COLOUR CHANGE IN PEPPER (*Capsicum annuum*)
DURING STORAGE

Aleksandra N. Tepić and Biserka L. Vujičić

Pouders of pepper were stored at ambient temperature, exposed to daylight. The final quality was evaluated by measuring the extractable colour by the American Spice Trade Association (ASTA). Also, the possibility of using surface colour measurement, as a supplement to extractable colour measurement was investigated. The use of the chromatic attributes L, a and b, suggested by the Commision Internationale de l’Eclairage (CIE), i.e., of the CIELAB space, made it possible to find the correlation between ASTA and apparent colour of paprika.

KEYWORDS: Pepper; colour measurement; storage; quality

INTRODUCTION

The range of food products that contain pepper or its chemical constituents is really wide. Paprika extracts are also used in pharmaceutical and cosmetic products. Yellow, orange and red colours of pepper originate from the carotenoid pigments formed in the fruit during ripening. Over 30 different carotenoids have been identified in capsicum fruits (1). Some of them are provitamin A carotenoids, essential to human nutrition, and the oxygenated carotenoids that have been studied as anti-cancer agents.

Since paprika is used as a colouring agent in food, its market value depends partly on the red colour. Many factors affect pepper colour loss during storage, and the most important is oxidative degradation of carotenoids, caused by exposure to heat, light or oxygen.

Colour of peppers can be evaluated from three different aspects (2): surface (apparent) colour, extractable colour, and carotenoids profiles (3 – 8). Extractable and surface colour measurements are standard quality evaluations in the spice industry (9 – 16). Surface colour measurements are used to specify colours perceived by the human eye. Verbal descriptions of colours can be difficult and confusing, because two people may describe the

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same colour in very different terms. The perception of colour varies according to the sensitivity of observer, the size of the object being viewed, the light source and illumination, the background colour and contrast, and the angle at which the object is viewed. Quantifying colours, or expressing colours numerically, facilitates colour communication and standardization (17). Surface colour varies according to cultivar, growing conditions, dehydration, milling and storage conditions. Extractable colour is a measure of total pigment content. Current procedures for measuring extractable colour (total pigments) in dehydrated capsicums and oleoresins were developed and approved by the Association of Official Analytical Chemists (18) and the American Spice Trade Association (ASTA) (9, 19). Extractable colour is measured using a spectrophotometer and is expressed in ASTA units. Generally, the higher the ASTA colour value, the greater the effect on the brightness or richness of the final product. Paprika with 200 ASTA colour units would give a brighter red to a finished product than an equivalent amount with 100 ASTA colour units (2).

EXPERIMENTAL

Samples. Aleva NK cultivars of paprika powder from two different regions (Djala and Stara Pazova) were used. Samples were purchased from the factory "Aleva" Novi Kneževac and stored at ambient temperature (20°C ± 2) in transparent bottles, exposed to daylight and shaken occasionally. Apparent (surface) colour and extractable colour were measured in paprika powders before storage and then monthly, for 4 months.

Apparent (surface) colour measurements. Surface colour was measured using a tristimulus photoelectric colorimeter MOM Color 100. The values L, a, b, λ, a/b and hue angle (h) were determined.

Extractable colour measurements. The extractable colour was measured according to ASTA 20 method (20). An amount of 0.07 – 0.11 g of paprika powder was put into a graduated 100 ml flask. Aceton was added to the mark, the mixture was shaken and kept in the dark for 4h. An aliquot of the transparent decanted extract was taken. The absorbance of the solution was measured using a JENWAY 6105 UV/VIS spectrophotometer, set at 460 nm and calibrated with an acetone blanc. ASTA 20 colour units were calculated from

\[
ASTA 20 = \frac{\text{Absorbance} \times 16.4 \times I_r}{\text{weight of sample (g)}}
\]

where \(I_r\) is a correction factor for the apparatus, which is calculated from the absorbance of a standard solution of potassium dichromate, ammonium sulphate and cobalt sulphate.

RESULTS AND DISCUSSION

Changes of ASTA 20 units during storage of paprika powders from two different localities (Djala and Stara Pazova) are presented in Figure 1. The results are in correlation with those of Osuna-Garcia et al. (17).
The Stara Pazova sample had a higher initial colour (225.95 ASTA units) than Djala (206.73 ASTA units). After 4 months storage, Stara Pazova lost 45.42 ASTA units, i.e. 20.10%, while Djala lost 60.14 ASTA units, i.e. 29.09% of the prestorage colour. The losses were high because samples were stored at room temperature, which accelerates colour loss rates.

Fig. 1. Changes of ASTA values in paprika powder during storage

Changes of parameters of apparent colour of Djala and Stara Pazova samples during storage are presented in Tables 2 and 3, respectively.

