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Original Research Article

The Effect of Local Production Differences on Physico - Chemical and Techno - Functional Properties of Artvin Kavut Flour

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ABSTRACT

Soups are quite significant components of Anatolian cuisine, which has a deep-rooted food culture. In Turkish food culture, soups are named according to their ingredients or the local region where they are cooked and featured by the local food or the region itself. Mainly used in soups and produced for many years in Artvin region, kavut flour is one of such ingredients. Since people believed that it treated the sick people with its high nutritive value, sent away the evil spirits and was the symbol of abundance, the ancient Turks made sure to have kavut flour at their homes. However, it has become one of those traditional foods which have sunk into oblivion for its limited use in Artvin region. This research aims to introduce the kavut flour whose production has been continued but consumption has been limited to the region as well as to analyse the impact of local production differences on the product's physico-chemical and techno-functional properties. To this end, kavut flour obtained from 10 different villages in Artvin were analysed for its water solubility index (WSI) (2,16 - 4,16 g/g), water absorption index (WAI) (240,92 - 344,13 g/g), oil absorption index (2,19 - 2,69 g/g), bulk density (10 -14,16 kg/m^3), compressed density (4,66 - 9,5 kg/m^3), ash content (1,59 - 2,28 %), moisture (5,35 -9,02%), acidity (0,02- 0,11 %) and protein amount (8,88 - 12%). According to the results, it has been observed that kavut flour has acceptable functional properties and local production differences significantly affect these properties. It has been determined that the physico-chemical properties of all kavut flours obtained from different regions are quite high.

Keywords: Water absorption, Water solubility, Oil absorption, Bulk density, Kavut flour,

INTRODUCTION

Nutritional and functional properties of foods have been gaining much importance recently. Consumers' increasing level of consciousness and quality of life influence their effort to access healthy food. The change in the world economics that was brought about especially by the globalization after 1980s as well as the rivalry accompanied by it raised the concern of bring different, having distinctive characteristics, and in short innovation. The sustainability of both the companies and the countries has become closely related with innovation in this new economic order (Kuşat 2012). As a consequence, demand for food products shaped by local and traditional lifestyles has increased (Onurlubaş and Taşdan 2017).

As is the case with any culture, Turkey also has a nutrition style shaped by traditions. In this nutrition style where climatic characteristics, economic situation and habits are notable, traditional products hold a significant place. Kavut flour, which is mainly made of wheat but also includes barley, corn, some other similar grains and pumpkin seeds can be shown as one of the examples of such traditional foods. Commonly used in soup making, kavut flour is also used in desserts, cookies and breads.

Grown since ancient times, wheat is one of the most important sources of nutrition for people and stands out as the main component of most commonly consumed foods. Kavut flour is also known as ground roasted wheat. Despite variations depending on the region, kavut flour is usually made up of mainly wheat and other grains such as corns, pumpkin seeds, and barley added to increase the nutrition value and the taste. For this reason, all grains to be used are firstly cleared of insect scraps, pebbles and spoilt grains. Cleaned grains are roasted in tin plates, baking ovens, and stoves used by the local people. The duration of the roasting and therefore the colour of the flour vary depending on the local people's choice. The roasted grains are ground in the mill after being mixed in chosen amounts. After the grinding process, the kavut flour is stored in a cool and dry place.

Kavut flour's place in our nutrition culture dates back to ancient times. It is known that Abu Sufyan took with him roasted wheat (Kavut/sevik) while going on a war in Prophet Muhammad's age (Algül et al. 2013). Sevik is a form of kavut flour which is cooked with water like a halwa (Peköz 2018). Uyghur Turks made women who

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newly gave birth to eat kavut flour mixed with oil and sugar (İnayet 2006). Evliya Çelebi mentions in his travelogue that people at mountainous areas ate gavut (kavut) meal made of grains. Seljuk saying "Those who have kavut add it to molasses, and those who have a mind listen to advices" shows that kavut flour was used in the making of molasses in Seljuk time (Baysal 1997). It is also known that kavut flour was used as a plaster after made into a paste by mixing peas, tare, beans, honey and vinegar (Acıduman et al. 2007). Kavut flour was also used as the symbol of abundance by Ardahan Turkmens (Yılmaz 2010).

After Turks migrated to Anatolia and chose Islam as their religion, their traditional foods were either totally removed from their cuisines or went through various changes accompanying the changing geography, culture and belief system (Ünal 2016). There are various studies being carried out in European countries to emphasize the importance of traditional food and to increase their consumption. Such studies recently increase in number and draw attention also in Turkey. However, although there are many traditional foods grown and produced in the country for long years, the studies conducted on this subject have not yet reached a substantial number. While some of the traditional foods which are barely studied or not studied at all are known across Turkey, others like kavut flour are known only within the limits of the region where they are produced.

There should be more studies on traditional kavut flour considering that it is rich in composition and nutrition value, can be easily conserved for a long time in freezer, is produced in a simple and easy way, and can be cooked easily. This study aims to identify the physio-chemical and techno-functional properties of kavut flour which is obtained from local grains and is consumed commonly in Artvin region.

MATERIALS AND METHODS

Material

Kavut flours were obtained from 10 different villages in Yusufeli district of Artvin. Samples were stored at +4 °C in 1 kg airtight plastic packages until they were analysed.

