COMPARISON OF COLOUR AGENT CONTENT AND COLOUR CHARICTERISTICS OF PAPRIKA POWDERS

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Abstract

In this paper we analyse the colour coordinates of paprika powders and their colour agent content paralel. 200 different quality paprika powders were measured. Hungarian, South American and South African varieties and mixed powder samples were investigated. Colour measurements were performed with a Minolta CR-300 tristimulus colour measuring instrument. The CIELab colour system was used for colour characterization. The ASTA unit was used to give the colour agent content of paprika powders. We state, that the L lightness coordinate, a* redness coordinate, b* yellowness coordinate, C* croma and* h^{o}_{ab} *hue angle of classes with various colour agent content don't differ significantly. The colour of samples which have similar colour agent content are different in 59 percents.cThe colour agent content of paprika powders doesn't define their colour.*

Keywords: (maximum 6): papika powder, colour agent content, colour measurement

INTRODUCTION

The use of natural food colours is preferred to the artificial dyestuffs for modern alimentary purposes. Paprika is a spice plant grown and consumed in considerable quantities world-wide, and also used as a natural food colour. Hungarian paprika powder is still regarded as a "Hungaricum" today. Paprika is cultivated in areas of the world such as Spain, China, South Africa and South America, where the weather is favourable for the growth of this plant and for the development of its red colouring agents. The large number of hours of sunshine allows the paprika to ripen on its stock, so that the basic material reaching the processing mills has a high dyestuff content. Hungarian paprika has a unique aroma and a specific smell, but the production of powder with a good red colour is a considerable problem. The colour of paprika powder is very important, because the consumer concludes its colouring power based on its colour. The colouring power is determined by quality and quantity of colouring agent of paprika squarely, but the colour of the powder is influenced by many factors besides the colouring agent content. The colour of the powder is influenced by its particle size, oil content and moisture content and first of all the colour agent content. The instrumental colour measurement isn't used in the industrial practise, the development of the colour of the paprika powder is made based on the empirical facts; therefore the quantity of the colour of the final-product often isn't correct.

Since the 1970s a number of papers have been published on measurements of the colour of paprika powders (Horváth és Kaffka, 1973, Drdak et al., 1980, Huszka et al., 1984, Drdak et al., 1989). Measurements have been performed related to the changes in the colour stimulus components X, Y and Z of powders during mixing (Huszka et al., 1984) and to the correlation between visual sensing and the instrumentally measured colour characteristics (Huszka et al., 1985, H.Horváth, 2007b). The effects of ionizing irradiation on the colour of paprika powder were investigated by Fekete-Halász et al. (1996). Minguez et al. (1997). They analysed how the colour of the powder is changed by the ratio of the yellow and red pigments within the total colouring agent content. There are many papers about the changes in the colour characteristics of the paprika during different dryings and storage processes (Park et al., 2007, Banout et al., 2011, Topaz et al., 2011, Chetti et al., 2012). In case of the Korean cultivars, no significant change in colour characteristics was detected when the moisture content varied between 10% and 15% (Chen et al., 1999). H.Horváth and Hodúr (2007a) investigated hungarian paprika powders and depicted that the colour of the powder was observed turning into darker and deeper red while increasing moisture content. Various investigations have been made of the connection between the colouring agent content of the powder and the colour characteristics measured by different techniques (Navarro et al., 1993, Nieto- Sandoval et al., 1999). Such investigations have yielded partial results, but there is no formula that describes the correlation between the colouring agent content and the colour characteristics.
In this paper we analyse the colour coordinates of paprika powders and their colour agent content paralel. The colour characteristics and colour agent content of paprika powder samples are compered.

MATERIAL AND METHOD

Measurement of colour and colour agent content

Colour measurements were performed with a Minolta CR-300 tristimulus colour measuring instrument. The CIELab colour system was used for colour characterization. In this colour space the colour points are characterized by three colour coordinates. L^* is the lightness coordinate ranging from no reflection for black (L^*=0) to perfect diffuse reflection for white (L^*=100). The a^* is the redness coordinate ranging from negative values for green to positive values for red. The b^* is the yellowness coordinate ranging from negative values for blue and positive values for yellow.

The total colour change is given by the colour difference (ΔE^*_{ab}), in terms of the spatial distance between two colour points interpreted in the colour space: (Hunter, 1987)

$$\Delta E^*_{ab} = \left[\left(L^*_1 - L^*_2\right)^2 + \left(a^*_1 - a^*_2\right)^2 + \left(b^*_1 - b^*_2\right)^2\right]^{1/2} \quad (1)$$

If 1.5< ΔE^*_{ab} <3, then the colour difference between two paprika grists can hardly be visually distinguished, if ΔE^*_{ab} >3, then the colour difference between two paprika grists can be visuall distinguished (H.Horváth, 2007b).
The chroma $\left(C^*_{ab}\right)$ was used to determine the change of colour.

$$C^*_{ab} = \left(\left(a^*\right)^2 + \left(b^*\right)^2\right)^{\frac{1}{2}} \quad (2)$$

The chroma represents colour saturation which varies dull at low chroma values to vivid colour at high chroma values (Hunter,1987).
The shade of colour point was characterised by CIELab h^0_{ab} hue angle .

$$h^o_{ab} = \mathrm{arctg}\left(\frac{b^*}{a^*}\right) \quad (3)$$

The ASTA unit was used to give the colour agent content of paprika powders.