Table 1. Changes of surface colour of Djala sample during storage

<table>
<thead>
<tr>
<th>Parameter*</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>27.97</td>
<td>34.29</td>
<td>26.11</td>
<td>27.99</td>
<td>30.44</td>
</tr>
<tr>
<td>b</td>
<td>23.08</td>
<td>29.55</td>
<td>23.52</td>
<td>26.86</td>
<td>31.17</td>
</tr>
<tr>
<td>L</td>
<td>39.46</td>
<td>43.21</td>
<td>48.22</td>
<td>46.94</td>
<td>44.17</td>
</tr>
<tr>
<td>λ (nm)</td>
<td>599</td>
<td>601</td>
<td>597.5</td>
<td>597</td>
<td>596</td>
</tr>
<tr>
<td>a/b</td>
<td>1.21</td>
<td>1.16</td>
<td>1.11</td>
<td>1.04</td>
<td>0.98</td>
</tr>
<tr>
<td>h</td>
<td>39.53</td>
<td>40.75</td>
<td>42.01</td>
<td>43.82</td>
<td>45.68</td>
</tr>
</tbody>
</table>

*a – red component; b – yellow component; L – brightness; h – hue angle, \( h = \arctan \frac{b}{a} \)

Table 2. Changes of surface colour of Stara Pazova sample during storage

<table>
<thead>
<tr>
<th>Parameter*</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>31.91</td>
<td>30.41</td>
<td>27.89</td>
<td>29.15</td>
<td>30.88</td>
</tr>
<tr>
<td>b</td>
<td>25.78</td>
<td>21.03</td>
<td>23.98</td>
<td>25.89</td>
<td>29.25</td>
</tr>
<tr>
<td>L</td>
<td>36.87</td>
<td>46.36</td>
<td>44.74</td>
<td>42.36</td>
<td>41.43</td>
</tr>
<tr>
<td>λ (nm)</td>
<td>601</td>
<td>602</td>
<td>598</td>
<td>598.5</td>
<td>599</td>
</tr>
<tr>
<td>a/b</td>
<td>1.24</td>
<td>1.45</td>
<td>1.16</td>
<td>1.13</td>
<td>1.06</td>
</tr>
<tr>
<td>h</td>
<td>38.93</td>
<td>34.67</td>
<td>40.69</td>
<td>41.61</td>
<td>43.45</td>
</tr>
</tbody>
</table>

*a – red component; b – yellow component; L – brightness; h – hue angle, \( h = \arctan \frac{b}{a} \)
From the chromatic attributes it can be seen that the a/b ratio decreased during storage, and the arctg b/a (hue angle) increased from 39.53 up to 45.67 (Djala) and from 38.93 up to 43.45 (Stara Pazova), which is the change from red to orange in the colour circle (2). These changes could have been the consequence of the applied agricultural conditions and meteorological factors, i.e. temperature, sunshine and rainfall (21), which influenced different levels of tocopherols and other antioxidants in pepper fruits. In this work, correlations between extractable colour (ASTA units) and hue angle were observed. Namely, while ASTA units decreased during storage, hue angles increased, indicating colour change from red to orange hues. Also, during storage hue angles of Stara Pazova pepper sample were lower than those for Djala samples, indicating less decolouration.

![Fig. 2. Changes of hue angle in paprika powder during storage](image)

**CONCLUSION**

The presented results show that the colour loss of paprika powders was significant. Pepper from Djala region lost 29.09 % (from 225.95 to 180.53 ASTA), while that from Stara Pazova lost 20.10 % (from 206.73 to 146.59 ASTA) of the initial colour. It is clear that Stara Pazova pepper behaved better than Djala, from the point of retaining colour.

**ACKNOWLEDGMENT**

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REFERENCES


ПРОМЕНА БОЈЕ МЛЕВЕНЕ ЗАЧИНСКЕ ПАПРИКЕ
(Capsicum annuum) ТОКОМ СКЛАДИШТЕЊА

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Узорци млевене зачинске паприке сорте Алева НК, са два локалитета складиштени су на собној температури, изложени дневном светлу. Квалитет боје је одређен мерењем екстрактабилне боје, ASTA 20 методом и мерењем површинске боје. Параметри којима се дефинише површинска боја (CIE Lab) најближи су утиску који се ствара при опажању оком. Током складиштења узорака дошло је до негативне промене боје, тј. смањења садржаја укупних пигментата (опадање ASTA вредности и промена "hue angle"-а од црвених ка жутим пигментима у CIE систему), чиме је утврђена корелација између параметара површинске боје и садржаја укупних пигментата (ASTA).

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