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Research Article

Diversity in Protein Characteristics of Some Wheat Varieties

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Abstract

The objective of this study is to evaluate protein characteristics of five wheat varieties. These varieties are Tosunbey (Turkey), Urfasert (Turkey), Esperia (Italy), Odeska (Ukraine) and imported wheat blend (Russia). Tosunbey, Urfasert, Esperia and Odeska were harvested in Turkey. Protein is an important component of wheat and influences the quality of wheat products. The hectoliter weight of wheat samples and gluten quality (gluten index, zeleny sedimentation, modified sedimentation) and rheological properties (extensograph) of flour samples were analyzed. Extensibility (mm), resistance to extension (BU) and maximum resistance (BU) values of samples were determined at 45, 90 and 135 min proving time. The results showed that the wheat samples were significantly different from each other in terms of hectoliter weight. Urfasert wheat flour had the lowest gluten index value, zeleny sedimentation value and modified sedimentation value in all samples. The other samples had statistically similar gluten index values. Zeleny sedimentation and modified sedimentation values of Russian wheat blend flour were significantly higher than those of the other samples. Russian wheat blend sample had also the highest resistance to extension and maximum resistance values at 45 min proving time. The extensibility value of Tosunbey wheat sample at all proving times was statistically similar to that of other wheat samples. The highest maximum resistance values at 90 and 135 min proving time were observed for Russian wheat blend sample. It was concluded that Russian wheat blend sample imported from Russia had high gluten quality, while Urfasert wheat sample harvested in Turkey had low gluten quality.

Keywords: Extensograph, sedimentation, gluten

Bazı Buğday Çeşitlerinin Protein Karakterizasyonundaki Farklılık

Öz

Bu çalışmanın amacı, beş buğday çeşidinin protein karakterini değerlendirmektir. Bu çeşitler Tosunbey (Türkiye), Urfasert (Türkiye), Esperia (İtalya), Odeska (Ukrayna) ve ithal buğday karışımıdır (Rusya). Tosunbey, Urfasert, Esperia ve Odeska, Türkiye'de hasat edilmiştir. Protein, buğdayın önemli bir bileşenidir ve buğday ürünlerinin kalitesini etkilemektedir. Buğday örneklerinin hektolitre ağırlığı ve gluten kalitesi (gluten indeks, Zeleny sedimentasyon, modifiye sedimentasyon ve un örneklerinin reolojik özellikleri (ekstensograf) analiz edilmiştir. Örneklerin ekstensibilite (mm), uzamaya karşı direnç (BU) ve maksimum direnç (BU) değerleri, 45, 90 ve 135 dakika bekleme sürelerinde değerlendirilmiştir. Sonuçlar bütün buğday örnrklerinin hektolitre ağırlığı cinsinden istatistiksel olarak farklı olduğunu göstermiştir. Urfasert buğday unu tüm örneklerde en düşük gluten indeks değeri, Zeleny sedimentasyon değeri ve modifiye sedimentasyon değerine sahiptir. Rusya buğday karışımının Zeleny sedimentasyon ve modifiye sedaimentasyon değerleri, diğer buğdayların aynı değerlerinden istatistiksel olarak yüksek bulunmuştur. Rusya buğday karışımı örneği 45. Dakika beklemede en yüksek uzamaya karşı direnç ve maksimum direnç değerine sahiptir. Tosunbey buğday örneğinin, bütün sürelerindeki ekstensibilite değeri, diğer buğday örneklerinin aynı değerlerine istatistiksel olarak benzer bulunmuştur. 90 dk ve 135. dakika en yüksek maksimum direnç değerini, Rusya buğday karışımı vermiştir. Sonuçlara bakıldığında, Rusya buğday karışımı yüksek gluten kalitesine sahipken, Urfasert buğday örneği düşük gluten kalitesine sahip olmuştur.

Anahtar Kelimeler: Ekstensograf, sedimentasyon, gluten

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1. Introduction

Protein is an important component of wheat and affects the quality of wheat products. The ratio of gliadin and glutenin proteins in wheat influences dough properties. More varied dough properties were obtained with increasing of high molecular weight (HMW) glutenin subunit number in flour and provide to improve of bread making properties (Sissons, 2008).

