Sensory Quality of Stored Croissant-Type Bakery Products

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Abstract

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The results are presented of the estimation of sensory quality (shape, odour, colour, taste, consistency, crust, crumb etc.), mould and yeast counts, a_w value, and pH in 8 bakery croissant-type products with nougat cream filling during storage under laboratory conditions (20 ± 2°C) for the periods of up to 90 days (0; 30; 45; 60; 75 and 90 days). The products differed in the type of dough (brioche, croissant), the a_w value of the cream, and in the presence or absence of sorbic acid in the spirit spray applied onto the surface of the products under investigation. The above-indicated parameters were examined also in the nougat cream samples on day 0 and 90 of the storage. The selected quality parameters permitted to estimate the shelf life of the products in the dependence on various technological conditions (sorbic acid, recipe, a_w value).

Keywords: croissants; sensory evaluation; moulds and yeasts; a_w; pH; sorbic acid

The production of bakery products constitutes an inherent part of the agricultural and food complex in ensuring the nourishment of the population. In connection with the development of new kinds of products, the volume of production and, simultaneously, the demand of the retail network stimulated by a larger supply of the assortment have been continuously growing. The main reasons are: taste variety, the availability for consumption, and long-term storability.

The basic criteria of the quality of durable products are health safety and optimum sensory properties. Both the quality and durability of products are influenced by the raw-material quality, recipe, and storage conditions. The durability of bakery products with the medium and high humidity contents is often limited by the growth of moulds. A lot of species are able to grow at the water activity value of 0.8 whereas some xerophilous species at that of 0.65. Losses caused by the moulding process vary between 1% and 5% in the dependence on the season, the type of product, and the mode of production (LEGAN 1993; NIJS *et al.* 1996; ABELLANA *et al.* 1997; HAASUM & NIELSEN 1998; VEGA *et al.* 1998).

Apart from the currently produced types of sweet durable bakery products such as biscuits, crackers, sponge and tea biscuits in the limelight of the market are also innovated and tasteful croissant-type products filled with various kinds of cream which are favoured especially by the children population; these are more and more frequently subjected to different technological treatments prolonging their durability (ingredients, packaging) (FRIEDRICH 1992; AKGÜN *et al.* 1997; GAUTCHIER & DYER 1997).

One of the croissant producers in Slovakia is a private firm with the commercial name "Resanka" which produces sweet crescent-shaped rolls filled with nuts, nougat, apricots, kiwis, cherries and, since recently, with Champagne cream (exported also to the Czech Republic). The guaranteed period of consumption amounts to three months from the date of production during which the stored products must comply with all necessary quality criteria (microbiological, physical, chemical, sensory, etc.) in accordance with the Food Codex of the Slovak Republic (1998) and the regional standard PN 01/98 (Norma kvality Croissant-Resanka. Ress, a.s., Senica). The most crucial factors influencing the microbiological and sensory quality of bakery products are: a_w value (BRACK 1994; ABELLANA *et al.* 1997; VEGA *et al.* 1998), pH (ABELLANA *et al.* 1997; ŠILHÁNKOVÁ 1995), food additives (GERRARD *et al.* 2000; HERMANN & SALDIVAR 2000), preserving substances such as sorbic acid, benzoic acid (FRIAS *et al.* 1996), propionic acid and its salts (ROSLYAKOV & PALA-

GINA 1996), ethanol, nitrogen and CO_2 (SMITH 1994; PHILLIPS 1996; DOULIA *et al*. 2000) and packaging material (SPARAKOWSKI 1993; SMITH 1994; SMITH *et al*. 1996; HORN & GEHR 1998; DOULIA *et al*. 2000).

