COLOUR MEASUREMENT OF HUNGARIAN WHEAT GRITS WITH DIFFERENT HARDNESS INDEX

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Abstract
Nowadays wheat has spread all over the world to its various usefulness. The colour of wheat grits is very important for the milling and baking industry, because its colour determines the colour of products made of it. The instrumental colour measuring is used first of all for durum wheat. We investigated the relationship between colour characteristics and grain size in case of differently hard aestivum wheats. We determined the colour using the CIE 1976 L^* , a^*, b^* colour system measured by MINOLTA CR-300 tristimulus colorymeter. After screening the colour of different grain size fraction of wheat grits was measured wet and dry. We determined the L, a*, b* colour coordinates and the whiteness index too. To evaluate the values, that we had obtained, we used analysis of variance and regression analysis. We pointed out that the colour of wheat grits with different grain size is dependent on the hardness index of wheat. The lightness coordinate (L*) of grits of the harder wheat is smaller and a* and b* coordinates are higher. We also found out that while the grain size rises the L* coordinate decreases and a* , b* values increase in case of every type of wheat. The colour of grits is determined by the colour of fraction of 250-400 μm size , independently from the average grain size. The whiteness index and the L* colour coordinate have a linear relation (R^2=0,9151), so the determination of whiteness index is not necessary. The L* value right characterises the whiteness of grits.*

Keywords: Colour measurement, wheat grits, colour of wheat

INTRODUCTION

Wheat grindings are one of the most important and most frequently used raw materials. As for every alimentary product, also for the wheat grindings the colour is an important paramenter, which gives a primary image of it. Especially for the durum wheat pasta, since they do not contain eggs. This explains the fact that instrumental colour measurements are applied on durum semolinas also in industrial practice. In the literature various research results report on colour measurements of wheat grindings.

Oliver et al. (1993) already in 1993 showed during the qualification, that the ash-content influences the colour of the flours. Halászné et al.(1995) proposed a qualification system based on the colour measurements of durum semolina.

D'egido and Pagani (1997) compared the colour characteristics of pasta made of durum flours obtained by different grinding procedures.

During the product manufacturing the colour characteristics were mainly used to determine the appropriate roastedness (Hotti et al., 2000). Humphries et al. (2004) found a correlation between CIE b* and lutein concentration of wheat. Konopka et al. (2004) established a relation between the colour characteristics of the flours and their lipid and colorant content. Gökmen and Senyuva (2006) investigated the effect of heating on the colour parameters of wheat flour. László et. al. (2008) examined effects of ozone, UV and combined ozone/UV treatment on the colour of wheat flour. Lamsal and Faubion (2009) studied effect of an enzyme preparation on wheat flour and dough colour and depicted, that enzyme preparation did not improve lightness (L*) and yellowness (b*) of flour system, but benzoyl peroxide sharply reduced b*.

We investigated how the colour characteristics depend on the grain size and hardness index of wheat. The relationship between the lightness coordinate and whiteness index was analysed too.

MATERIALS AND METHODS

In course of our investigation we used three different hard wheat. We can see their genus and hardness indexes in Table 1. At first the samples were milled in drawn and air-dry condition then their colour characteristics were measured.

Table 1.

Wheat genus and their hardness index

Wheat genus	Hardness index
GK-Jubilejnaja-50 (J-50)	80,44
GK-Öthalom (Öthalom)	71,66
GK-Mérő (Mérő)	20,78

After then 250 gram of grits made of different wheat types was screened for 10 minutes to separate different grain size particle. The Table 2. shows grading limits of fractions. Then we measured the mass and colour coordinates of parts.

Table 2

Grading limits of classes

Grading limits of classes
0 µm – 100 µm
100 µm – 250 µm
250 µm – 400 µm
400 µm – 600 µm
600 µm – 800 µm
800 µm – 1000 µm
1000 µm – 1250 µm

We determined the colour using the CIE 1976 L^* , a^*, b^* colour system measured by MINOLTA CR-300 tristimulus colorymeter. We applied to define the difference between two colour point the value ΔE^*_{ab} colour difference (Park, 1993).

$$\Delta E^*_{ab} = \sqrt{\left(L^*_1 - L^*_2\right)^2 + \left(a^*_1 - a^*_2\right)^2 + \left(b^*_1 - b^*_2\right)^2}$$

The L* (lightness), a* (redness) and b*(yellows) parameters and whiteness index (WI) were measured. Measurements were made on 5 parallel samples and the colour coordinates were measured dry and wet. We estimated the measured values using analysis of variance and regression analysis (Rice, 1995).

