

Utilisation of buckwheat (*Fagopyrum esculentum* M.) and different legume flours in traditional couscous production in Turkey

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Abstract

Couscous is a traditional cereal product that is generally produced by coating wheat bulgur with the wheat flour and water or milk in Turkey. In this study, different ratios of legume flours (soy bean flour, SBF; chickpea flour, CF; common bean flour, CBF; lentil flour, LF and lupine flour, LUF), buckwheat flour (BWF), and wheat germ were used in the production of couscous in order to improve the nutritional status. Some selected properties of couscous, such as, colour (L^* , a^* and b^*) weight increase (WI) and volume increase, cooking loss (CL), moisture, ash, crude protein, phytic acid contents, minerals and sensory properties were determined. The addition of BWF and different legumes flours (SBF, CF, CBF, LF and LUF) resulted in higher redness (a^*) and yellowness (b^*), along with lower brightness (L^*) values. Generally, the WI and CL of couscous samples increased significantly ($P < 0.05$) with BWF and legume flour. Also the ash, crude protein, phytic acid, Ca, Mg, K, P, Fe and Zn contents of the couscous increased by BWF and legume flour addition. According to the sensory analysis results, legume flour significantly affected taste-odour, appearance, firmness, stickiness and overall acceptability of couscous ($P < 0.05$). The couscous containing LUF and CF samples had the highest scores for overall acceptability. As a result, BWF and different legume flour can be used in couscous formulation for nutritional enrichment with minimum adverse effect on colour and technologic properties.

Keywords: buckwheat, cereal-based product, couscous, legume, nutrition

1. Introduction

Couscous is a semi-prepared foodstuff, which is produced since the ancient times within the scope of winter preparations (Coşkun, 2013). Industrially couscous is a kind of pasta product made of durum semolina and water (Demir *et al.*, 2010a). Today, in many countries including Turkey, couscous is made mechanically using extrusion technology and each couscous granule represents an aggregate of several semolina particles (Çelik *et al.*, 2004; Debbouz and Donnelly, 1996). However, it can traditionally be made by hand as Turkish women. Traditional couscous types made in the Middle East and some African countries are very different from the industrial one in the ingredients and production methods (Demir *et al.*, 2010a). It has many different names in different countries and it has also become popular in Spain, Portugal, Italy, and Greece (Coşkun,

2013). Turkish couscous is made of wheat bulgur granules, enveloping them with dough made of wheat flour (WF) and water or milk to the larger and round particles about 3-5 mm in diameter and dried (Demir *et al.*, 2010a). Çelik *et al.* (2004) used soy and oat flours and Demir *et al.* (2010a) used chickpea flour (CF) for enrichment of Turkish couscous. It is easy to prepare for eating and being nutritious, couscous is quite popular in many countries. Couscous has a great nutritional value due to its ingredients. It contains only 100-120 calories per half-cup serving, and includes complex carbohydrates, vitamin B and minerals (Çelik *et al.*, 2004).

Legumes (Deshpande and Damodaran, 1990; Ertaş and Türker, 2014), wheat germ (Al-Hooti *et al.*, 2002; Sidhu *et al.*, 2007) and buckwheat (Levent and Bilgiçli, 2011; Wijngaard and Arendt, 2006) are rich and good sources of complex carbohydrates, protein, high quality dietary fibre, several

B-complex vitamins and minerals. They are important raw material in functional food production. Considering nutritional and functional properties, legumes, wheat germ and buckwheat have high potential to use in different foods. There are numerous studies on supplementation of legume flour in bread, pasta, and noodle and cookie formulation (Demir *et al.*, 2010b). In literature, various legume seed and flour (lentil, yellow pea, green pea, navy bean, fava bean, cowpea, soy bean and chickpea) were used in pasta or noodle production (Bergman *et al.*, 1994; Chillo *et al.*, 2008; Jeffers *et al.*, 1979; Sabanis *et al.*, 2006; Singh *et al.*, 2007; Zhao *et al.*, 2005). Wheat germ provides three times as much protein, seven times as much fat, six times as much mineral contents compared to WF. Also, wheat germ has good potential to increase the nutritional status of many foods such as bread, macaroni, cookie, and tarhana, due to its rich composition (Levent *et al.*, 2015).