Katyal et al. (2016) studied the flour and protein characteristics of Indian wheat varieties. It was reported that ash and protein contents of flours milled from various wheat samples ranged from 0.31% to 0.50% and from 8.89 % to 12.77 %, respectively. L*, a* and b* color values of wheat varieties ranged from 92.12 to 94.58, from 0.11 to 0.40 and from 7.77 to 11.55, respectively. It was also reported that sedimentation values of samples ranged from 27.8 to 51 mL Ktenioudaki et al. (2010) investigated rheological properties of eight wheat samles from various geographical regions. These varieties were Herewand (UK), Raffles (Ireland), Tzeneroso (Greece), Cordrale (Ireland), Malacca (UK), Tzemele (Greece), Caphorn (France) and Canadian blend (mix of at least three wheat samples). Control flour was grist of several Irish wheat varieties. It was reported that protein content of wheat samples ranged from 8.2 % to 13.4 % and Canadian blend had the highest protein content, whereas Irish wheat samples and Greek wheat samples had the lowest protein content. Although two Irish wheat varieties and two Greek wheat samples had similar protein content differences was observed in uniaxial extension. Irish wheat samples had high maximum resistance to extension and low extensibility, while Greek wheat samples had low maximum resistance to extension and high extensibility. Aalami et al. (2007) investigated the physical properties of six Indian durum wheat and physicochemical and rheological properties of semolina samples and reported that hardness of these wheat varieties was high and relationships between semolina characteristics (total protein, scanning electron mixographs, farinographs) were strong. Kibar (2015) evaluated the effect of storage conditions (180 days) on the properties of wheat samples (cv. Bezostaja and Lancer). It was reported that zeleny sedimentation value and dry gluten content increased when stored until two monts and then decreased, while falling number increased with increasing of storage period. Karaman and Sağdıç (2018) investigated the effects of phytase active lactic acid bacteria and yeast isolates on dough rheology of whole wheat bread and reported that dough rheology changed significantly according to the culture combination. Alkay et al. (2020) reported that sourdoughs provide better rheology compared to products obtained using commercial yeast. Mustafa and Dizlek (2020) reported that hectoliter weight, zeleny sedimentation and modified sedimentation values of Adana-99 were 83.1 kg, 38 mL and 31 mL while those of wheat imported from Russia were 82.7, 32 mL and 20 ml, respectively.

The aim of this study is to evalute the differences in protein characteristics of flours milled from some wheat samples.

2. Material and Method

2.1. Materials

Five wheat varieties, harvested between the years of 2014 and 2015, were obtained from Tınaztepe Flour Factory (Afyon, Turkey). These samples are Tosunbey, Urfasert, Esperia, Odeska and Russian blend. Wheat varieties were milled and sifted to under 1 mm.

2.2. Hectoliter weight of grains

Hectoliter weight of wheat varieties was determined according to the AACC method 55-31 (AACC, 2000).

2.3. Protein content

Protein content (Nx5.70, dry weight) of the flours milled from different wheat varieties was determined according to AACC 46-10 method (AACC, 2000).

2.4.Gluten index value

Gluten index value of the flours milled from different wheat samples was analyzed according to AACC 38-10 method (AACC, 2000). Gluten index value determines gluten characteristics in terms of weak or strong.

2.5. Sedimentation value

Zeleny sedimentation and modified sedimentation values of the flours milled from different wheat samples were determined according to the ICC method no 116/1(ICC, 1994).

2.6. Extensograph properties

The extensibility, the maximum resistance to extension and maximum resistance values of the samples were determined according to ICC method no 114/1 (ICC, 1992) by using Brabender Extensograph (Type 860000, Brabender OHG, Duisburg, Germany). A piece of dough was moulded on the balling unit of the Extensograph and shaped into a standard cylindirical shape. The test piece was allowed to rest for 45 min, 90 min and 135 min in the Extensograph rest cabinet. After the resting period, a look stretched the dough until rupture occuved.

2.7. Statistical analysis

Analysis of variance was used to test the data and the difference among the means were compared using Duncan test.