RESULTS AND DISCUSSION

Effect of grain size on colour coordinates

Results of analysis of variance were calculated on colour parameters of different grain size fractions in case of J-50, Öthalom and Mérő wheats were similar. The L* lightness coordinate, a* redness coordinate and b* yellowness coordinate were influenced significantly by grain size. We present only result was given in case of J-50 wheat.

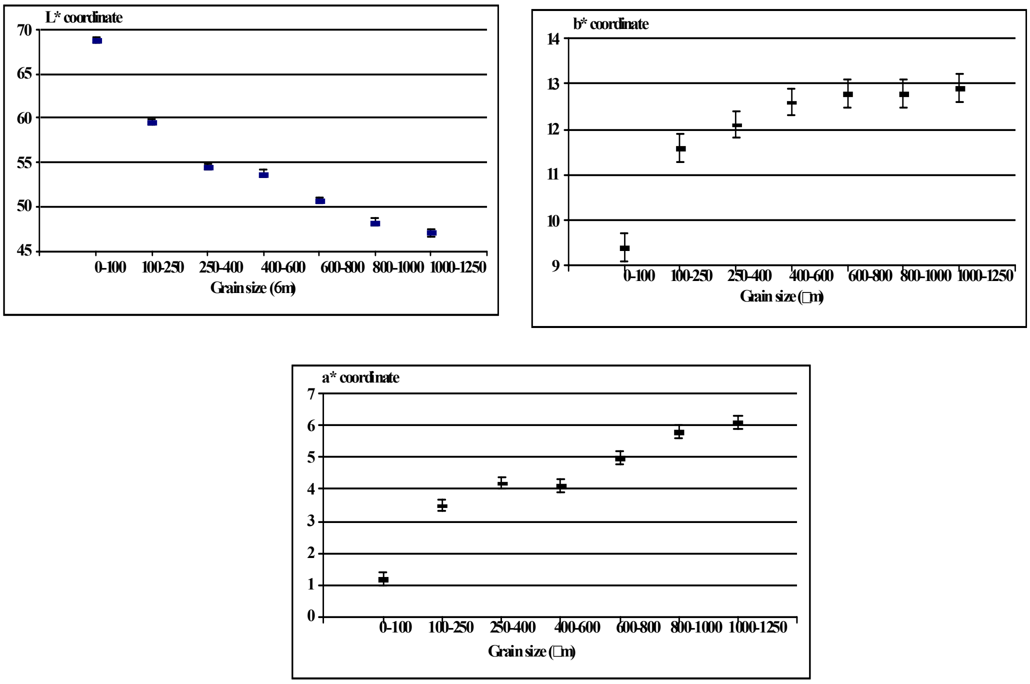

Fig. 1. Effect of grain size on colour coordinates. Results of analysis of variance (Averange ± ½ $SD_{95\%}$)

On Figure 1. we marked average values with significant difference that appertains to 95% probability level ($SD_{95\%}$). It good seems, that while the grain size rises the L* coordinate decreases. Consequently the grains that smaller than 100 μm are the lightest and whitest, the bigger grains are darkest. The a* coordinate and b* coordinate increase while the grain size rises, so the bigger grains are redder and more yellow.

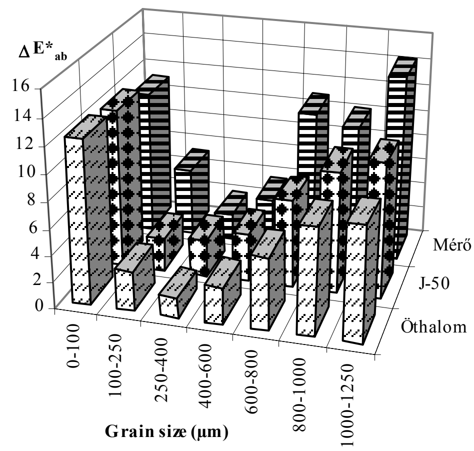

Fig. 2. Colour difference between wheaten grits and their different grain size fraction

We analysed, which size grains determine the colour of grits. Therefore we calculated the colour difference values between grits and their different grain size fraction. You can show up results on Figure 2. It was found, that smallest ΔE^*_{ab} values were given in case of fraction 250-400 µm at all times. So they determine the colour of grits, all the same that these grain size fractions – it shows the Table 3. - are only 11,80 – 16,67 % of whole grits.