Therefore, this study aimed to investigate the production of couscous with different ratios of legumes (soy bean, chickpea, lupine, lentil and common bean), buckwheat and wheat germ to determine the physical, chemical, nutritional, sensory properties of couscous samples.

2. Materials and methods

Materials

The WF used in couscous preparation was commercial flour with a crude protein content of 11.21% ($N \times 5.7$, w/w, dry basis). The cow's milk used had a protein and fat content of 3.0 and 3.1% (w/w), respectively. Wheat bulgur was obtained from Duru Bulgur A.Ş, Karaman, Turkey. Buckwheat samples were obtained from Yar Gıda, Antalya, Turkey. Common bean, soy bean, lentil, chickpea and lupine seeds were purchased from a local market in Konya, Turkey. Common bean, soy bean and chickpea seeds were washed and tempered up to 20% moisture level with distilled water for 12 h at room temperature. After tempering, the seeds were ground in a lab mill (falling number 3100 laboratory mill; Perten Instruments AB, Huddinge, Sweden). Lentil, lupine and buckwheat seeds were directly ground in same mill.

Couscous preparation

In this study, couscous samples were prepared according to a traditional method given by Çelik *et al.* (2004). Traditional couscous is made by the coating wheat bulgur granules with WF dough giving the bulgur granule spherical shape. For couscous preparation, wheat bulgur (8.4 g), different flour blends (total 30.0 g; 70% WF, 20% legume flour and 10% wheat germ) and milk (12.9 g) were used. Wheat bulgur was placed in a large bowl and wetted with milk. Then the mixture was rolled by rubbing hand while flour blend was being added. Thus the surfaces of the bulgur granules were

covered and coated by the dough. These wetting and rolling processes were continued until the size of couscous particles had reached a diameter of 3-5 mm. Then, the couscous was dried on a flat plate for 3-4 days at room temperature (25 ± 1 °C) to decrease the moisture content below 10% (Çelik *et al.*, 2004). Afterwards dried couscous samples were kept in closed glass containers at room temperature until used.

Technological properties

Cooking properties and colour values of the samples are technologic quality parameters of couscous. For evaluation of cooking properties, weight increase (WI), volume increase (VI) and cooking loss (CL) analysis were performed on the couscous samples. For WI and VI determination, 10 g couscous sample was boiled for 18 min in 300 ml distilled water. After cooking, samples were washed with distilled water and left for 2 min for draining of water. WI and VI were determined in drained couscous. Drained cooking water was dried to constant weight and CL was calculated. WI was calculated by differences between dry (before cooking) and cooked (after draining) couscous weights. For VI measurement raw and cooked couscous was poured into a 250 ml graduated glass cylinder with 150 ml of distilled water. The increase in the water level for raw and cooked couscous was measured and VI% was calculated.

Colour measurement was performed using Hunter Lab Color Quest II Minolta CR 400 (Konica Minolta Sensing, Inc., Osaka, Japan). The colour measurements were determined according to the CIELab colour space system (Francis, 1998). Colour was expressed as L^* (100 = white; 0 = black), a^* (+ = redness; - = greenness), and b^* (+ = yellowness; - = blueness).

Laboratory analysis

The AACC International methods were used for the determination of moisture (method 44-19.01), ash (method 08-01.01) and crude protein (method 46-12.01; AACCI, 2000).

Phytic acid was measured by a colourimetric method according to Haugh and Lantzsch (1983). Phytic acid in the sample was extracted with a solution of HCl (0.2 N) and precipitated with solution of ammonium iron (III) sulphate $\cdot 12 H_2O$.

The mineral (Ca, Fe, K, Mg, P and Zn) contents of the couscous samples were determined by inductively coupled plasma atomic emission spectrometry (ICP-AES; Vista series; Varian International AG, Cham, Switzerland) with an automatic sampler system. Approximately 0.5 g of the couscous sample was put into a burning cup, and 5 ml of $HNO_3 + 5$ ml H_2SO_4 was added. The samples were

incinerated in a microwave oven (Mars 5; CEM Corporation, Matthews, NC, USA). The solution was diluted to 100 ml with water. Concentrations were determined by ICP-AES (Bubert and Hagenah, 1987).