3. Results and Discussion

3.1. Grain characteristics

Hectoliter weight of the five wheat varieties is given in Table 1. Hectoliter weight of the five wheat varieties ranged from 75.20 kg/hl to 80.90 kg/hl (Table 1). Hectoliter weight is an indicator of wheat quality and flour yield (Gooding and Davies, 1997, Posner and Hibbs, 2005; Manley et al., 2009). Urfasert wheat sample has the highest hectoliter weight, while Russian wheat blend sample showed the lowest hectoliter weight in all samples. All wheat samples had hectoliter weight values above the reference used in the synthetic index of quality (75.00 kg/ hl). The hectoliter weight value of Tosunbey wheat sample was not statistically different from that of Urfasert wheat sample and Odeska wheat sample. The hectoliter weight of Russian wheat blend sample was not statistically different from that of Esperia wheat sample and Odeska wheat sample. These values are similar to the results of the study reported by Migliorini et al. (2016). Average hectoliter weight of wheat samples cultivated in Italy was found as 74.2 kg/hl (Migliorini et al., 2016).

Table 1. Hectoliter weight values of the five wheat varieties

Samples	Hectoliter weight (kg/hL)
Tosunbey	79.70 ab
Urfasert	80.90 a
Esperia	75.20 d
Odeska	77.75 bc
Russian	77.00 cd

Mean values in the same column are significantly different ($p<0.05$).

3.2. Protein content

Protein content of flours milled from five wheat samples ranged from 10.8 % to 12.2% (dw).

3.3. Gluten index value of flour samples

Gluten index value of flours milled from five wheat samples is given in Table 2. Gluten index value of samples ranged from 75.5 to 98.0 (Table 2). Flours of Tosunbey, Esperia, Odeska wheat sample and Russian wheat blend sample showed significantly higher gluten index values than that of Urfasert wheat sample. There was no significant difference among the gluten index values of Tosunbey, Esperia, Odeska wheat samples and Russian wheat blend sample. Gluten index is an indicator of the polydisperse polymer quantity in developed gluten (Edwards et al., 2007). Optimum gluten index value is 65-80. Gluten index value more than 80 expresses strong gluten (Migliorini et al., 2016). The wheat samples except Urfasert wheat sample had strong gluten, while Urfasert wheat sample had optimum gluten index value. According to Migliorini et al. (2016), gluten index is correlated with the strength and elasticity of gluten protein. Migliorini et al. (2016) reported that wheat samples, which were cultivated in Italy, had gluten index values of 57-80.3 and affected by the year (the gluten index values of the wheat varieties of 2012 was higher than those of 2011).

3.4. Sedimentation values of flour saples

Zeleny sedimentation values and modified sedimentation values of flours milled from five wheat samples are given in Table 2. Zeleny sedimentation value of flours milled from different wheat samples ranged from 21.0 to 50.5 ml, while modified sedimentation values of flours milled from different wheat samples ranged from 23.0 to 64.0 ml (Table 2). These values are similar to results of the study reported by Kaur et al. (2013). It was reported that flours milled from different Indian wheat varieties had zeleny sedimentation values between 36 and 56 ml. Katyal et al. (2016) demonstrated that there was a strong positive relation between protein content and sedimentation value (R=0.739). Urfasert wheat sample showed the lowest zeleny sedimentation value, whereas Russian wheat blend sample showed the highest zeleny sedimentation value. The zeleny sedimentation value of Tosunbey wheat sample was not statistically different from that of Esperia wheat sample and that of Odeska wheat sample. The highest modified sedimentation value was obtained by Russian wheat blend sample, while the lowest modified sedimentation value was obtained by Urfasert wheat sample. The modified sedimentation value of Esperia wheat sample was not statistically different from that of Tosunbey wheat sample and Odeska wheat sample.

Table 2. Quality characteristics of the flours milled from the five wheat varieties

Samples	Gluten index	Zeleny sedimentation (mL)	Modified sedimentation (mL)
Tosunbey	95.0 a	31.5 b	32.0 c
Urfasert	75.5 b	21.0 c	23.0 d
Esperia	98.0 a	36.0 b	39.0 bc
Odeska	97.0 a	37.0 b	42.0 b
Russian	98.0 a	50.5 a	64.0 a

Mean values in the same column are significantly different ($p<0.05$).

