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INSTRUMENTAL COLOUR MEASUREMENT OF PAPRIKA GRIST

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1. INTRODUCTION

Paprika is a spice plant, which is grown and consumed in the biggest quantity both in Hungary and internationally. The quality of paprika grist is mainly determined by its colouring power and the visually perceptible colour of the colouring substance in it. The colouring power of paprika is determined by its colour agent, but the visually colour of paprika is dependent on its other characteristics. The effect of grain size, water content, and oil content is well known in the industrial practise. The relation between colour agent and colour coordinates was investigated (Nieto-Sandova et al. 1999), but there is not a common formula to give the relationship between colour characteristics and pigment content. So, to guarantee the suitable colour of end-product paprika grist is the most problematical step of its making. The instrumental colour measuring is not used in industrial practise.

We can find a lot of papers that deal with constituents that have effects on the change of colour agent, such as technological factors (Márkus et al. 1999, Varon et al. 2000, Landron de Guevara et al. 2002), ripening factors (Gomez et al. 1998, Márkus et al. 1998), storage conditions (Landron de Guevara et al.2002). There are less papers that treat with the change of colour using instrumental colour measuring. (Kispéter et al. 2003, Varon et al. 2000, Navarro et al. 1993, Huszka et al., 1991, Qingchun-Chen et al. 1999).

In this paper first we prove the empirical fact that the colour agent doesn't define the colour of paprika grist squarely used colour characteristics measured by instrument. After that we investigate how the storage effects on the colour coordinates of paprika grist with different grain size.

2. MATERIALS AND METHODS

2.1. The measurement of colour agent and colour coordinates

To investigate the colour agent and colour of paprika together, we measured 200 different quality paprika powders. The samples were made from Hungarian, Brazilian and South-African primary commodity. The average of grain size of grist was between 245-255 μm. We determined the colour using the CIE 1976 L^*, a^*, b^* colour system measured by MINOLTA CR-300 tristimulus colorimeter. We applied to define the difference between two-colour point the value ΔE^*_{ab} colour difference: (Lukács, 1982)

$$\Delta E^*_{ab} = \left(\left(L_1^* - L_2^*\right)^2 + \left(a_1^* - a_2^*\right)^2 + \left(b_1^* - b_2^*\right)^2\right)^{\frac{1}{2}} \qquad (1)$$

The relationship between ΔE^*_{ab} and colour difference that we can see is presented in Table 1. (Lukács, 1982)

Table 1. The relationship between ΔE^*_{ab} and sensible colour difference

ΔE^*_{ab} value	Sensation with eyes
$\Delta E^*_{ab} \leq 1,5$	The difference isn't
$1,5 < \Delta E^*_{ab} \leq 3$	The difference is sensible
$3 < \Delta E^*_{ab}$	The difference is sensible

We used to give the colour agent of paprika gris the ASTA unit.

2.2. The measurement of colour of paprika grist with different grain size

We examined 8 types of paprika with different quality from Hungary, Brasilia and South-Africa:

- ✓ 3 South-African samples
- ✓ 1 Brazilian sample
- ✓ 4 Hungarian samples

The samples were taken after milling on hammer mill and from the end-product paprika grist as well.

First we screened the samples taken after milling on hammer mill to the following grain size fractions.

Grain size fraction: 630-1000μm
0-630μm → 125-250μm
250-315μm
315-400μm
400-500μm
500-630μm

The grist doesn't have grains less than 125μ. The average grain size of samples taken from the end-product paprika grist was between 240 and 255 μm. After screening the colour of different grain size fraction of paprika grist and of the end-product was measured. We made measurings after milling and 6 months following, because the guaranteed time of paprika grist is 6 months. The samples were stored in dark place, its temperature was 23 °C on average.