Sensory evaluation

In panel tests, 500 g couscous samples (wet basis) were simmered in 1000 ml water for 18 min. The samples were subject to sensory evaluation. Couscous samples were evaluated by ten panellists, who are familiar with the characteristics of couscous. Ages ranged from 23 to 45. Six of them were females. All panellists were non-smokers. The samples were coded with letters and the order of sample presentation was completely randomised for serving to the panellists to guard against any bias. Panellists had access to water to help cleanse their palates prior to proceeding to the next sample. Sensory evaluation was performed in a room with appropriate temperature in open sitting. All couscous samples were served at the same time in the same day. The panellists were asked to score the couscous in terms of taste-odour, appearance, firmness, stickiness and overall acceptability using a 5-point scale where 1 represented 'dislike extremely', 3 represented 'acceptable' and 5 represented 'like extremely' in a particular attribute.

Statistical analysis

A commercial software program (version 4.0; Tarist, Izmir, Turkey) was used to perform statistical analyses. Data were assessed by analysis of variance. Means that were statistically different from each other were compared using Duncan's multiple range tests at 5% confidence interval. Standard deviations were calculated using the same software.

3. Results and discussion

Cooking properties of couscous

Cooking properties have the greatest importance among the couscous characteristics in terms of consumer acceptance. Cooking properties (WI, VI and CL values) for couscous samples are given in Table 1. WI is responsible for the texture of cooked pasta (Sabanis *et al.*, 2006). WI values increased significantly ($P<0.05$) with buckwheat flour (BWF) and different legume flour. The highest WI values are obtained with CF ($355.7\pm 7.50\%$). Jeffers *et al.* (1979) found that WI of udon noodle was increased by 10% yellow bean flour addition, but decreased by 20% addition level compared to the control. The VI showed a similar trend to WI and higher values of VI in couscous samples made from common bean flour (CBF), lupine flour (LUF) and CF. Significant differences ($P<0.05$) were not observed in the VI values of couscous with addition soy bean flour (SBF), lentil flour (LF) and BWF. Demir *et al.* (2010b) reported that 10% CPF addition increased the VI values of erişte which is pasta-like product. CL is an important quality parameter for pasta and pasta like products. CL is related to the breakdown of noodle during cooking and regarded as an indicator of cooking performance (Özkaya *et al.*, 2001).

According to Table 1, the CL of couscous samples increased significantly ($P<0.05$) with BWF and legume flour. The highest CL values were determined for couscous made with LUF and SBF addition level. CL values of couscous samples, when ordered from highest to lowest, were obtained as SBF ($7.52\pm 0.28\%$), LUF ($7.27\pm 0.17\%$), LF ($6.64\pm 0.18\%$), CBF ($6.33\pm 0.11\%$), BWF ($6.13\pm 0.11\%$) and CF ($4.81\pm 0.14\%$; Table 1). The lowest CL values were determined in the couscous samples made with control couscous samples. Sabanis *et al.* (2006) reported that CL of lasagne increased from 5.1 g (100% durum WF) to 13.8 g (50% CF) with CF addition.

Table 1. Effect of buckwheat and legume flour addition on cooking properties of couscous samples (mean values \pm standard deviation)¹.

Couscous samples ²	Weight increase (%)	Volume increase (%)	Cooking loss (%)
Control	148.8 \pm 1.70 ^e	143.8 \pm 1.06 ^c	4.16 \pm 0.06 ^e
SBF	186.2 \pm 3.82 ^d	137.3 \pm 3.68 ^c	7.52 \pm 0.28 ^a
CF	355.7 \pm 7.50 ^a	239.4 \pm 6.08 ^a	4.81 \pm 0.14 ^d
LUF	179.7 \pm 5.23 ^d	194.3 \pm 3.11 ^b	7.27 \pm 0.17 ^a
CBF	192.7 \pm 4.81 ^{cd}	197.7 \pm 4.38 ^b	6.33 \pm 0.11 ^{bc}
LF	218.1 \pm 6.93 ^b	145.1 \pm 4.67 ^c	6.64 \pm 0.18 ^b
BWF	208.6 \pm 7.78 ^{bc}	142.6 \pm 3.82 ^c	6.13 \pm 0.11 ^c

¹ Duncan's multiple range test. The means with the same letter in a column are not significantly different ($P<0.05$).