However, only a minimum number of research works have been engaged so far in the qualitative evaluation of this type of products (HAASUM & NIELSEN 1998). The accessible data, namely the patented ones, consider primarily the technological aspects of production (equipments, recipes) (UENO & TASHIRO 1992; MORIHAWA & UENO 1993). Our objective was to search, in co-operation with the above-indicated firm, for mutual connections and relations affecting the microbiological and sensory quality of the shelf life of croissant-type products, and on the basis of the results to suggest the producers suitable solutions for improving and optimizing the production in order to achieve a prolonged shelf life of the final products.

In the model experiment, parameters such as: organoleptic properties (shape, odour, colour, taste, consistency, etc.), mould and yeast counts, pH and a_w values (as complementary factors) were pursued during 90-day storage (at intervals of 0, 30, 45, 60, 75 and 90 days) at $t = 20 \pm 2$°C in 8 types of croissants filled with nougat cream, the products differing in the type of dough (brioche, croissant), a_w value, and the presence or absence of sorbic acid in the spirit spray (0.62%). These parameters were examined individually also in the nougat cream samples, but only at the beginning (zero day) and at the end of the storage (90^{th} day).

MATERIALS AND METHODS

The croissant "Resanka" (40 g) is a sweet crescent-shape roll filled with nougat cream and composed of: wheat flour, nougat cream, margarine, water, sugar, eggs, starch syrup, dried milk, yeast, emulsifier E-471, vanillin sugar and lemon aroma.

The sensory quality, mould and yeast counts, and a_w and pH values were evaluated in the samples of two types of products:

Type 1 products "Brioche" (30 g dough + 10 g filling)

Resanka Vita – nougat cream C1 ($a_w = 0.79$) with sorbic acid

Resanka Vita – nougat cream C1 ($a_w = 0.79$) without sorbic acid

Resanka Vita – nougat cream C3 ($a_w = 0.86$) with sorbic acid

Resanka Vita – nougat cream C3 ($a_w = 0.79$) without sorbic acid

Type 2 products "Croissant" (27 g dough + 13 g filling)

Croissant – nougat cream C2 ($a_w = 0.82$) with sorbic acid

Croissant – nougat cream C2 ($a_w = 0.82$) without sorbic acid

Croissant – nougat cream C2 ($a_w = 0.86$) with sorbic acid

Croissant – nougat cream C2 ($a_w = 0.86$) without sorbic acid

Technological procedure of production. Standardized raw-materials are used to prepare leavened dough which is weighed out into small loaves and left for a fixed time to rest. Then the dough is molded with a molder to a fixed thickness and distributed into triangular forms. After being shaped, the products are coiled and laid on plates which are put on carriages and allowed to ferment in the fermentation chamber. The leavened products are baked for 15 min at 220°C in a semi-automatic multiple-hearth furnace, then filled by means of three injection punctures and wrapped into cellophane foil. The wrapped products are put into cardboards and dispatched (PN 01/98).

Note: The brioche dough is not let to rest; it is immediately shaped after kneading.

Packaging material. The foil is produced from raw-materials harmless to health. It should comply with the hygienic requirements for a direct contact with eatables. It has favourable barrier properties against the water vapour permeability and contains some aromatic substances. The foil is characterized by its metal-bright appearance (PND 12-184-00 – Plasty, kombinované filmy a kópie).

For the microbiological examination of the products, 5 packages (10 g each) were used with the addition of 90 ml of physiological solution. Homogenization proceeded in a separating funnel for 20 to 30 min. Both the samples and the nougat cream (10 g) were analysed by 2 and 3 parallel determinations.

1. Sensory evaluation was accomplished by the 5-point hedonic scale determination and the profiling of tastiness was carried out by 6 panel assessors (POKORNÝ 1993).
2. Yeast and mould count were determined by the plate count method, on the chloramphenicol glucose extract agar (Šarišské Michaľany, Slovak Republic) (STN ISO 7954 1997 – Mikrobiológia. Všeobecné pokyny na stanovenie počtu kvasiniek a plesní. Metóda počítania kolónií kultivovaných pri 25 °C).
3. The a_w value was determined according to the Slovak Standard STN 56 0030, 1996 – Stanovenie aktivity vody v potravinách (Thermoconstanter-Defensor AG-Novasina, Switzerland).
4. Measurement of the pH value was carried out using a pH meter inoLab, pH level 1 with a Blue Line glass electrode.
5. Mathematical and statistical evaluation of the results (x, s, s_r%) was carried out after CHATFIELD (1995).

