EFFECT OF OIL CONTENT ON THE COLOUR OF PAPRIKA POWDERS

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Abstract

We investigated the several quality Hungarian paprika powders. The oil contents of paprika powders were increased by 1%, 2%, 3%, and 4% relative to the initial sample. The colour, determined by using the CIE L^*, a^*, b^* colour system, was measured with a Minolta CR-300 tristimulus colorimeter. The colour coordinates were evaluated by using variance analysis of one factor. The colour differences (ΔE^*_{ab}) and hue differences (ΔH^*_{ab}) of the initial samples and the samples with various added oil contents were calculated to determine the changes in colour. The lightness coordinate L^* and yellowness coordinate b^* were found to decrease significantly. The redness coordinate a^* did not change significantly. A significant and perceptible change relative to the initial samples is observed at an added oil content of 3%. The changes in the colour characteristics in response to oil content increase can be observed visually, the powder becoming darker and redder.

Key words: Paprika powders, oil content, colour coordinate

INTRODUCTION

The use of natural food colours is preferred to that of artificial dyestuffs for modern alimentary purposes. Paprika is a spice plant grown and consumed in considerable quantities worldwide, 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, 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 powerful based on its colour, although the relation isn't unequivocal between them (H.Horváth, 2005). The colouring powerful 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. 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. Since the 1970s a number of papers have been published on measurements of the colour of paprika powders (Horváth&Kaffka, 1973, Drdak et al., 1980, Huszka et al., 1984, Drdak et al., 1989). Measurements have been performed relating 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). The effects of ionizing irradiation on the colour of paprika powder were investigated by Fekete-Halász et al. (1996). Minguez et al. (1997) analysed how the colour of the powder is changed by the ratio of the yellow and red pigments within the total colouring agent content. Chen et al. (1999) investigated the effects of particle size in Korean cultivars and established that the lightness coordinate of the powder was influenced by the particle size. Applying a Hungarian milling technique, Horváth&Halász-Fekete (2005) demonstrated that the particle size exerts a significant influence on all three colouring characteristics of powders made from Hungarian, South African and South American paprika. Kispéter et al. (2003) investigated the influence exerted on the colour by saturated steam used for germ reduction. In the case of 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&Hodúr (2007a) investigated Hungarian paprika powders and depicted, that the colour of the powder was observed to turn into darker and deeper red with increasing moisture content.

The influence of physical and chemical properties of Hungarian paprika powder on its colour was investigated in course of our work. In this paper is presented, how the colour characteristics of Hungarian paprika powders change following increase of the oil content.

MATERIAL AND METHOD

Ten paprika powder samples were prepared from different Hungarian paprika varieties. The oil content of each of the samples was increased by 1%, 2%, 3% and 4% relative to the initial sample. The samples of 10 g of powder were weighed with four-digit accuracy on an analytical balance, after the 0.1 g, 0.2 g , 0.3g and 0.4g of oil was added to samples. After homogenisation the colour coordinates of these samples were measured in 3 parallel measurements. The data were evaluated by using variance analysis of one factor.

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)

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

If ΔE^*_{ab} >1.5, then the colour difference between two paprika grists can be visually distinguished (H.Horváth, 2007b).

The chroma $\left(C^*_{ab}\right)$ the hue difference were used to determine the change of colour.

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

The chroma represents colour saturation which varies dull at low chroma values to vivid colour at high chroma values (Hunter,1987).

The equations used to describe the hue difference (ΔH^*_{ab}) between two colour points are as follows:

$$\Delta H^*_{ab} = \mathrm{sign}\left(a^*_1 \cdot b^*_2 - a^*_2 \cdot b^*_1\right) \cdot \left(\left(\Delta E^*_{ab}\right)^2 - \left(\Delta L^*\right)^2 - \left(\Delta C^*_{ab}\right)^2\right)^{\frac{1}{2}} \qquad (3)$$

RESULTS AND DISSCUSIONS

Tables 1-3. present the variance analysis results. The data in Tables 1-3 demonstrate the lightness and yellowness coordinates were significantly influenced by increasing oil content (significant level was p=0.0335 and p=0.0811), whereas there was no influence on the redness coordinate. As concerns the detailed analysis, the average values of the colour coordinates are presented in Figs 1-3, differences being taken as significant at a level p = 0.05.

Table 1

Variance table for lightness coordinate L^*

Source of variation	SQ	DF	MQ	F-ratio	p
Between groups	20.96	4	5.24	2.871	0.0335
Within groups	82.14	45	1.82		
Total	103.10	49			

Table 2

Variance table for redness coordinate a*

Source of variation	SQ	DF	MQ	F-ratio	p
Between groups	17.31	4	4.32	1.681	0.1700
Within groups	115.82	45	2.57		
Total	133.13	49			

Table 3

Variance table for yellowness coordinate b*

Source of variation	SQ	DF	MQ	F-ratio	p
Between groups	48.13	4	12.03	2.22	0.0811
Within groups	243.14	45	5.40		
Total	291.27	49			

It can be seen that the lightness coordinate L^* progressively decreased with increasing oil content. An added 3% oil content caused a significant and well-perceptible change. Further added oil did not induce any additional perceptible decrease. The average value of redness coordinate a^* similarly decreased with increasing oil content, as compared with the initial sample, the difference was 1 unit at an added oil content of 4 %. The yellowness coordinate b^* changed more strongly. With increasing oil content, the average values of b^* decreased significantly, 2.1 units at added oil contents of 3%.