² Control = 100% wheat flour; SBF = 70% wheat flour + 20% soy bean flour + 10% wheat germ; CF = 70% wheat flour + 20% chickpea flour + 10% wheat germ; CBF = 70% wheat flour + 20% common bean flour + 10% wheat germ; LF = 70% wheat flour + 20% lentil flour + 10% wheat germ; LUF = 70% wheat flour + 20% lupine flour + 10% wheat germ; BWF = 70% wheat flour + 20% buckwheat flour + 10% wheat germ.

Decreasing amount of gluten with legume flour and BWF addition resulted in higher dry matter losses into cooking water compared to control couscous containing 100% WF. Here possibly, BWF and different legume flour showed diluting effect on wheat gluten and additionally there was no any interaction between legume/buckwheat and wheat proteins. These results confirmed those reported by Demir *et al.* (2010b) for erişte produced from CF.

Colour properties of couscous

Colour of couscous is an important quality parameter for consumer acceptability. A bright yellow creamy colour is preferred commonly (Demir *et al.*, 2010a). Table 2 shows the changes in the colour values (L^* , a^* and b^*) of the couscous samples. According to the Table 2, the L^* values of couscous samples ranged from 77.70 ± 0.16 to 87.26 ± 0.21 . Brightness (L^*) values of couscous samples declined after the BWF and legume flour addition. Çelik *et al.* (2004) reported that usage of the soy or oat flours in couscous preparation decreased brightness (L^*) value. When compared with the control samples, legume and BWF addition gave higher redness (a^*) and yellowness (b^*), but led to significantly ($P < 0.05$) lower brightness (L^*). The couscous samples containing LF had the highest a^* values, while couscous samples containing LUF had the highest b^* values. This was an expected result, because LF has a deep orange-red colour. The samples in control couscous samples had the lowest a^* and b^* values. Generally, usage of different legume flour in couscous formulation resulted in darker and more yellowish colour. These results confirmed those reported by Lee *et al.* (1998), who found that fortification of Cantonese noodle with garbanzo bean decreased brightness slightly, and increased yellowness significantly. Also, Demir *et al.* (2010b) reported that CF addition level increased, darkness and yellowness of the erişte increased. The high natural colour intensity of legume flour and the increasing Maillard

reaction risk due to increasing nitrogenous compounds of legume in formulation are the probable causes of the colour changes (Demir *et al.*, 2010a).

Chemical composition and mineral content of couscous

The moisture, ash, crude protein and phytic acid contents of the couscous samples produced from BWF and different legume flour are presented in Table 3. Utilisation of BWF and different legume flour (SBF, CF, CBF, LF and LUF) in couscous formulation resulted in significant ($P < 0.05$) increases in ash, crude protein and phytic acid contents of the couscous when compared with control group (Table 3). This was an expected result, because legume, buckwheat and their flour are very nutrient rich products (Atalay *et al.*, 2013; Deshpande and Damodaran, 1990). Crude protein, ash and phytic acid content of the couscous samples ranged between 11.33-19.06%, 0.86-2.26% and 215.66-651.59 mg/100 g, respectively. The highest ash and phytic acid contents were obtained with SBF addition while the highest increase in crude protein content was detected in LUF incorporated samples. Sabanis *et al.* (2006) reported that ash and protein contents of 'durum WF:CF' (50:50) blends increased from 0.94 to 1.68% and 12.8 to 16.8%, respectively, according to 100% durum WF. Similar to the results of Demir *et al.* (2010a), couscous containing different ratios of CF (25, 50, 75 and 100%) showed higher ash, protein, cellulose and phytic acid contents than couscous prepared with WF.