We determined the colour using the CIE 1976 L^* , a^*, b^* colour system measured by MINOLTA CR-300 tristimulus colorimeter too. We applied to define the difference between two colour points with ΔE^*_{ab}

colour difference value (1) , ΔH^*_{ab} hue difference, defined by (2), and ΔC^*_{ab} chroma difference, defined by (3) (Lukács,1982) .

$$\Delta H^*_{ab} = \mathrm{sign}\left(a_1^* \cdot b_2^* - a_2^* \cdot b_1^*\right) \cdot \left(\left(\Delta E^*_{ab}\right)^2 - \left(\Delta L^*\right)^2 - \left(\Delta H^*_{ab}\right)^2\right)^{\frac{1}{2}} \qquad (2)$$

$$\Delta C^*_{ab} = \left(\left(a_1^*\right)^2 + \left(b_1^*\right)^2\right)^{\frac{1}{2}} - \left(\left(a_2^*\right)^2 + \left(b_2^*\right)^2\right)^{\frac{1}{2}} \qquad (3)$$

3. RESULTS AND DISCUSSION

3.1. Analysing of colour agent and colour coordinate values

We investigated if the colour agent of paprika grist determines its colour squarely. Therefore we classified the samples based on their colour agent. We composed 13 classes. After then we calculated the colour difference of samples that are in the same colour content class. Next we categorized the calculated ΔE^*_a values to three class as based on Table 1 and made frequency histogram. The result we present in Figure 1.

It seems good, that the frequencies of colour difference values that are higher than 3 are lower than 59% in all colour agent classes, namely the colour of samples, which have similar colour agent, are different in 59 percent. So we can state, that the colour agent of paprika grist doesn't define their colour squarely.

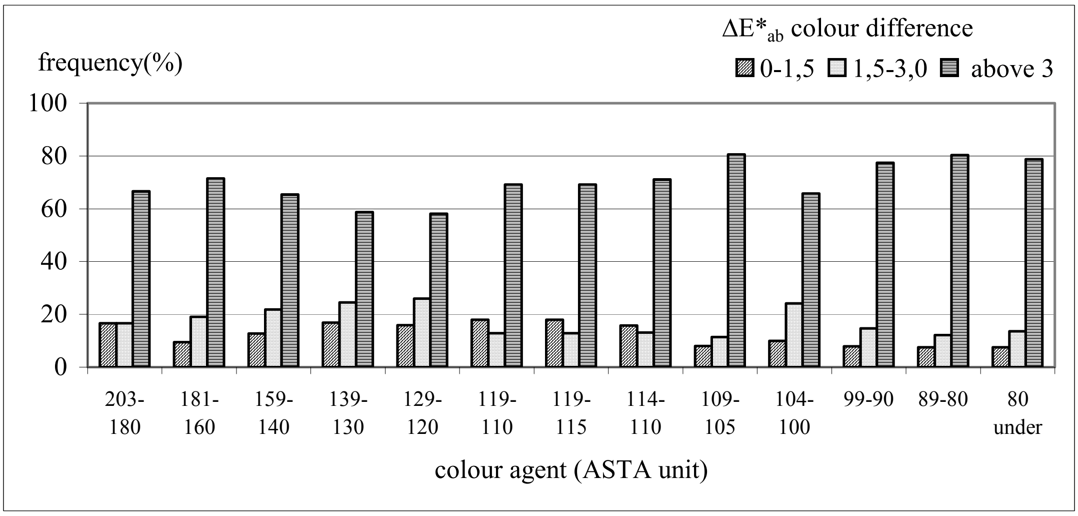
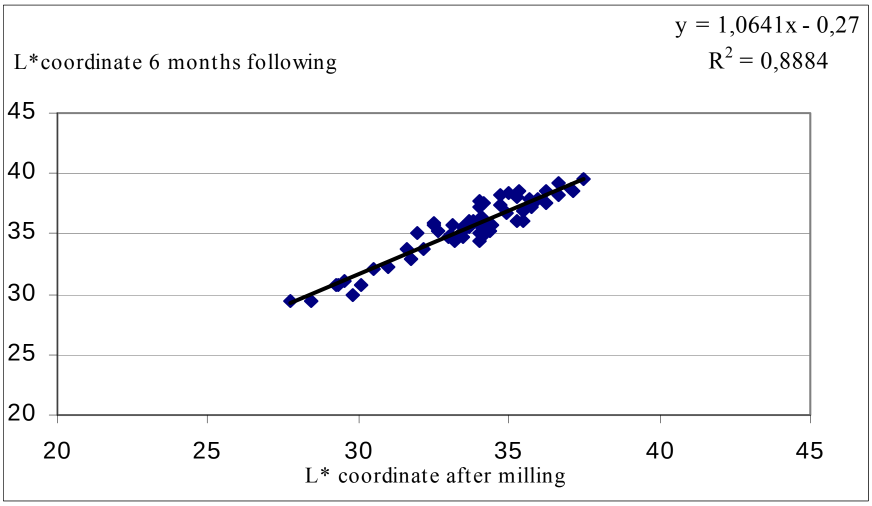
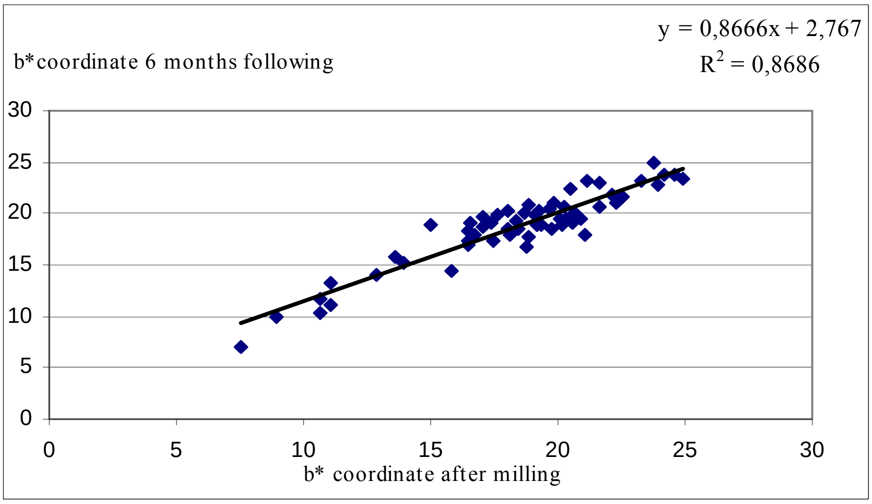