Parameters of studied paprika powders

200 different quality paprika powders were measured. Hungarian, South American and South African varieties and mixed powder samples were investigated. The colouring agent content changed from 63 to 203 ASTA units. The particle size was between 0-500 μm. The average particle size of the powders was between 245 μm and 355 μm. The moisture content changed from 7% to 12%.

RESULTS AND DISSCUSIONS

To investigate the colour agent and colour characteristics of paprika powders we classified the samples based on their colour agent content. 10 classes were composed, accordingly to Table 1.

Table 1. The colour agent content classes

ASTA unit	under 80	80-89	90-99	100-109	110-119	120-129	130-139	140-159	160-180	180-203

After the colour characteristics of samples are in the same colour agent content class were compared. Values of L* lightness coordinate, a* redness coordinate, b* yellowness coordinate, C* chroma and h^{o}_{ab} hue angle were analysed. First, the distribution of values was what we investigated. Using Shapiro-Wilk-test was detected, that distribution of the L*, a*, b*, C* and h^{o}_{ab} values are in the same colour agent content class different significantly ($p<0.05$) from Gaussian distribution. So Kruskal-Wallis test was used to analyse data. In the Fig.1.-Fig.5. we can see the median, quartilies, minimum and maximum values of the L*, a*, b* coordinates, C* and hue angle of different colour agent content classes.

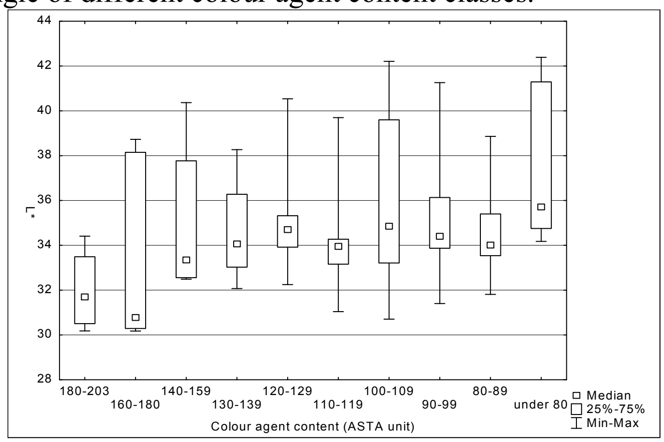

Fig. 1. The median, quartilies, minimum and maximum values of the L* coordinates of different colour agent content classes

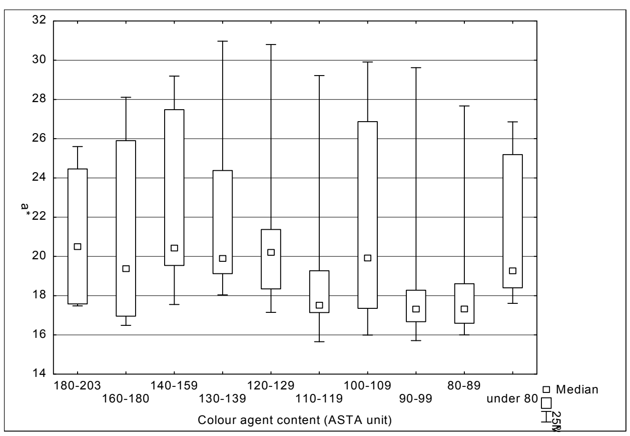

Fig. 2. The median, quartilies, minimum and maximum values of the a* coordinates of different colour agent content classes

The results of Kruskal-Wallis test show that the significant ($p<0.05$) difference was only between median of under 80 and 180-203, under 80 and 160-180, under 80 and 110-119 colour agent content classes in case of L* coordinate. The difference was significant ($p<0.05$) between median of 110-

119 and 120-129, 130-139, 140-149 classes and between 90-99 and 120-129, 130-139, 140-149 classes, but the difference wasn't significant for example between median of 180-203 and under 80 colour agent content classes in case of a* coordinate. The difference was significant for median of b* between under 80 and 180-203, 160-180 classes, between 110-119 and 90-99, 100-109, 110-119, 120-129, 130-139 classes. But the difference wasn't significant for example between median of 180-203 and 80-89 classes.

