (5.41) recorded in C_0 (Table 5). The results revealed that with the increase in wheat flour and reduction in buckwheat flour, content of developed cookies improved. The

Table 5. Colour, taste, texture and overall acceptability of different treatments of developed buckwheat cookies

Treatments	Colour	Taste	Texture	Overall acceptability
C_0	5.11^f	5.26^e	5.41^d	5.26^f
C_1	5.75^e	5.66^e	5.62^d	5.67^e
C_2	6.31^d	5.98^d	6.00^c	6.10^d
C_3	6.88^c	6.38^c	6.74^b	6.67^c
C_4	7.53^b	6.91^b	7.00^b	7.15^b
C_5	8.15^a	7.54^a	7.84^a	7.85^a

9-point hedonic scale (points: likeness/dislike); 9. Like extremely; 8. Like very much; 7. Like moderately; 6. Like slightly; 5. Neither like nor dislike; 4. Dislike slightly; 3. Dislike moderately; 2. Dislike very much; 1. Dislike extrem.

results achieved are in close confirmation with the finding of Tyagi *et al.* (2007) who reported same result when incorporation of biscuits with mustard flour was evaluated. Eneche (1999) also indicated maximum sensory score points for texture and overall acceptability for the biscuits developed from incorporation of 65% millet flour with 35% pigeon pea flour.

Overall acceptability. Supplementation of wheat flour significantly effect quality score in terms of overall acceptability of common buckwheat flour based cookies. Results showed that quality score of buckwheat cookies increased with gradual increase of wheat flour incorporation. The maximum point score (7.85) was received in C_5, while lowest point scored (5.26) recorded in C_0 (Table 5). From these results it is clear that with the increase in wheat flour and reduction in buckwheat flour content, overall acceptability of developed cookies improved. The results achieved are in close confirmation with the findings of Tyagi *et al.* (2007) who reported the same result when the end product of mustard flour incorporation into biscuits was evaluated. Singh *et al.* (1993) also observed maximum mean score points for overall acceptability at 30% incorporation level of soy flour.

Conclusion

It is concluded from this research work that supplementation of wheat flour with buckwheat flour could produce acceptable cookies having nutritional value. Supplementation of wheat flour significantly influenced the proximate and mineral composition of buckwheat flour based cookies. Moisture contents, crude fibre contents and NFE (nitrogen free extract) increased whereas crude fat contents, crude protein contents and ash content decreased. Mineral contents (Fe, Ca, K, Zn and Mg) of developed buckwheat cookies decreased with the increase in wheat flour supplementation levels. Sensory evaluation of buckwheat cookies in terms of colour, texture, test and overall acceptability increased with the increase in wheat flour supplementation levels. Buckwheat leaves are used as green tea in many countries of the world so it is recommended that research work be carried out on green tea. It is also recommended that other varieties of buckwheat grown in Pakistan be looked into for its utilization.

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