RESULTS AND DISCUSSION

Sensory evaluation

Products. Changes in the organoleptic properties of 8 kinds of the croissant samples "Resanka" stored at lab-

oratory temperature (20 ± 2°C) were evaluated at time intervals of 0, 30, 45, 60, 75 and 90 days. The individual samples differed in the type of dough (brioche and croissant), the a_w value of the cream, and the addition (or absence) of sorbic acid in the spirit spray.

The six-member panel evaluated the following sensory parameters: shape, crust, odour, hardness, crumb, taste, the appearance of the cream, taste + consistency of the nougat cream, and adhesiveness to palate (5-point hedonic scale, according to which the maximum value of 5 points corresponded to the highest degree of the evaluated product's quality whereas the lowest degree of the evaluation expressed by 1 point demonstrated its fundamental qualitative deficiencies). The results of the sensory evaluation are summarized in Tables 1 and 2.

It was found that:

– in the samples produced from the croissant dough, more remarkable changes in the sensory properties took place in comparison with those from the brioche dough; the changes were observed in individual sensory parameters, especially in hardness, odour, taste, crust and shape. Moreover, also the general evaluation was lower in the products made of the croissant dough as manifested by the minimum value of 30.5 (s = 0.52, s_r = 10.7%) whereas in the products made of the brioche dough the minimum value of 35.7 (s = 0.55, s_r = 11.1%) was found. It is obvious that the lower sensory quality is associated with the difference in dough fat contents (the brioche dough contains 15% of fat while the croissant dough as much as 25%). It may be suggested that du-

Table 1. Scale of the sensory scoring evaluation of "Croissants"

Attribute	Characteristics
Shape	
5	regular, well-formed
4	regular, slightly formed
3	slightly regular, slightly formed
2	irregular
1	flat, deformed
Crust	
5	golden-brown, fragile, smooth
4	darker or lighter, less fragile, smooth
3	darker or lighter, medium-fragile, fine-cracked
2	dark or light, medium-fragile, more cracked
1	very dark or light, non-fragile, more cracked
Odour	
5	much pastry-like, harmonizing with an applied nougat filling
4	less pastry-like
3	slightly pastry-like
2	alcoholic, acidic up to inexpressive
1	malodorous, strange
Hardness	
5	very soft
4	softer
3	soft
2	slightly hard
1	hard
Crumb	
5	even, soft walls, medium pores, very good
4	less even, medium pores, white with a soft shade, good
3	very rough walls, large pores, yellowish, sufficient
2	rough walls, thick pores, yellow shade, low, friable
1	rough walls, almost no pores, yellow or grey, non-elastic, adhesive
Taste	
5	very agreeable pastry-like, harmonizing with an applied nougat filling
4	suitable, less expressive
3	slightly expressive pastry-like up to inexpressive
2	acidic, alcoholic
1	strongly disagreeable, strange
Cream appearance	
5	evenly distributed, with no outflow on the surface
4	evenly distributed, with some outflow on the surface
3	unevenly distributed, with no outflow on the surface
2	unevenly distributed, with some outflow on the surface
1	filled insufficiently or not at all
Taste + consistency of the nougat cream	
5	liquid, delicious
4	semi-solid, delicious
3	more solid, inexpressive
2	solid, delicious
1	solid, disagreeable
Adhesiveness to palate	
5	very slightly adhesive
4	slightly adhesive, separative
3	medium-adhesive
2	considerably adhesive
1	very adhesive