Method

Physico-chemical properties

Moisture and ash value of the kavut flours were determined according to AOAC Method No: 925.40 and 933.03, respectively (AOAC 1990). Acidity and pH were determined according to the methods described by Uylaşer and Başoğlu (2011). The nitrogen content was determined using kjeldahl method for crude protein (N x 6,25) (AACC Method No: 46 - 10.01) determination (AACC 2008). The colour analysis was determined by using Minolta Brand CM 3600d Model colorimeter. The colorimeter was calibrated using a standard white plate. The colour parameters were L^* (L^* = 0, black and L^* = 100, white), a^* ($-a^*$ = green and $+a^*$ = red-purple) and b^* ($-b^*$ = blue and +b = yellow). Falling number (FN), zeleny sedimentation (ZS) and delayed sedimentation (DS) of the kavut flours were determined according to AACC Medhod No: 56-81 B, 116/1 (AACC 2008) and Atlı et al. (1988), respectively. All the analyses were conducted for triplicate in samples of kavut flours.

Techno-functional properties

Water absorption index (WAI), water solubility index (WSI) and oil absorption index (OAI) were determined by the method of Cano-Chauca et al. (2005) and Rodriguez-Ambriz et al. (2008). WAI, WSI and OAI were calculated using the following formulas:

WAI (g/g) = Weight of wet sediment (g) / Dry weight of kavut flour (g)

WSI (g/g) = Weight of dried supernatant (g) / Dry weight of kavut flour (g)

OAI (g/g) = Weight of oil absorbed (g) / Weight of kavut flour (g)

Bulk density was determined according to the methods of Jinapong et al. (2008). For this reason, the kavut flours (50 g) were weighed into a 100 mL graduated cylinder. After that, the samples were tapped 30 times. The volumes of the samples were recorded. The bulk density was calculated by using the following formula:

Bulk density (g/cm^3) = Weight of kavut flour (g) / Volume of kavut flour after tapping (cm^3).

The bulk density of kavut flours placed in a tape measure was determined after being compressed into a fixed volume, similarly to that of volume density (Jinapong et al. 2008).

Statistical analysis

The mean values were analyzed with Minitab 18 Statistical Software Program. Differences in samples were tested for statistical significance at $p < 0.05$ level.

RESULTS AND DISCUSSION

Physico-chemical properties of kavut flours

Results for physico-chemical properties of kavut flours are given in Table 1. For all the samples, the values differed considerably as the moisture were 5,35 - 9,02%, ash contents 1,59 - 2,28%, amount of protein 8,88 - 12,0%, acidity 0,024 - 0,114% and pH 3,42 - 7,83. The difference between samples arises from the difference of materials and one region to the other. Also, the fact that people living in different regions adapted the kavut flour to their own taste is also one of the other factors.

The study shows that while the highest moisture level (9,02%) belongs to village no. 5, the lowest (5,35%) come from village no. 8. According to Turkish Food Codex – Wheat Flour Edict, the moisture content of wheat flours should not be more than 14,5% (TGK 1999). It is seen in Table 1 that the moisture content is in conformity with the edict. When kavut flour is compared with similar products, Verwimp et al. (2004) and Hung et al. (2007) reported that moisture content of wheat flour samples were 14,12% and 13,4 %, respectively. In another study done by Prabhasankar and Rao (2001) with two different kinds of wheat flour, the moisture content were determined as 9,5% and 9,2%.

When the contents of ash and raw protein are considered, it is seen that ash and protein amounts of rice flour is less than (0,47 - 1,57% and 6,51 - 7,61%) our results (Kraithong et al. 2018). Moreover, ash contents of kavut samples is higher and also their protein content is similar or higher (0,46 - 0,96%) (8,4 - 10,8%) than flour of various wheat varieties from different regions (Ekinci and Ünal 2001). The protein content of kavut flour is similar to that of the minimum amount of protein of tarhana that is one of the traditional products with high nutritive value (Anonymous 2004).

Table 1. Physico-chemical analysis results for kavut flours[a] (mean ± S.D).

Village No.	Moisture (%)	Ash* (%)	Protein* (%)	Acidity** (%)	pH	ZS(mL)	DS (mL)	FN (s)
1	7,20 ± 0,051^{d}	2,28±0,014^{a}	10,06±0,137^{de}	0,061±0.02^{e}	6,85±0.02^{b}	20	23	76
2	8,83 ± 0,018^{a}	1,78±0,007^{e}	12,00±0,438^{a}	0,032±0.02^{g}	5,87±0.00^{d}	15	14	384
3	8,42±0,094^{b}	2,01+0,021^{c}	8,88±1,518^{e}	0,036±0.01^{f}	3,42±0.01^{i}	27	25	427
4	7,15±0,177^{de}	2,14±0,014^{b}	10,07±0,060^{de}	0,08+0.01^{c}	6,36±0.01^{c}	29	34	74
5	9,02±0,014^{a}	1,74±0,014^{f}	11,48±0,212^{abc}	0,024±0.01^{h}	5,87±0.01^{d}	24	21	522
6	7,51±0,009^{c}	1,59±0,028^{g}	10,89±0,786^{cd}	0,032±0.03^{g}	5,38±0.02^{e}	15	15	352
7	7,34±0,024^{d}	2,02±0,014^{c}	11,15±0,595^{abc}	0,08+0.01^{c}	4,89±0.03^{f}	29	30	69
8	5,35±0,170^{g}	1,91±0,014^{d}	11,89±0,341^{ab}	0,103±0.02^{b}	7,83±0.02^{a}	38	40	500
9	6,74±0,006^{f}	2,26±0,007^{a}	9,59±0,613^{e}	0,076±0.01^{d}	4,28±0.01^{h}	33	34	73
10	7,03±0,052^{e}	2,28±0,007^{a}	10,96±0,511^{bcd}	0,114±0.01^{a}	4,40±0.00^{g}	31	31	62

S.D: standard deviation

* Calculated for the dry product.