In recent years, there has been an increase in diseases, such as osteoporosis and anaemia, caused by low and disorderly mineral intake. For this reason, fortification of some food products with minerals is an important nutritional approach (Çelik *et al.*, 2004). Total mineral contents (Ca, Fe, K, Mg, P and Zn values) of the couscous samples were also given in Table 4. All of the investigated mineral content in

Table 2. Effect of buckwheat and legume flour addition on colour values of couscous samples (mean values \pm standard deviation)¹.

Couscous samples ²	L^*	a^*	b^*
Control	87.26 ± 0.21^a	-0.99 ± 0.04^f	12.04 ± 0.08^f
SBF	82.18 ± 0.03^d	1.80 ± 0.08^{de}	15.44 ± 0.17^c
CF	83.28 ± 0.06^c	1.99 ± 0.10^{cd}	15.45 ± 0.08^c
LUF	83.30 ± 0.25^c	2.09 ± 0.11^c	16.93 ± 0.13^a
CBF	84.19 ± 0.13^b	1.60 ± 0.07^e	13.74 ± 0.14^e
LF	81.83 ± 0.28^d	6.02 ± 0.08^a	16.21 ± 0.16^b
BWF	77.70 ± 0.16^e	3.33 ± 0.04^b	14.65 ± 0.07^d

¹ Duncan's multiple range test. The means with the same letter in a column are not significantly different ($P < 0.05$).

² Control = 100% wheat flour; SBF = 70% wheat flour + 20% soy bean flour + 10% wheat germ; CF = 70% wheat flour + 20% chickpea flour + 10% wheat germ; CBF = 70% wheat flour + 20% common bean flour + 10% wheat germ; LF = 70% wheat flour + 20% lentil flour + 10% wheat germ; LUF = 70% wheat flour + 20% lupine flour + 10% wheat germ; BWF = 70% wheat flour + 20% buckwheat flour + 10% wheat germ.

L^* = light/dark; a^* = green (negative values) / red (positive values); b^* = blue (negative values) / yellow (positive values).

Table 3. Effect of buckwheat and legume flour addition on chemical properties of couscous samples (mean values \pm standard deviation)^{1,2}.

Couscous samples ³	Moisture (%)	Crude protein (%)	Ash (%)	Phytic acid (mg/100 g)
Control	6.23 \pm 0.04 ^b	11.33 \pm 0.18 ^a	0.86 \pm 0.01 ^e	215.66 \pm 7.55 ^d
SBF	6.55 \pm 0.07 ^{ab}	17.39 \pm 0.07 ^b	2.26 \pm 0.07 ^a	651.59 \pm 4.58 ^a
CF	6.82 \pm 0.14 ^a	14.54 \pm 0.04 ^e	1.23 \pm 0.04 ^{bc}	606.86 \pm 6.42 ^c
LUF	6.77 \pm 0.03 ^a	19.06 \pm 0.06 ^a	1.11 \pm 0.03 ^{cd}	629.75 \pm 6.55 ^b
CBF	6.90 \pm 0.11 ^a	14.75 \pm 0.01 ^d	1.35 \pm 0.07 ^b	631.22 \pm 5.46 ^b
LF	6.30 \pm 0.08 ^b	15.57 \pm 0.03 ^c	1.26 \pm 0.06 ^b	629.33 \pm 2.35 ^b
BWF	6.95 \pm 0.34 ^a	13.92 \pm 0.08 ^f	1.06 \pm 0.04 ^d	632.27 \pm 3.04 ^{ab}

¹ Duncan's multiple range test. The means with the same letter in a column are not significantly different ($P < 0.05$).

² Chemical properties are on a dry weight basis.

