SENSORY AND INSTRUMENTAL EVALUATION OF PHYSICAL CHARACTERISTICS OF LABORATORY-MADE CHOCOLATE

Olga Lj. Jovanović and Biljana S. Pajin

Sensory evaluation of chocolate, as a complex multicomponent system, is one of the ways to define and control its physico-chemical characteristics, i.e. quality. Chocolate quality depends on structure and ingredients percentage that influence its appearance, taste and behaviour in the production processes and storage. The aim of this work was to compare certain quality factors of laboratory-made chocolate with added emulsifier – blooming inhibitor, determined by sensory and instrumental analyses. Sensory evaluation of chocolate samples was made according to ISO 6685:1985 method (total score system). This ISO standard method was supplemented with QDA method for determination of mouth feel. The results of colour sensory evaluation showed good agreement with whiteness obtained on a MOM Colour 100 instrument by Hunter system evaluation. This showed that the sensory analysis, in comparison with instrumental determination of some quality factors, is an objective method.

KEY WORDS: chocolate, sensory evaluation, quality, instrumental methods

INTRODUCTION

The aim of food production is to obtain high quality products that are accepted by consumers. Sensory analysis is one of the ways to control physico-chemical characteristics, i.e. quality of the products. In a sensory analysis the product properties are described by five main senses: sight, touch, taste, smell and hearing (1). Nowadays, sensory analysis is often combined with appropriate instrumental methods, in order to obtain objective results.

The aim of this work was to investigate the quality of laboratory-made chocolate with addition of emulsifier – blooming inhibitor, as well as the comparison of some quality factors obtained by instrumental methods. Sensory evaluation of chocolate

Dr. Olga Lj. Jovanović, Assist. Prof., Biljana S. Pajin, M. Sc. Assist., University of Novi Sad, Faculty of Technology, 21000 Novi Sad, Bulevar Cara Lazara 1, Yugoslavia
samples made by total score system, in combination with the QDA (Quantity Descriptive Analysis) method, provide a complete evaluation of chocolate characteristics.

EXPERIMENTAL

Materials

1. Chocolate mass, taken at the end of conching process (fat content 35.44%) was obtained from the factory "Banat", Vrsac.
2. Emulsifier – blooming inhibitor: Milk acid monoglyceride (Lactodan P22, "Danisco ingredients", Denmark).

Methods

1. Preparation of chocolate samples

Chocolate samples were prepared in laboratory by precrystallization process on a modified Brabender pharinograph. Pre-crystallization was performed at three temperatures 23°C, 25°C and 27°C. Chocolate samples were prepared without blooming inhibitor and with addition of 1%, 2% and 3% (calculated on chocolate mass fat content) of blooming inhibitor.

2. Quality investigation

2.1. Sensory characteristics: total score method (2) and QDA method (3)
2.2. Hardness: Penetration value – penetration of needle mass 175g for 15s at 20°C
2.3. Colour: Whiteness by Hunter system evaluation on a MOM Colour 100 (4)
2.4. Fat bloom stability: Thermo-cycle test 32/20°C. Chocolate samples were stored at 32°C and 20°C. Temperature was changed every 12 hours, in cycles. Changes on samples surface were followed every 24 hours (1 cycle) by sensory evaluation. Colour (whiteness) of the samples was measured by a MOM Colour 100 photoelectric colorimeter, at the beginning of the first cycle and at the end of the last cycle (complete fat blooming).

RESULTS AND DISCUSSION

Sensory characteristics of laboratory-made chocolate

During sensory evaluation of samples with emulsifier Lactodan P22 it was concluded it that had no influence on smell and taste of samples, which is the reason why the investigation of physical characteristics was our of main concern.

Sensory characteristics of the laboratory-made chocolate in dependence of pre-crystallization temperature and Lactodan P22 concentration are presented in Table 1.

The increase in pre-crystallization temperature and concentration of Lactodan P22 emulsifier resulted in lower sensory characteristics of the chocolate. Chocolate samples
without emulsifier had better and similar sensory characteristics irrespective of pre-crystallization temperature. Of the chocolate samples with addition of emulsifier, best sensory characteristics were achieved with addition 1% of emulsifier Lactodan P22 and pre-crystallization temperature of 23°C. The increase of pre-crystallization temperature and concentration of Lactodan P22 led to the loss of shine and appearance of grey spots, and finally to surface damage. Chocolate snap is crude and uncharacteristic and structure is with crude crystals, sandy or granular.

Table 1. Dependence of sensory characteristics of chocolate samples on pre-crystallization temperature and Lactodan P22 concentration.

<table>
<thead>
<tr>
<th>Quality factor</th>
<th>Factor of importance</th>
<th>Temperature of pre-crystallization (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>23</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Shape</td>
<td>0.4</td>
<td>2</td>
</tr>
<tr>
<td>Colour</td>
<td>0.4</td>
<td>2</td>
</tr>
<tr>
<td>Gloss</td>
<td>0.8</td>
<td>3.8</td>
</tr>
<tr>
<td>Surface</td>
<td>0.4</td>
<td>2</td>
</tr>
<tr>
<td>Snap</td>
<td>0.6</td>
<td>3</td>
</tr>
<tr>
<td>Structure</td>
<td>0.8</td>
<td>4</td>
</tr>
<tr>
<td>Mastication</td>
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</tr>
<tr>
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<td>19.8</td>
</tr>
<tr>
<td>Quality number</td>
<td></td>
<td>4.9</td>
</tr>
</tbody>
</table>

The results of texture quality evaluation and chewing characteristics are shown in Figure 1.