** Acidity was calculated for sulfuric acid.

ZS: Zeleny Sedimentation, DS: Delayed Sedimentation, FN: Falling Number

[a] There is a statistically significant difference of $p < 0.05$ between the averages shown with different letters in LSD test.

Karaoğlu and Kotancılar (2005) searched about the best processing method and formula for kavut flour by using four different flour combinations (100% wheat, 75% wheat + 25% barley, 50% wheat + 50% barley, 25% wheat + 75% barley), two different kinds of oil (butter and margarine) and three different durations of roasting (1, 1.5, 2 minutes) at 250 °C. The increase in barley flour level decreased the moisture, protein and pH of kavut flour while increasing the ash. It is seen that there were differences of moisture content in kavut flour samples ($p < 0.05$). Another reason for this difference is thought to be loss of moisture during storing and grinding processes. In the research done by Kilci (2012) about the impact of adding oat on the quality of tarhana, the content of moisture, ash and protein in wheat flour changed as 13,40%, 0,64% and 13,28%, respectively. When wheat flour with such levels are used in tarhana production, moisture, ash, and protein values of tarhana appeared to be 9,27%, 1,53% and 13,28%, respectively. When compared to kavut flours, it is seen that the amounts of moisture, ash, and protein in tarhana are similar. In another study by Menteş-Yılmaz (2011), protein amount in wheat types varied between 10,92% and 17,43%.

Demir (2018) indicated that the moisture of tarhana samples produced by substituting different amounts of wheat flour varied between 4,37% and 4,55% and that moisture amount did not statistically differ ($p<0.05$) with the increase in wheat flour proportions. The highest amount of ash was 2,85% in tarhana samples produced with 100% wheat flour and average protein content changed between 15,29% and 17,19%. In a study made with different kinds of wheat flour in Turkey, the amounts of ash and protein were found to be 0,39 - 0,44% and 10,9 - 12,5%, respectively (Ünal et al. 1996). Being a similar product to kavut flour, tarhana samples produced by Çevik (2016) had an average protein amount that was differed from 12,86% to 13,33%. When compared to their results, our results showed similarity. In a study conducted by Hede et al. (2001) in order to compare the composition properties of triticale with other commonly grown grains, the protein amounts of wheat, barley and corn were found to be 13,94%, 11,10% and 10%, respectively. In this study, the highest ash content (3,15%) was determined in barley. It was found that the ash content was 1,72% in wheat and 1,53% in corn.

When acidity and pH values of kavut flours were examined, it showed a significant difference ($p < 0.05$). It was observed that pH value changed between 3,42 - 7,83, while the highest pH value was from village no. 8 and the lowest from village no. 3. Rehman and Shah (1999) and Rehman (2006) stated that moisture content and storage conditions could cause some changes in acidity and pH of grains. As a result of the breakdown of the oils within the wheat stored under inappropriate conditions, free fatty acids are formed (Özkaya and Özkaya 2005). Rehman (2006) reported that the wheat samples stored in 25 °C and 45 °C for 6 months showed increase in acidity and decrease in pH value.

In our study, sedimentation values of kavut flours changed between 15 - 38 mL (Table 1). Ünal (2002) indicated that the sedimentation values are defined as weak for 15 - 20 mL, medium for 20 - 25 mL, good for 25 - 30 mL and very good for over 30 mL. Kavut flour of village no. 8 is defined as very good according to this study. When the other studies conducted for sedimentation feature were examined, the normal sedimentation value was reported by Bilgin (2001) to be 21,83 - 31,67 mL, Altınbaş et al. (2004) to be 22,7-31,2 mL, Elagib et al. (2004) to be 13,67-27.93 mL, Sözen and Yağdı (2005) to be 19.51-31.34 mL, Erkul (2006) to be 16.33-24,33 mL, Krejčířová et al. (2008) to be 15-28 mL and 23-32 mL, and their results in parallel to the sedimentation values determined in kavut flours.

Sedimentation value is an indicator of gluten content and gluten quality. Therefore, it is very important for bread making. Sedimentation test results are stated as very good for 36 mL and above for bread wheats, good for 25 - 36 mL, weak for 15 - 25 mL and not suitable for making bread for 15 mL and below (Ekmekçi et al. 1996). On the other hand, Azizi et al. (2006) determined lower sedimentation values as 11,27 mL. The following studies reported higher sedimentation results than the mean values determined in our study: Lukow and Mc.Vetty (1991), 53 - 78 mL, Bojnanska and Francakova (2002), 31 - 46 mL, Tayyar (2005) 61,0 - 30,5 mL, Zecevic et al. (2007) 35,2 - 55 mL, Kahraman et al. (2008) 44,25 - 60,25 mL, Egesel et al. (2009) 30,7 - 53,5 mL, Taghouti et al. (2010) 44,25 - 61,06 mL.