³ Control = 100% wheat flour; SBF = 70% wheat flour + 20% soy bean flour + 10% wheat germ; CF = 70% wheat flour + 20% chickpea flour + 10% wheat germ; CBF = 70% wheat flour + 20% common bean flour + 10% wheat germ; LF = 70% wheat flour + 20% lentil flour + 10% wheat germ; LUF = 70% wheat flour + 20% lupine flour + 10% wheat germ; BWF = 70% wheat flour + 20% buckwheat flour + 10% wheat germ.

couscous samples increased with BWF and legume flour addition. Especially, addition of legume flour showed a significant effect on total mineral contents. According to Table 4, couscous samples containing 100% WF (control group) had the lowest content of Ca, Fe, K, Mg, P and Zn minerals. Otherwise, the couscous samples prepared with SBF contained the highest levels of Ca (45.09 \pm 0.62 mg/100 g), K (691.96 \pm 8.54 mg/100 g), Mg (59.82 \pm 2.19 mg/100 g), P (407.86 \pm 4.30 mg/100 g) and Zn (1.99 \pm 0.03 mg/100 g) minerals. Also, the highest Fe contents were obtained with LUF and CBF addition. This was an expected result. It has been reported by many studies that legume is a very rich source of major and minor minerals (Cabrera *et al.*, 2003; Deshpande and Damodaran, 1990; Iqbal *et al.*, 2006). Thus,

the use of BWF and legume flour instead of WF which have high contents of minerals led to an increase in total mineral content of the final product.

Sensory properties of couscous

The scores of sensory properties of couscous made with BWF and different legume flour were presented in Figure 1. Panellists were asked to evaluate taste-odour, appearance, firmness, stickiness and overall acceptability during sensory analysis. It can be seen in Figure 1, BWF a different legume flour affected the scores of sensory properties of couscous samples. Statistically, all of the CF and LUF containing samples had the same or higher sensory scores compared

Table 4. Effect of buckwheat and legume flour addition on mineral content of couscous samples (mg/100 g) (mean values \pm standard deviation)^{1,2}.

Couscous samples ³	Ca	Fe	K	Mg	P	Zn
Control	20.66 \pm 0.47 ^d	1.71 \pm 0.01 ^d	246.76 \pm 4.58 ^e	28.37 \pm 0.37 ^d	263.17 \pm 3.06 ^e	1.06 \pm 0.01 ^d
SBF	45.09 \pm 0.62 ^a	2.20 \pm 0.01 ^b	691.96 \pm 8.54 ^a	59.82 \pm 2.19 ^a	407.86 \pm 4.30 ^a	1.99 \pm 0.03 ^a
CF	32.65 \pm 0.76 ^b	2.25 \pm 0.01 ^b	570.19 \pm 1.33 ^b	47.51 \pm 0.90 ^b	364.41 \pm 1.09 ^d	1.62 \pm 0.05 ^c
LUF	46.49 \pm 1.41 ^a	2.49 \pm 0.03 ^a	378.71 \pm 1.16 ^d	46.61 \pm 2.11 ^b	383.13 \pm 2.81 ^c	1.93 \pm 0.01 ^a
CBF	45.62 \pm 1.44 ^a	2.49 \pm 0.01 ^a	699.19 \pm 3.18 ^a	57.82 \pm 1.68 ^a	388.06 \pm 1.54 ^c	1.76 \pm 0.03 ^b
LF	28.28 \pm 1.17 ^c	2.10 \pm 0.05 ^c	575.63 \pm 8.23 ^b	41.95 \pm 0.29 ^c	396.35 \pm 0.97 ^b	1.81 \pm 0.01 ^b
BWF	27.37 \pm 1.82 ^c	2.09 \pm 0.01 ^c	458.30 \pm 4.76 ^c	55.80 \pm 2.21 ^a	399.39 \pm 3.21 ^{ab}	1.58 \pm 0.04 ^c

¹ Duncan's multiple range test. The means with the same letter in a column are not significantly different ($P < 0.05$).

² Values are on a dry weight basis.

³ Control = 100% wheat flour; SBF = 70% wheat flour + 20% soy bean flour + 10% wheat germ; CF = 70% wheat flour + 20% chickpea flour + 10% wheat germ; CBF = 70% wheat flour + 20% common bean flour + 10% wheat germ; LF = 70% wheat flour + 20% lentil flour + 10% wheat germ; LUF = 70% wheat flour + 20% lupine flour + 10% wheat germ; BWF = 70% wheat flour + 20% buckwheat flour + 10% wheat germ.