![Figure 1](image)

Fig. 1. Influence of pre-crystallization temperature and concentration of Lactodan P22 on texture and chewing characteristics – QDA method.

As can be seen from the figure the shape of surface obtained by QDA method shows that the biggest deference in hardness and brittleness of chocolate samples, for different
emulsifier concentration was achieved at pre-crystallization temperature of 23°C. The increase of pre-crystallization temperature and emulsifier concentration influenced sample characteristics, especially melting, causing thus a decrease in quality. Generally, chocolate samples with addition of Lactodan P22 and pre-crystallization at 25°C and 27°C had lower quality of texture and chewing property.

**Hardness**

The penetration values as criteria for chocolate samples hardness in dependence of the pre-crystallization temperature and emulsifier concentration, are presented in Figure 2.

![Penetration values](image)

*Fig. 2. Dependence of hardness of chocolate samples on pre-crystallization temperature and Lactodan P22 concentration*

Lactodan P22 in applied concentration had no significant influence on chocolate hardness, while the hardness was lowered with increase in pre-crystallization.
temperature. The results obtained by penetration method as an objective (instrumental) procedure proved that sensory analysis is a good quality indicator.

*Fat bloom stability*

The dependence of fat blooming dynamics of chocolate samples on pre-crystallization temperature and Lactodan P22 concentration is presented in Figure 3.

The results of blooming test 32/20°C showed that the fat bloom stability decreased with increase of pre-crystallization temperature. Chocolate samples pre-crystallized at 23°C with addition of 3% emulsifier have the longest time before first sign of blooming was noticed. Higher fat bloom stability (highest total number of cycles) was found for chocolate samples prepared at 23°C. Lactodan P22 had no influence on total number of cycles, but this emulsifier slowed down the blooming process (appearance of first sign of blooming) of chocolate samples prepared at 25°C and 27°C.

![Diagram of chocolate bloom stability](image)

**Fig. 3.** The dependence of fat bloom stability of chocolate samples on pre-crystallization temperature and Lactodan P22 concentration

Changes of chocolate whiteness before and after blooming test, given as Hunters' whiteness value are presented in Figure 4.
These data show that the initial chocolate samples had a uniform whiteness (L\textsubscript{hu} value) irrespective of pre-crystallization temperature and emulsifier concentration. Whiteness of chocolate samples was measured after the blooming test. It was found that the whiteness of chocolate increased with increase of pre-crystallization temperature. Such changes in whiteness are result of the same effect of temperature on chocolate fat bloom stability. Also, it was found that increase in emulsifier concentration resulted in decrease in a chocolate whiteness. Higher whiteness observed in the chocolate sample prepared at 25°C with 1% Lactodan P22 and the one prepared at 27°C with 2% emulsifier, are probably the result of the specific position of the measuring device on the chocolate surface, but not whiteness itself. Addition of emulsifier retarded fat blooming process in the way of polymorphic transformation process of cocoa butter from V to VI polymorphic form. As a result, a lower density bloom film on chocolate surface was formed.

![Graph showing whiteness of chocolate surface before and after blooming test as a function of pre-crystallization temperature and Lactodan P22 concentration.]

**Fig. 4.** Whiteness of chocolate surface before and after blooming test as a function of pre-crystallization temperature and Lactodan P22 concentration.

**CONCLUSION**

- The best chocolate sensory quality was achieved with the lowest pre-crystallization temperature (23°C) and Lactodan P22 concentration (1%).
- Lactodan P22 does not influence colour and whiteness of laboratory-made chocolate samples, and has a small influence on hardness of investigated samples.
- The highest fat bloom stability (36 cycles) was found for the chocolate mass pre-crystallized at 23°C with addition of 3% Lactodan P22.
- Changes in pre-crystallization temperature have more significant influence on sensory and physical characteristics of chocolate than emulsifier Lactodan P22 concentration.
- QDA diagrams clearly demonstrate the differences between some factors that define the structure and melting attributes of chocolate. These diagrams are recommended for routine quality control of confectionery products in the industry.

REFERENCES

2. ISO/TC 34/SC 12, Sensory Analysis, DC 1985-02-05

СЕНЗОРНА И ИНСТРУМЕНТАЛНА ОЦЕНА ФИЗИЧКИХ ОСОБИНА ЛАБОРАТОРІЈСКИ ПРИПРЕМЉЕНЕ ЧОКОЛАДЕ

Олга Јовановић и Биљана Пајин

Сензорна оценаЧоколаде, као комплексног вишекомпонентног система, је један од начина којим се дефинишу и контролишу његове физичко-хемијске карактеристике, односно квалитет. Квалитет чоколаде зависи од структуре и удела великог броја компоненти које улазе у њен састав и које утичу на изглед, укус, мирис и понашање у току производње и чувања. Циљ овог рада је да се сензорном оценом испита квалитет лабораторијски добијене чоколаде уз додатак емулгатора – инхибатора сивљења и да се покаже њена објективност поређењем са инструменталним мережењем појединих показатеља квалитета. Сензорна оцена испитиваних узорака је урађена по методи ИСО 6658:1985 (систем бодовања). Испитивања изведена овом методом су допуњена применом QDA методе за процену осећаја у устима при жвакању. Резултати сензорне анализе боје чоколаде су показали добро слагање са измереном светлошћом по Хантеровом систему на MOM Колору 100. Сензорно оцењивање допуњено QDA методом је допринело бољем сагледавању утицаја испитиваних фактора на квалитет лабораторијски припремљене чоколаде.

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