Mean values of the samples in terms of delayed sedimentation varied between 14 - 40 mL. When the other studies conducted for delayed sedimentation feature are examined, it can be seen that Bilgin (2001) determined it is between 18,50 - 34,83 mL, Tayyar (2005) between 25 - 69 mL, and Egesel et al. (2009) between

21.0 - 34.7 mL. It was seen that the values found in these studies were in parallel with the values obtained in our study.

TGK (1999) states that the sedimentation value will not be regarded for the special wheat flour and whole wheat flour and that wheat flour for bread making should be at least 30 mL. It is also observed that the results obtained also show similarity with this value.

When the falling numbers of kavut flour are analyzed, it is seen that the falling number of sample obtained from village no 5 is quite high. This shows that the α-amylase enzyme activity in this samples is very low. The kavut flours of village no. 5 and 8 have the highest and the kavut flours belonging to village no. 7 and 10 have the lowest falling number. Flours that are inadequate for α-amylase content must be added with α-amylase preparations for high quality bread production. However, such an addition is not required for the production of kavut flour.

Colour is one of the important factors affecting the image and attractiveness of a product (Yalçın 2005). Colour and appearance are the first quality characteristics observed by the consumers. Table 2 shows the results of the colour analysis of kavut flours. When the color values were analyzed statistically, it was seen that there were statistically significant ($p < 0.05$) differences. L * value of kavut flours ranged from 64,10 to 79,37, the highest L * value (79.37) was determined in the kavut flour from village no. 7, and the lowest L * value (64,10) was determined in the flour from village no.4. The a ** value of kavut flour varied between 4,75 - 8,91. It was determined that the highest a ** value (8,91) belongs to village no. 4 and the lowest a ** value (4,75) belongs to the kavut flour obtained from village no. 10. The b *** values of kavut flours ranged from 19,43 to 26,24. The highest b *** value (26,24) was determined to belong to village no. 7 and the lowest b *** (19,43) belonged to the kavut flour obtained from village no. 3. It is seen that the traditional production has a significant effect on L *, a ** and b *** values ($p < 0.05$).

Table 2. Colour analysis results of kavut flours

Villages No.	Colour		
	L*	**a****	**b*****
1	$71,26 \pm 0,355^{f}$	$5,44 \pm 0,015^{d}$	$20,73 \pm 0,098^{g}$
2	$74,40 \pm 0,372^{d}$	$6,02 \pm 0,066^{c}$	$23,10 \pm 0,127^{e}$
3	$78,14 \pm 0,488^{b}$	$5,16 \pm 0,112^{e}$	$19,43 \pm 0,305^{h}$
4	$64,10 \pm 0,645^{g}$	$8,91 \pm 0,313^{a}$	$27,18 \pm 0,423^{a}$
5	$71,26 \pm 0,355^{f}$	$5,44 \pm 0,015^{d}$	$20,73 \pm 0,098^{g}$
6	$75,94 \pm 0,660^{c}$	$5,93 \pm 0,231^{c}$	$22,00 \pm 0,538^{f}$
7	$79,37 \pm 0,255^{a}$	$5,23 \pm 0,090^{de}$	$26,24 \pm 0,246^{b}$
8	$73,68 \pm 0,308^{de}$	$6,11 \pm 0,052^{c}$	$23,80 \pm 0,115^{d}$
9	$72,98 \pm 1,075^{e}$	$6,73 \pm 0,040^{b}$	$25,61 \pm 0,209^{c}$
10	$77,57 \pm 0,567^{b}$	$4,75 \pm 0,090^{f}$	$19,91 \pm 0,457^{h}$

L*: Lightness; a**: Redness; b***: Yellowness
There was a statistically significant difference with $p < 0.05$ between the averages indicated in different letters in the LSD test.

Karaoglu and Kotancılar (2005) found that barley flour was much more affected by roasting because it contains much bran. They observed that the colour of the flour was turned black with the increase in the proportion of barley flour in the formulation.

Bilgiçli and İbanoglu (2007) emphasized in their study about tarhana that they used wheat germ and bran as contribution and the use of these contributions caused the formation of dark colour by reducing the values of L * and b ***. Elgün et al. (1999) stated that the colour of high-yielded flour is darker than low - yielded flours. Yıldız (1993) also reported that the colour of the flour may vary depending on the type of wheat and the yield of the milled flour, and the hard wheat flour is generally yellowish and the soft wheat flour is relatively white. In addition, the colour of flour with a high yield is reported to be darker than low-yield flour.

Techno-functional properties of kavut flours

Water solubility index, water absorption index, oil absorption index, bulk density and compressed density analysis results of kavut flour are given in Table 3. In our study, water solubility indexes of kavut flours ranged between 2,16 - 4,16 g /g and were close to each other. While there was no statistically significant difference ($p < 0.05$) between the water solubility levels of kavut flours obtained from village no. 3 - 5, 6 - 8 and 2 – 7 - 10 (Table 3). High solubility in water is an indication that the amount of water - soluble substance dispersed to the environment during the cooking process is high. In addition, high value shows that the foods have also high adhesiveness and stickiness. The high WSI value reduces the ability to preserve the structure of the food during the cooking process (Keawpeng and Meenune 2012, Kraithoung et al. 2018, Shafi et al. 2016, Wang et al. 2016). The high quantity and quality of gluten is a characteristic determining the quality of wheat (Kent 1982). Gluten increases the water absorption index of the flour, and its structure is stabilized after dehydrated when it is heated to 85 °C (Bushuk and Wadhawan 1989). According to some researchers, the complexity of starch with proteins or lipids may reduce the WSI value due to the reduction of soluble components within the starch molecule (Kraithoung et al. 2018, Keawpeng and Meenune 2012).