3.5. Extensograph properties

The results of the extensograph analyses are given in Table 3, 4 and 5. The rheological properties of wheat dough are considered of great importance in determining the baking quality of wheat flours. Russian wheat blend sample had the highest resistance to

extension, maximum resistance and also the highest extensibility, while Urfasert wheat sample had the lowest extensibility at 45 min proving time (Table 3). The resistance to extension of Esperia wheat sample was not statistically different from that of other wheat samples (Table 3). The extensibility of Tosunbey wheat sample was not statistically different from that of other wheat samples (Table 3). According to the results in Table 4 and Table 5, resistance to extension and extensibility of samples were not statistically different from each other at 90 min or 135 min proving time. The maximum resistance of Russian wheat blend sample was the highest at 90 min or 135 min proving time (Table 4 and Table 5). Ktenoudaki et al. (2010) reported that two Irish wheat varieties had high maximum resistance to extension and low extensibility, while two Greek wheat varieties had low maximum resistance to extension and high extensibility. Canadian blend had the highest maximum resistance to extension and the highest extensibility. Gupta et al. (1993) reported that HMW glutenin subunits affect maximum resistance, while the extensibility is affected by HMW glutenin subunits and also LMW glutenin subunits.

Table 3 Extensograph properties of the flours milled from the five wheat varieties (Proving time: 45 min)

Samples	Resistance to extension (BU)	Extensibility (mm)	Maximum resistance (BU)
Tosunbey	348.5 b	130.0 ab	425.0 b
Urfasert	353.5 b	119.5 b	373.5 b
Esperia	437.0 ab	139.5 a	558.0 b
Odeska	380.0 b	130.0 ab	457.0 b
Russian	549.5 a	143.0 a	780.5 a

Mean values in the same column are significantly different ($p<0.05$).

Table 4. Extensograph properties of the flours milled from the five wheat varieties (Proving time: 90 min)

Samples	Resistance to extension (BU)	Extensibility (mm)	Maximum resistance (BU)
Tosunbey	485.0 a	114.5 a	543.0 b
Urfasert	466.0 a	117.5 a	484.5 b
Esperia	544.5 a	132.0 a	684.5 ab
Odeska	516.5 a	121.5 a	608.5 b
Russian	794.0 a	121.5 a	1046.5 a

Mean values in the same column are significantly different ($p<0.05$).

Table 5. Extensograph properties of the flours milled from the five wheat varieties (Proving time: 135 min)

Samples	Resistance to extension (BU)	Extensibility (mm)	Maximum resistance (BU)
Tosunbey	484.5 a	109.5 a	532.5 b
Urfasert	470.5 a	112.5 a	485.0 b
Esperia	561.5 a	121.0 a	666.5 ab
Odeska	561.0 a	112.5 a	638.0 ab
Russian	777.5 a	119.5 a	989.0 a

Mean values in the same column are significantly different ($p<0.05$).

4. Conclusions and Recommendations

Protein quality characteristics of different wheat varieties were evaluated in this study. Hectoliter weight of grains, gluten index value, zeleny sedimentation value, modified sedimentation value and extensograph properties (resistance to extension, extensibility and maximum resistance at 45 min, 90 min and 135 min proving time) of flours milled from five wheat varieties (Tosunbey, Urfasert, Esperia, Odeska, Russian blend) were analyzed. The highest hectoliter weight value was obtained by Urfasert wheat variety in all wheat varieties. Urfasert wheat variety had significantly lowest gluten index value, zeleny sedimentation value and extensibility in all wheat samples. Russian wheat blend sample had significantly highest zeleny sedimentation value and resistance to extension. Ranging from the weaker to stronger type, the four quality are defined as wheat for biscuits, ordinary bread making wheat, superior bread making wheat and improved wheat (Borasio, 1997). This classification is suitable for industrial processing which require grains with a high gluten content and high dough strength in order to obtain standardized loaves. Results of this study indicated that Russian wheat blend sample had high gluten quality, whereas Urfasert wheat sample had low gluten quality. This study gives important knowledge about wheat quality for flour factories.

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