Figure 1. The frequency histogram of different colour difference values in case of variant colour agent classes

3.2. Effect of storage on colour coordinates

To evaluate the colour coordinate values measured first and 6 moths following, we calculated averages and standard deviation of data were measured on samples that have got similar grain size at first. The values are presented in Figure 3. We marked average values with confidence interval that appertains to 95% confidence level. We plotted the averages of values measured after milling and 6 months following in the same diagram. We can appoint that the L* (lightness) coordinate went up, and the a* (redness) dropped independent of grain size. The change of a* coordinate of end-product paprika powder was lower, in the other cases the variation of redness coordinates were averagely 3 units. The L* increased on average with 2 units. The b* (yellowness) changed significantly only in case of end-product.





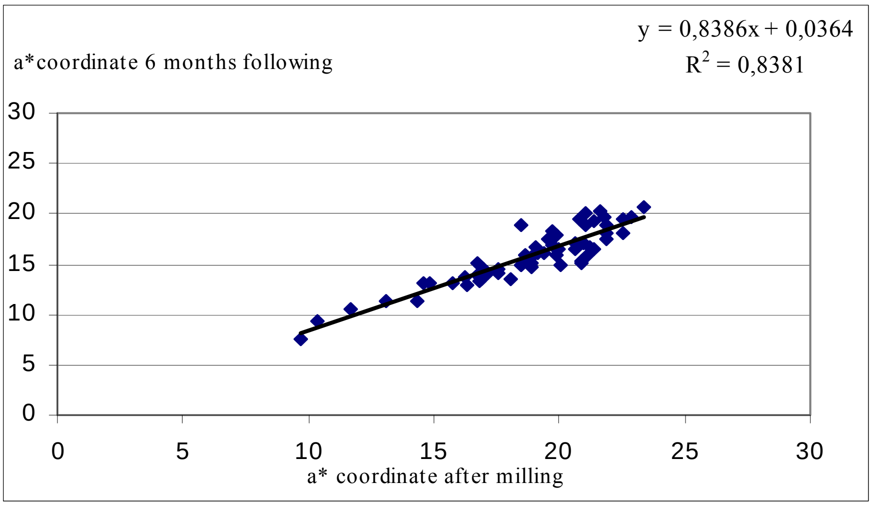
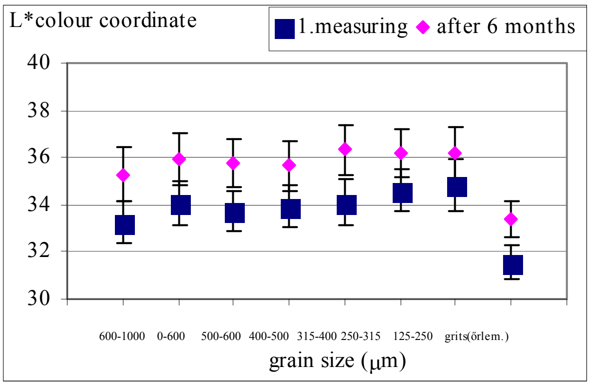
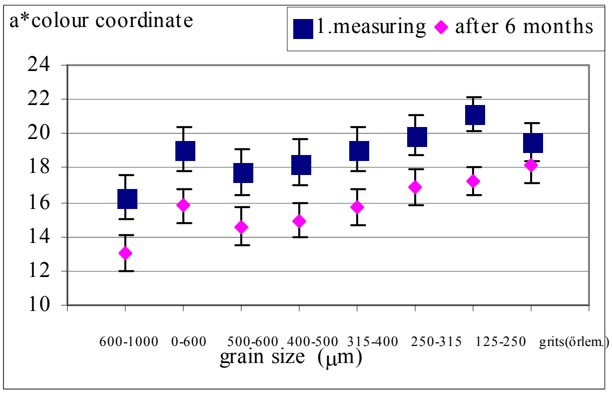