Water absorption index is a parameter that indicates the level of interaction of flour with water molecules. The WAI values of kavut flours were found between 240,92 - 344,13 g/g (Table 3). These values are quite high compared to some research results made with different flours (Aydın and Gocmen 2015, Kraithong et al. 2018). Many researchers report that water retention capacity is related to the dietary fiber, protein content and physical state of the starch (Alkarkhi et al. 2011, Flade et al. 2014). The high WAI values suggest that the dietary fiber levels of the cumin flour samples are likely to be high. In addition, the fact that this value is an indicator that higher than hydrophilic groups within the starch molecules are large in number. These groups give the food softness, smoothness and viscosity (Aprianita et al. 2014, Alcazar-Alay and Meireles 2015, Aydın and Gocmen 2015, Kraithong et al. 2018). It is observed that kavut flours have very high techno-functional characteristic with high WAI value. Many researchers report that water absorption capacity is related to the dietary fiber, protein content and physical state of the starch (Alkarkhi et al. 2011, Flade et al. 2014).

Another functional feature of kavut flour is its oil absorption index. Oil is important in terms of mouth sensation of foods as it acts as a flavor preservative in foods. Rodriguez-Ambriz et al. (2008) reports that the oil absorption index is related to the hydrophilic structure of starch. In addition, oil absorption index of the fibers in grains is affected by fiber length and fiber particle size. As fiber length and particle size increase, its oil absorption index also increases (Anderson and Berry 2000, Burdurlu and Karadeniz 2003, Serdaroğlu and Yıldız-Turp 2004, Carbonell-Aleson et al. 2005). As can be seen in Table 3, it was observed that the results of oil absorption index analysis ranged between 2,19-2,63 g/g.

Table 3. Techno-functional properties of kavut flours [a]

Village No.	WSI (g/g)	WAI (g/g)	OAI (g/g)	BD (g/cm^3)	CD (g/cm^3)
1	2,16 ± 0,364[d]	344,13±3,381[a]	2,57±0,066[a]	12,66±0,763[b]	7,16±0,288[c]
2	3,28±0,091[abc]	276,24±4,804[e]	2,23±0,029[bc]	12,00±0,000[bc]	9,50±0,500[a]
3	3,89±0,740[ab]	336,30±3,150[b]	2,69±0,016[a]	14,16±1,755[a]	7,83±0,288[b]
4	2,78±0,236[cd]	240,92±0,204[g]	2,25±0,165[bc]	11,5±0,500[bcd]	5,00±0,000[ef]
5	3,93±0,462[ab]	291,25±4,412[d]	2,36±0,030[b]	12,00±0,000[bc]	6.66±0,288[cd]
6	3,12±0,567[bc]	247,48±5,886[fg]	2,19±0,026[c]	10,16±0,288[e]	5,33±0,577[e]
7	3,29±0,627[abc]	319,78±4,894[c]	2,26±0,054[bc]	10,33±0,288[de]	6.50±0,000[d]
8	3,15±0,064[bc]	254,25±3,954[f]	2,29±0,051[bc]	11,00±0,500[cde]	4,66±0,577[f]
9	4,16±0,962[a]	240,94±5,582[g]	2,63±0,145[a]	10,00±0,866[e]	6,83±0,288[cd]
10	3,30±0,230[abc]	291,60±3,271[d]	2,57±0,066[bc]	12,00±1,000[bc]	5,33±0,353[e]

WSI: Water Solubility Index, WAI: Water Absorption Index, OAI: Oil Absorption Index, BD: Bulk Density, CD: Compressed Density

[a] There was a statistically significant difference with $p < 0.05$ between the averages indicated in different letters in the LSD test.

The oil absorption index was determined to be the lowest in village no. 6 with 2,19 g/g, while the highest oil absorption index came from village no. 3 flour with 2,69 g/g. Sosulski and Cadden (1982) reported that wheat bran included 2,0 g/g oil absorption index. This value was observed to be quite low when compared to our results. It was also observed that it showed similar results (2,94 -1,95 g/g) in different studies (Mutlu 2002).

The bulk density values of kavut flours ranged between 10 - 14,16 g/cm^3 (Table 3). The lowest bulk density was determined to be in village no. 9 flour with 10 g/cm^3 while the highest was in village no. 3 flour with 14,16 g/cm^3. It was reported that the bulk density increased as the particle size increased (Kraithong et al. 2018). The differences in the bulk density analysis results were connected to the particle size of the kavut flour.

Compressed density analysis results were observed to vary between 4,66 - 9,5 g/cm^3 (Table 3). The lowest compressed density was determined with 4,66 g/cm^3 in village no. 8 while the highest compressed density was determined with 9,5 g/cm^3 in the flour of village no. 2. According to Abdullah and Geldart (1999), the bulk and compressed density will be increased with decreasing volume, and this is because the free flowing powders can be associated with less tendency to subside while thin and sticky powders tend to subside more and faster.