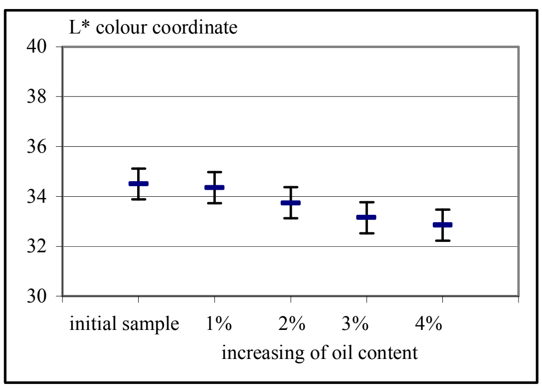

Fig. 1. Result of variance analysis of lightness coordinate (average±$SD_{0.05}$)

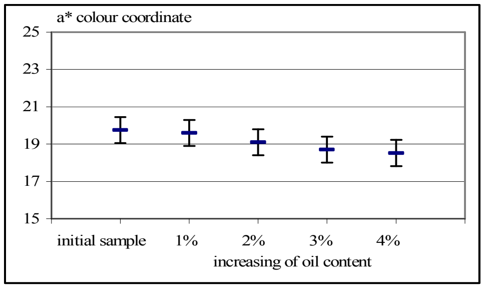

Fig. 2. Result of variance analysis of redness coordinate (average±$SD_{0.05}$)

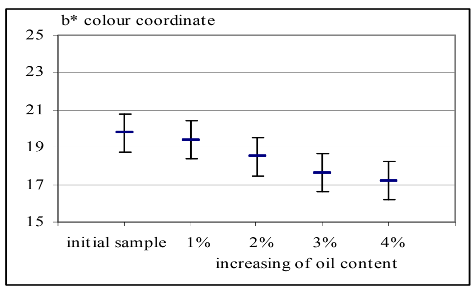

Fig. 3. Result of variance analysis of yellowness coordinate (average±$SD_{0.05}$)

The colour (ΔE^*_{ab}) and hue (ΔH^*_{ab}) differences of the initial samples and the samples with various added oil contents were calculated to determine the changes in colour. The values are shown in Table 4.

Table 4

The colour (ΔE^*_{ab}) and hue (ΔH^*_{ab}) differences of the initial samples and the samples with various added oil contents

Sample	Increasing of oil content							
	1 %		2 %		3 %		4 %	
	ΔE^*_{ab}	ΔH^*_{ab}	ΔE^*_{ab}	ΔH^*_{ab}	ΔE^*_{ab}	ΔH^*_{ab}	ΔE^*_{ab}	ΔH^*_{ab}
P1	**0,69**	*-0,36*	**1,57**	*-0,15*	**2,43**	*-0,82*	**4,09**	*-1,08*
P2	**0,93**	*0,48*	**1,09**	*-0,34*	**2,44**	*-0,80*	**3,42**	*-1,09*
P3	**1,10**	*0,43*	**2,09**	*-1,15*	**1,53**	*-0,52*	**2,23**	*-0,62*
P4	**1,09**	*-0,43*	**3,43**	*-1,40*	**3,58**	*-0,93*	**4,35**	*-0,72*
P5	**0,70**	*0,03*	**1,48**	*0,05*	**3,10**	*-0,91*	**3,70**	*-1,23*
P6	**0,33**	*0,11*	**1,31**	*-0,04*	**2,93**	*-0,41*	**3,28**	*-0,49*
P7	**0,49**	*-0,14*	**2,75**	*-1,43*	**3,35**	*-1,53*	**3,14**	*-0,71*
P8	**2,91**	*-1,41*	**2,78**	*-1,24*	**4,84**	*-1,68*	**5,56**	*-1,37*
P9	**0,57**	*-0,43*	**2,49**	*-1,28*	**1,79**	*-0,37*	**2,38**	*-0,39*
P10	**1,13**	*-0,42*	**1,05**	*0,01*	**2,65**	*-0,71*	**3,62**	*-0,72*

We can see, that the value of ΔE^*_{ab}>1.5 for all samples at an added oil content of 3%, therefore an added 3% oil content caused a significant and perceptible change.
The hue difference was negative for all samples at an added oil content of 3%, too. This indicates that the paprika powders became redder.

CONCLUSIONS

- ✓ The oil content influenced the lightness coordinate L^* significantly, it decreases with increasing added oil content.
- ✓ The oil content influenced yellowness coordinate b^* significantly , too, gradually decreases with increasing added oil content.
- ✓ The redness coordinate a^* did not change significantly.
- ✓ A perceptible change relative to the initial samples is observed at an added oil content of 3%.
- ✓ The changes in the colour characteristics as the added oil content is increased can be observed visually: the powders became darker and redder.

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