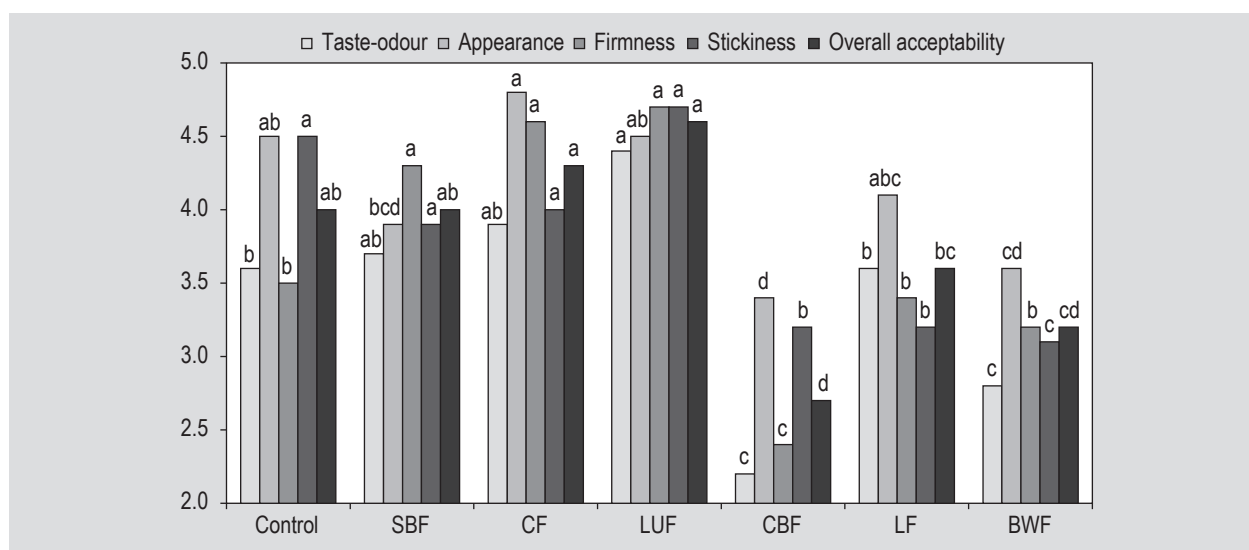


Figure 1. Sensory properties of couscous samples (Control = 100% wheat flour; SBF = 70% wheat flour + 20% soy bean flour + 10% wheat germ; CF = 70% wheat flour + 20% chickpea flour + 10% wheat germ; CBF = 70% wheat flour + 20% common bean flour + 10% wheat germ; LF = 70% wheat flour + 20% lentil flour + 10% wheat germ; LUF = 70% wheat flour + 20% lupine flour + 10% wheat germ; BWF = 70% wheat flour + 20% buckwheat flour + 10% wheat germ).

to control couscous samples. Also, all sensory scores were negatively affected by CBF and BWF addition. Sabanis *et al.* (2006) reported that the taste of lasagne containing CPF was very intense, and the taste scores decreased by CPF addition above 10%. According to the results, couscous made of CBF had lowest scores in terms of taste-odour and overall acceptability. The couscous containing LUF and CF samples had the highest scores for overall acceptability.

4. Conclusions

Malnutrition is currently widespread in many areas of the world. Therefore, must be focused on the cheap, but nutritious plant protein and mineral sources, such as legume and cereals. Several recent studies have showed the successful formulation of pseudocereal and legume containing cereal based products. In the present study, the applicability of soy bean, chickpea, lupine, lentil, common bean and BWF in traditional couscous production were investigated. According to the results, the colour values were negatively affected by the addition of BWF and legume flour. Generally, the WI and CL of couscous samples increased significantly with BWF and legume flour. The ash, crude protein, phytic and mineral contents of the couscous increased BWF and legume flour addition. The couscous containing LUF and CF samples had the highest scores for overall acceptability. As a result, it is advisable to replace WF with BWF and different legume flour in products such as couscous, noodle and pasta formulation for the enrichment of nutritional and sensory properties.

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