CONCLUSIONS

Despite the differences of ingredient compositions, kavut flours have quite good techno-functional properties (WAI, WSI, OAI and Bulk density). The fact that consumers turn to more natural and healthier foods every passing day makes kavut and similar products more attractive. It can be used as an additive to increase the nutritional value and improve the functional properties of some products (bakery products, deserts etc.) directly after making some improvements in the proportions of the ingredients and processing parameters according to the consumer preferences.

REFERENCES

AACC (2008). Standard Methods of International Association for Cereal Science and Technology (ICC), Vienna, Austria.

Abdullah EC and Geldart D (1999). The use of bulk density measurements as flowability indicators. Powder Technology, 102:151-165.

Acıduman A, Er U and Belen D (2007). Osmanlı döneminden ''Yazarı Bilinmeyen Cerrahname''. Türk Nöroşirürji Dergisi, 17(3):162-169.

Alcazar-Alay SC and Meireles MAA (2015). Physico-chemical properties, modifications and applications of starches from different botanical sources. Food Science Technology, 35: 215-236.

Algül H, Yiğit İ, Savaş R, Demircan A and Avcı C (2013). İlk dönem islam tarihi. T.C. Anadolu Üniversitesi Paper No:2054, Açıköğretim Fakültesi Paper No:1088, 255p.

Alkarkhi AFM, Ramli SB, Yong YS and Easa AM (2011). Comparing physic-chemical properties of banana pulp and peel flours prepared from green and ripe fruits. Food Chemistry, 129: 312–318.

Altınbaş M, Tosun M, Yüce S, Konak C, Köse E and Can RA (2004). Ekmeklik buğdayda (T. aestivum l.) tane verimi ve bazı kalite özellikleri üzerinde genotip ve lokasyon etkileri. Ege Üniversitesi Ziraat Fakültesi Dergisi, 41(1): 65-74.

Anderson ET and Berry BW (2000). Sensory, shear and cooking properties of lower- fat beef patties made with inner pea fiber. Food Chemistry and Toxicology, 65(5):805-810.

Anonymous (2004). Tarhana Standardı (TS 2282). Türk Standartları Enstitüsü, Ankara.AOAC (1990). Official methods of analysis of association of official analytical chemists. Washington, DC, USA.

Aprianita A, Vasiljevic T, Bannikova A and Kasapis S (2014). Physico-chemical properties of flours and starches derived from traditional Indonesian tubers and roots. Journal of Food Science and Technology, 51:3669-3679.

Atlı A, Koksel H and Dağ A (1988). Unda süne ve kımıl zararının belirlenmesi için geliştirilen yöntemler ve bu yöntemlerin uygulanabilirliği üzerine araştırmalar. Tarla Bitkileri Merkez Enstitüsü Paper No:3, Ankara.

Aydın E and Göçmen D (2015). The influences of drying method and metabisulfite pre- treatment on the color, functional properties and phenolic acids contents and bioaccessibility of pumpkin flour. LWT- Food Science and Technology, 60:385-392.

Azizi MH, Sayeddin SM and Payghambardoost SH (2006). Effect of flour extraction level on flour composition, dough rheological characteristics and quality of flat bread. Journal of Agriculture Science Technology, 8: 323-330.

Baysal A (1997). Türk mutfağında pekmez ve ürünleri. V. Milletlerarası Türk Halk Kültürü Kongresi, Halk Kültürünü Araştırma ve Geliştirme Genel Müdürlüğü Yayınları, 249: 118- 124.

Bilgiçli N and İbanoğlu Ş (2007). Effect of wheat germ and wheat bran on the fermentation activity, phytic acid content and colour of tarhana, a wheat flour-yoghurt mixture. Journal of Food Engineering, 78:681-686.

Bilgin O (2001). Bazı ekmeklik buğday (Triticum aestivum L.) çeşit ve hatlarında genetik uzaklıklar, verim ve kalite özelliklerinin belirlenmesi. Doktora Tezi, Trakya Üniversitesi Fen Bilimleri Enstitüsü Tarla Bitkileri Anabilim Dalı, Tekirdağ.

Bojnanska T and Francakova H (2002). The use of spelt wheat (Triticum spelta L.) for baking applications. Rostlınná Výroba, 48(4): 141-147.

Burdurlu HS and Karadeniz F (2003). Gıdalarda diyet lifin önemi. Gıda Mühendisliği Dergisi, 7(15):18-25.