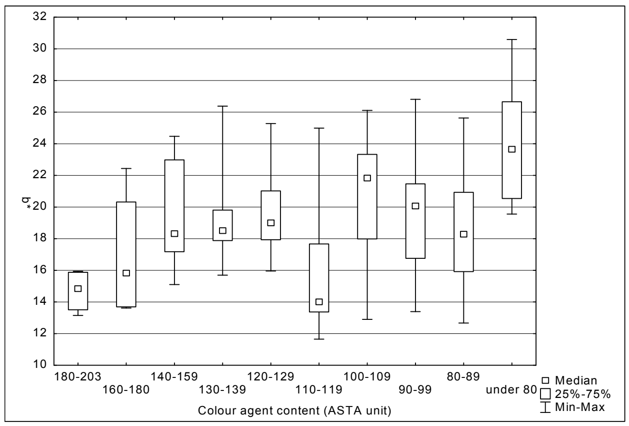

Fig. 3. The median, quartilies, minimum and maximum values of the b* coordinates of different colour agent content classes

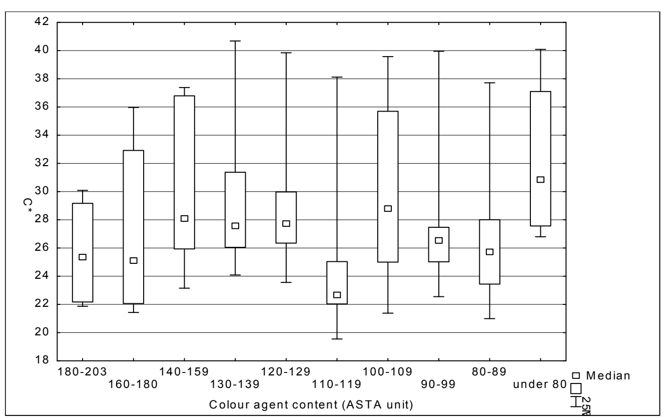

Fig. 4. The median, quartilies, minimum and maximum values of the C* coordinates of different colour agent content classes

In case of C* croma the difference was significant only between median of 110-119 and 140-159, 130-139, 120-129, 100-109, under 80 colour agent classes. The significant difference was found only between 90-99 and other classes, under 80 and other classes in case of hue angle. On the whole we can state that the colour characteristics of classes with various colour agent content don't differ significant.

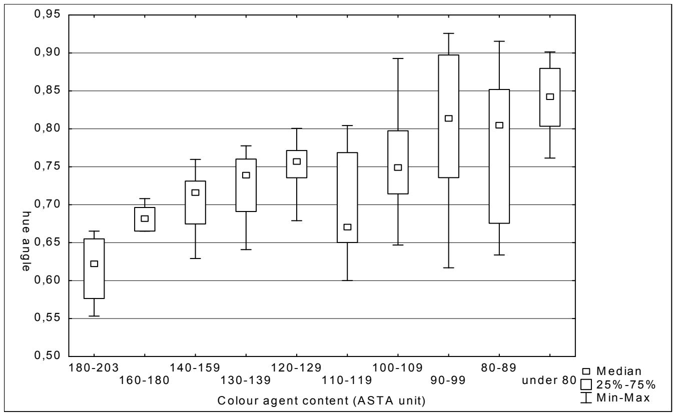

Fig. 5. The median, quartilies, minimum and maximum values of the h^{o}_{ab} hue angle of different colour agent content class

After the colour differences of samples that are in the same colour content class were calculated. To analyse the ΔE^*_{ab} colour differences were categorized to tree classes based on Table 2. and were made frequency histogram.

Table 2. 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 sensible.
$1,5<\Delta E^*_{ab}\leq 3$	The difference is sensible just.
$3<\Delta E^*_{ab}$	The difference is sensible well.

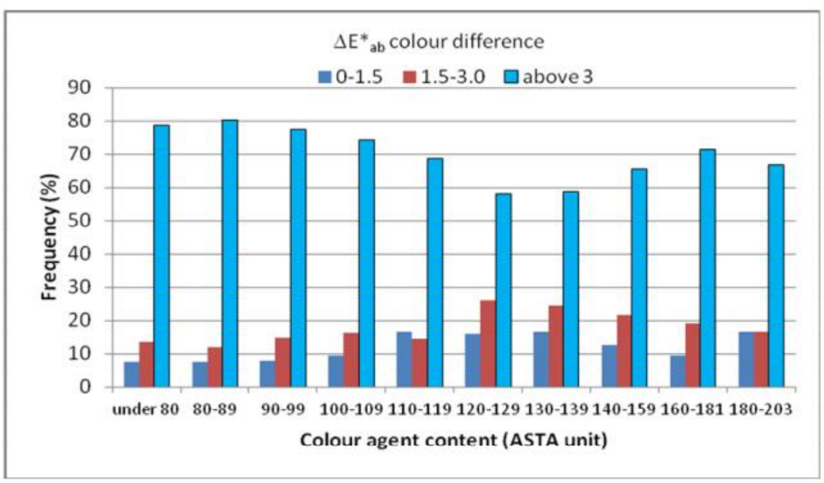

Fig. 6. The frequency histogram of different colour difference values in case of variant colour agent classes

We present the result in Figure 6. It is well seenable 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 have similar colour agent are different in 59 percents. So we can state that the colour agent content of paprika powders doesn't define their colour squarely.

CONCLUSIONS

- The L* lightness coordinate, a* redness coordinate, b* yellowness coordinate, C* croma and h^{o}_{ab} hue angle of classes with various colour agent content don't differ significant.
- The colour of samples which have similar colour agent content are different in 59 percents.
- The colour agent content of paprika powders doesn't define their colour squarely.

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