Table 2. Scale of the sensory scoring evaluation of nougat creams

Attribute	Characteristics
Odour	
5	expressive, typical cocoa
4	less expressive, cocoa
3	slightly expressive
2	inexpressive alcoholic up to acidic
1	disagreeable, strange
Taste	
5	very agreeable, cocoa with a filbert core after-taste
4	suitable, less expressive cocoa, less expressive filbert-core after-taste
3	slightly expressive, cocoa up to inexpressive
2	acidic, alcoholic
1	disagreeable, strange
Consistency	
5	semi-solid, paste-like, soft
4	more solid, soft
3	more solid, with small clods
2	solid
1	very solid
Colour	
5	light-brown up to brown
4	brown
3	dark-brown
2	dark-brown, sporadically darker or lighter spots
1	dark-brown, remarkable colour changes, large stains
Appearance	
5	bright smooth surface, homogeneous without visible small clods
4	less bright surface, presence of small clods
3	brightless surface, presence of small clods
2	dull surface, presence of big clods
1	considerably unequal surface, presence of big clods and foreign matters

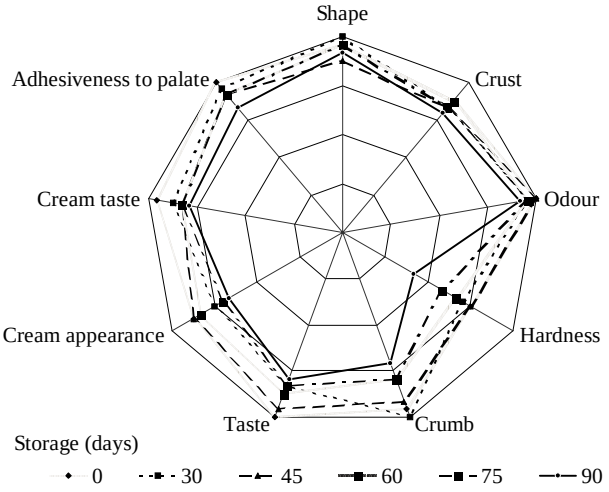

Fig. 1. Diagram of croissant sensory evaluation [Brioche dough, cream C1 (a_w = 0.79) + sorbic acid]

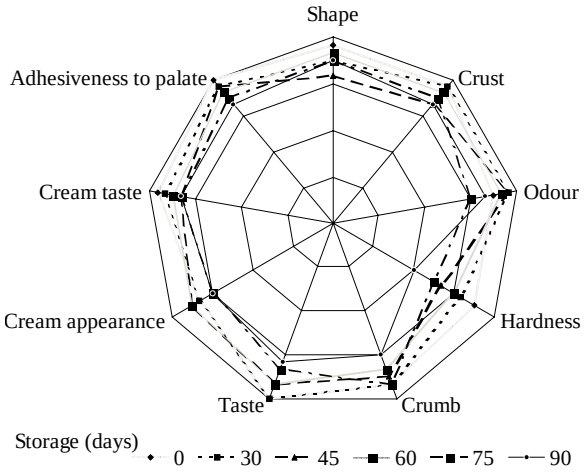

Fig. 2. Diagram of croissant sensory evaluation [Brioche dough, cream C1 (a_w = 0.79)]

ring the storage some undesirable changes take place in the fat and affect the sensory properties (Figs 1–8);
– the different application of the cream also affected the sensory quality of the investigated products, namely their appearance, taste, and the consistency of the cream. In creams C1 (a_w = 0.79) and C3 (a_w = 0.86) comparable results were found while cream C2 (a_w = 0.82) revealed lower values of the parameters under investigation. It appears that the water activity value did not have a crucial influence on the sensory properties, and that the above-indicated differences were apparently caused by different recipes for the individual nougat creams;
– no influence of the addition of sorbic acid on the sensory properties was observed. The applied concentration of 0.62% did not affect any sensory parameters.