Bushuk W and Wadhawan C (1989). Wheat gluten is good not only for breadmaking: In Wheat is Unique, Ed: Pomeranz, Y., AACC, St Paul, Minnesota, 263p.
Cano-Chauca M, Stringheta PC, Ramos AM and Cal-Vidal J (2005). Effect of the carriers on the microstructure of mango powder obtained by spray drying and its functional
characterization. Innovative Food Science and Emerging Technology, 6(4):420-428.
Carbonell-Aleson L (2005). Charecteristics of beef burger as influenced by various types of lemon albedo. Innovative Food Science and Emerging Technology, 6:247-255.
Çevik A (2016). Tarhananın besinsel zenginleştirilmesinde kinoa, karabuğday ve lüpen unlarının kullanımı. Yüksek Lisans Tezi, Necmettin Erbakan Üniversitesi, Fen Bilimleri Enstitüsü, Gıda Mühendisliği Anabilim Dalı, Konya.
Demir MK (2018). Geleneksel tarhana üretiminde tam buğday unu kullanımı. Akademik Gıda, 16(2):148-155.
Egesel CÖ, Kahrıma F, Tayyar S and Baytekin H (2009). Ekmeklik buğdayda un kalite özellikleri ile dane veriminin karşılıklı etkileşimleri ve uygun çeşit seçimi. Anadolu Tarım Bilimleri Dergisi, 24(2):76-83.
Ekinci R and Ünal SS (2001). Tükiyenin farklı bölgelerinde üretilen değişik un tiplerinin tiamin ve riboflavin miktarları. *Pamukkale Üniversitesi Mühendislik Bilimleri Dergisi*, 8(3):343-348.
Ekmekçi S, Cenik N and Dinç M (1996). Bölgelere göre Türkiye buğday kalitesi harita çalışması. 2. Un, Bulgur ve Bisküvi Sempozyomu, 28-30 Mayıs, Karaman.
Elagib E, Bureng E and Mohamed B (2004). Proteins and baking quality of three Sudanese wheat cultivars I. The relationship between protein soluble fractions and breadmaking properties. Journal of Agricultural Science, 12 (3):391-404.
Elgün A, Ertugay Z, Certel M and Kotancılar HG (1999). Tahıl ürünlerinde analitik kalite kontrolü ve laboratuvar uygulama kılavuzu. Ankara Üniversitesi Ziraat Fakültesi Paper No: 335, Erzurum.
Erkul A (2006). Sulamalı koşullarda ileri ekmeklik buğday (Triticum aestivum) hatlarının tane verimi ve bazı kalite özelliklerinin belirlenmesi. Adnan Menderes Üniversitesi Ziraat Fakültesi Dergisi, 3(1):27-32.
Flade KO, Semon M, Fadario OS, Oladunjoye AO and Orou KK (2014). Functional and physico-chemical properties of flours and starches of African rice cultivars. Food Hydrocolloids, 39:41-50.
Hede AR, Lozono-Del Rio J, Bejar-Hinojose M and Rivadeneria M (2001). Triticale for feed and forage: case studies from Mexico and Ecuador. Proceedings of the Warren E. Kronstad Symposium (ISBN 970-648-084-6), 15-17 March, Mexico.
Hung PV, Tomoko M and Naofumi M (2007). Dough and bread qualities of flours with whole waxy wheat flour substitution. Food Research International, 40:273-279.
İnayet A (2006). Divanü Lügati't Türk'te doğumla ilgili örf adet ve ritüeller. Divanü Lugat-it- Türk, 3:163.
Jinapong N, Suphantharika M and Jamnong P (2008). Production of instant soymilk powders by ultrafiltration, spray drying and fluidized bed agglomeration. Journal of Food Engineering, 84(2): 194–205.
Kahraman T, Avcı R and Öztürk İ (2008). Islah çalışmaları sonucu geliştirilen bazı ekmeklik buğday hatlarının tane verimi ve bazı kalite özelliklerinin belirlenmesi. Ülkesel Tahıl Sempozyumu, 2-5 Haziran, Konya.
Karaoğlu MM and Kotancilar HG (2005). Kavut, a traditional Turkish cereal product: production method and some chemical and sensorial properties. International Food Science and Technology, 40:1-9.
Keawpeng I and Meenune M (2012). Physico-chemical properties of organic and inorganic Phatthalung Sungyod rice. International Food Research Journal, 19:857-861.
Kent NL (1982). Technology of cereals. Pergamon Press, USA.Kilci A (2012). Yulaf katkısının tarhana kalitesine etkisi. Yüksek Lisans Tezi, Bursa Uludağ Üniversitesi, Fen Bilimleri Enstitüsü, Gıda Mühendisliği Anabilim Dalı, Bursa.
Kraithong S, Lee S and Rawdkuen S (2018). Physico-chemical and functional properties of Thai organic rice flour. Journal of Cereal Science, 79:259-266.
Krejčířová L, Capouchová I, Bicanová E and Faměra O (2008). Storage protein composition of winter wheat from organic farming. Scientia Agriculturae Bohemica, 39(1):6-11.
Kuşat N (2012). Bölgesel kalkınmada geleneksel gıda ürünlerinin rolü ve geleneksel gıdalarda inovasyon belirleyicileri üzerine bir çalışma: Afyon örneği. Yönetim ve Ekonomi, 19(2):261-275.
Lukow OM and McVetty PBE (1991). Effect of cultivar and environment on quality Characteristics on spring wheat. Cereal Chemistry, 68(6): 597-601.
Menteş-Yılmaz Ö (2011). Türkiye'de yetiştirilen başlıca buğday çeşitlerinin antioksidan aktivitelerinin ve fenolik asit dağılımlarının belirlenmesi ve ekmeğin nar kabuğu ekstraktı ile zenginleştirilmesi. Doktora Tezi, Ankara Üniversitesi, Fen Bilimleri Enstitüsü, Gıda Mühendisliği Anabilim Dalı, Ankara.
Mutlu M (2002). Yağı alınmış, öğütülmüş üzüm çekirdeği ile diğer bazı ticari lif kaynaklarının fizikokimyasal özelliklerinin karşılaştırılması. Yüksek Lisans Tezi, İstanbul Teknik Üniversitesi, Fen Bilimleri Enstitüsü, İstanbul.
Onurlubaş E and Taşdan K (2017). Geleneksel ürün tüketimini etkileyen faktörler üzerine bir araştırma. Bolu Abant İzzet Baysal Üniversitesi Sosyal Bilimler Enstitüsü Dergisi, 17(17):115-132.
Özkaya H and Özkaya B (2005). Öğütme teknolojisi. Gıda Teknolojisi Derneği Paper No: 130, 757p.
Peköz E (2018). Asr-ı saâdette müslümanlığın medeniyete hizmetleri. Iğdır Journal of Islamic Research, 29(1): 117-29.
Prabhasankar P and Rao P (2001). Effect of different milling methods on chemical composition of whole wheat flour. European Food Research and Technology, 213(6):465- 469.
Rehman ZU and Shah WH (1999). Biochemical changes in wheat during storage at three temperatures. Plant Foods for Human Nutrition, 54:109-117.
Rehman ZU (2006). Storage effects on nutritional quality of commonly consumed cereals. Food Chemistry, 95: 53-57.
Rodriguez-Ambriz SL, Islas-Hernández JJ, Agama-Acevedo E, Tovar J and Bello-Pérez LA (2008). Characterization of a fiber-rich powder prepared by liquefaction of unripe banana flour. Food Chemistry, 107: 1515-1521.