Figure 2. The relationship of colour coordinates were measured after milling and 6 months following





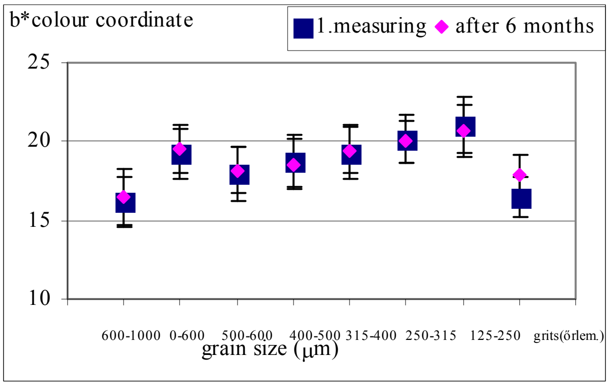


Figure 3. Effect of storage on colour coordinates in case of paprika grist with different grain size (Averange and its confidence interval)

Table 2. shows the averages of fluctuation of colour difference, of hue difference and of croma difference values with standard deviations. We can see, that the colour difference higher, than 3, so the variation is well sensible. The positive value of ΔC^*_{ab} points, that the colour of paprika grist becomes less saturated. By reason of hue difference we can say, that the colour of paprika turn into more yellow.

Table 2. The averagely change of colour characteristics in course of storage

	ΔL^*	ΔE^*_{ab}	ΔC^*_{ab}	ΔH^*_{ab}
Average	-1,88	3,90	1,77	2,45
Standard deviation	0,84	1,19	1,50	1,01

Next we searched connection between data were measured after milling and 6 months following using regression analysis. We represent the result in Figure 3. The values measured 6 months following are illustrated depend on values measured at first. We marked the regression lines and R^2 values in the figure. We can establish, that the values measured first and in the second time have linear connection in case of all colour coordinates, R^2 values are higher than 0,83. So the change of colour coordinates in 6 months is appraisable using this formula.

CONCLUSION

- ✓ The colour agent of paprika grist doesn't define its colour squarely, the colour of samples, that have similar colour agent is different in 59 percent.
- ✓ The lightness (L*) coordinate rises, the redness (a*) coordinate drops in course of storage, independent of grain size of grist, so its colour becomes lighter. The b* (yellowness) changed significantly only in case of the end-product.
- ✓ The colour of paprika grist becomes less saturated and more yellow in 6 months independent of grain size of grist.
- ✓ The colour coordinates were measured after milling and 6 months following have linear connection. In case of L* coordinate R^2=0,8884, in case of a* coordinate R^2=0,8381, in -case of b* coordinate R^2=0,8686.

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