Table 3

Grain size distribution of samples (%)

Grain size	JK-50	Öthalom	Mérő
0 µm – 100 µm	3,75	3,15	4,85
100 µm – 250 µm	11,38	12,20	18,90
250 µm – 400 µm	11,80	11,80	16,47
400 µm – 600 µm	32,60	31,99	31,01
600 µm – 800 µm	32,99	34,15	20,91
800 µm – 1000 µm	6,42	6,02	5,52
1000 µm – 1250 µm	1,06	0,69	2,34

Effect of hardness index of wheat on colour coordinates

The result of analysis of variance we made to compare the colour coordinates of different hard wheat you can see on Figure 3. We could say, that the L* and a*coordinates of hard wheats (J-10 and Öthalom) don't differ significantly, but they differ from Mérő has hardness index 20,78 significantly. The b* yellowness coordinate of hard wheats are higher. Therefore we can say, that the colour of wheat with high hardness index was darker, redder and more yellow.

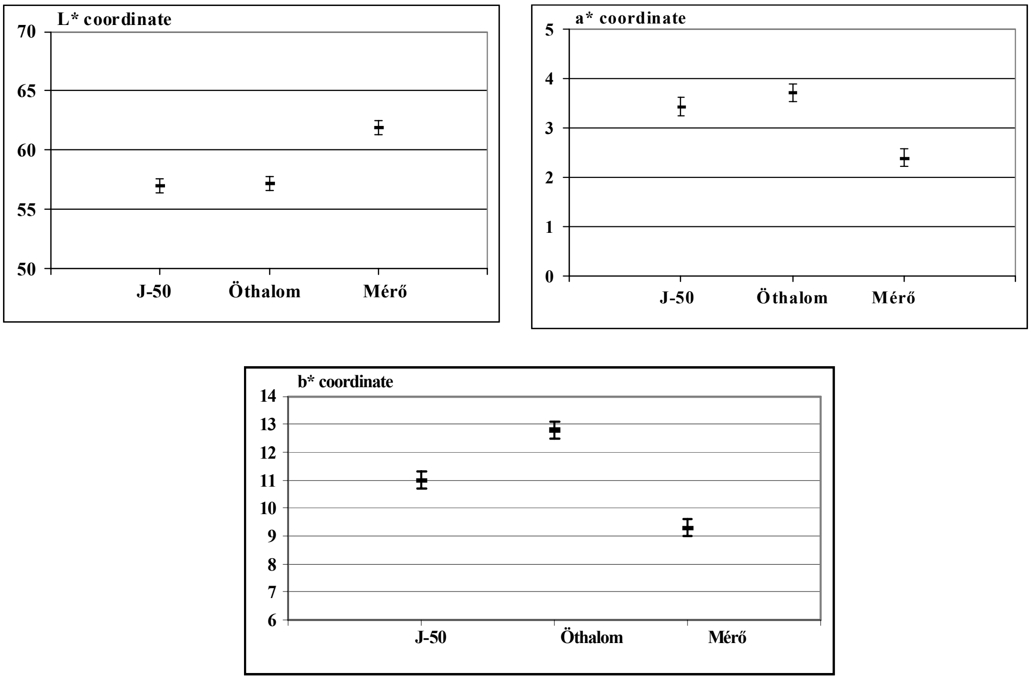

Fig. 3. Effect of hardness of wheat on colour coordinates, results of analysis of variance (Averange ± ½ $SD_{95\%}$)

Relationship between whiteness index and lightness coordinate

The relationship of whiteness index and L* lightness coordinate was examined. On the Figure 4 we plot the whiteness indexes as a function of lightness coordinates measured on samples wet. The equation of regression line and determination coefficient is represent on figure. We can see, that they have significant linear relation (r=0,9151), so the determination of whiteness index is not necessary. The L* value right characterises the whiteness of grits.

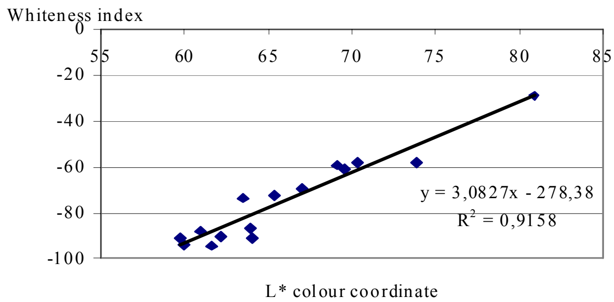

Fig. 4. Relationship between whiteness index and lightness coordinate were measured wet

CONCLUSIONS

Summary we can say, that

- The colour parameters of wheat grits are significant depend on grain size, if it rises the grits would be darker and redder.
- The colour of wheat grits is determined by colour of grains between 250-400 μm.
- The colour of wheaten grits with different grain size is dependent on the hardness index of wheat. The lightness coordinate (L*) of grits of the harder wheat is smaller and a* and b* coordinates are higher.
- The whiteness index and the L* colour coordinate have a linear relation (r=0,9151), so the determination of whiteness index is not necessary.

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