Serdaroğlu M and Yıldız Turp G (2004). Diyet lifi ve et ürünlerinde diyet lifi kullanılması. Akademik Gıda Dergisi, 2(10):18-21.

Shafi S, Wani IA, Gani A, Sharma P, Wani HM, Masoodi FA, Khan AA and Hamdani AM (2016). Effect of water and ether extraction on functional and antioxidant properties of Indian horse chestnut (Aesculus indica Colebr) flour. Food Measurement and Characterization, 10:387-395.

Sosulski FW and Cadden AM (1982). Composition and pysiolocigal properties of several sources of dietary fiber. Journal of Food Science, 47:1472-1476.

Sözen E and Yağdı K (2005). Bazı ileri makarnalık buğday (Triticum durum Desf.) hatlarının kalite özelliklerinin belirlenmesi. Uludag Üniversitesi Ziraat Fakültesi Dergisi, 19(2):69-81.

TGK (1999). Türk Gıda Kodeksi- Buğday Unu Tebliği. Resmi Gazete, 23614.

Taghouti M, Gaboun F, Nsarellah N, Rhib R, El-Hilal M, Kamarl M, Abbad Andaloussil F and Udupa SM (2010). Genotype x environment interaction for quality traits in durum wheat cultivars adapted to different environments. *African Journal of Biotechnology*, 9(21):3054-3062.

Tayyar Ş (2005). Biga koşullarında yetiştirilen farklı ekmeklik buğday (Triticum aestivum L.) çeşit ve hatlarının verim ve bazı kalite özelliklerinin saptanması. Akdeniz Üniversitesi Ziraat Fakültesi Dergisi, 18(3):405-409.

Uylaşer V and Başoğlu F (2011). Temel gıda analizleri. Dora Yayıncılık, Bursa, 125p.

Ünal SS, Olçay M and Özer Ç (1996). Bazı ekmeklik buğday çeşitlerinin kalite niteliklerinin belirlenmesi. Gıda, 21(6):451-456.

Ünal SS (2002). Buğdayda kalitenin önemi ve belirlenmesinde kullanılan yöntemler. Hububat Ürünleri Teknolojisi Kongre ve Sergisi, 3-4 Ekim, Gaziantep.

Ünal Y (2016). Refik Halit Karay'ın eserlerinde batı imgesi. Bartın Üniversitesi Çağdaş Türkiye Tarihi Araştırmaları Dergisi, 16(33):307-324.

Wang L, Guo J, Wang R, Shen C, Li Y, Luo X, Li Y and Chen Z (2016). Studies on quality of potato flour blends with rice flour for making extruded noodles. Cereal Chemistry, 93:593- 598.

Verwimp T, Vandeputte GE, Marrant K and Delcour JA (2004). Isolation and characterization of rye starch. Journal of Cereal Science, 39(1):85-90.

Yalçın S (2005). Glutensiz erişte üretimi üzerine bir araştırma. Yüksek Lisans Tezi, Hacettepe Üniversitesi, Fen Bilimleri Enstitüsü, Ankara.

Yıldız G (1993). Sivas ilinde kullanılan unların bildirilen tipleri ile gerçek tipleri arasındaki farklar ve bazı kimyasal bileşimlerinin 'buğday unu' standartlarına uygunluğu üzerine bir araştırma. Yüksek lisans tezi, Cumhuriyet Üniversitesi, Fen Bilimleri Enstitüsü, Sivas.

Yılmaz B (2010). Ardahan türkmenleri müzik geleneği. Yüksek Lisans Tezi, İstanbul Teknik Üniversitesi, Sosyal Bilimler Enstitüsü, İstanbul.

Zecevic V, Kneževıc D and Mıcanovıc D (2007). Variability of technological quality components in winter wheat. Genetika, 39(1):365-374.