Creams

Changes in the organoleptic properties (odour, taste, consistency, colour, appearance) of creams prepared with different a_w values were evaluated at the beginning (zero day) and at the end of the storage (90th day). The average values are summarized in Figs 9–11.

During the storage following changes in the sensory parameters of creams were recorded:
– in cream C1 (a_w = 0.79) only minimal qualitative changes occurred. Neither the consistency nor the colour changed. In evaluating the taste and appearance, the minimum

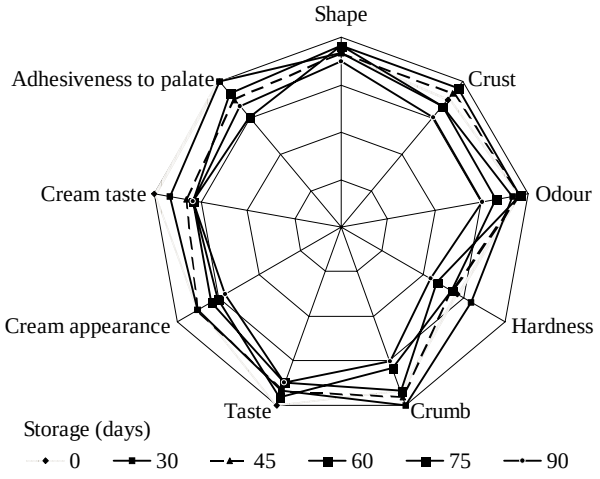

Fig. 3. Diagram of croissant sensory evaluation [Brioche dough, cream C3 (a_w = 0.86) + sorbic acid]

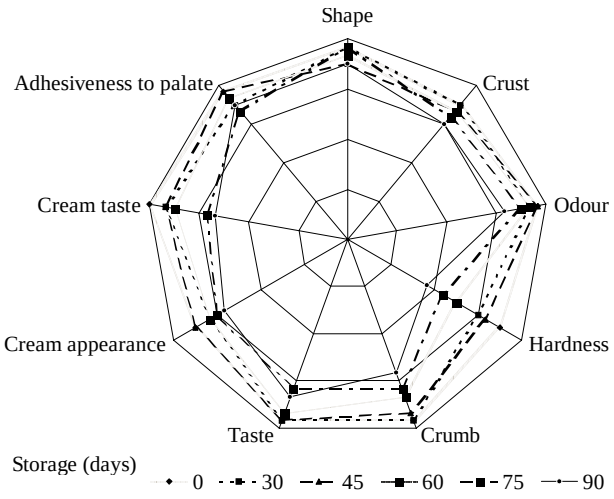

Fig. 4. Diagram of croissant sensory evaluation [Brioche dough, cream C3 (a_w = 0.86)]

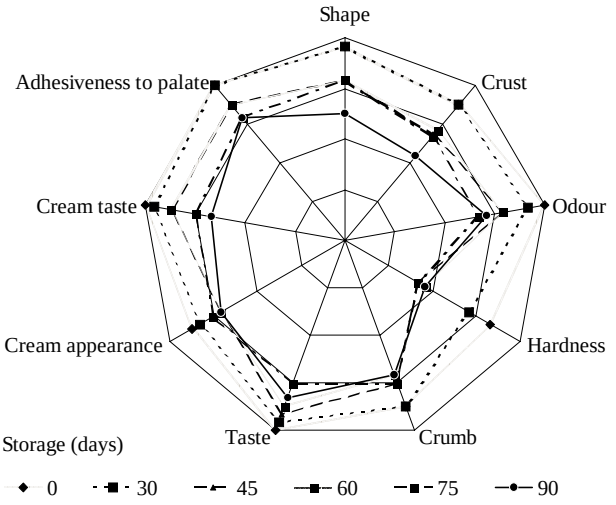

Fig. 5. Diagram of croissant sensory evaluation [Croissant dough, cream C2 (a_w = 0.82) + sorbic acid]

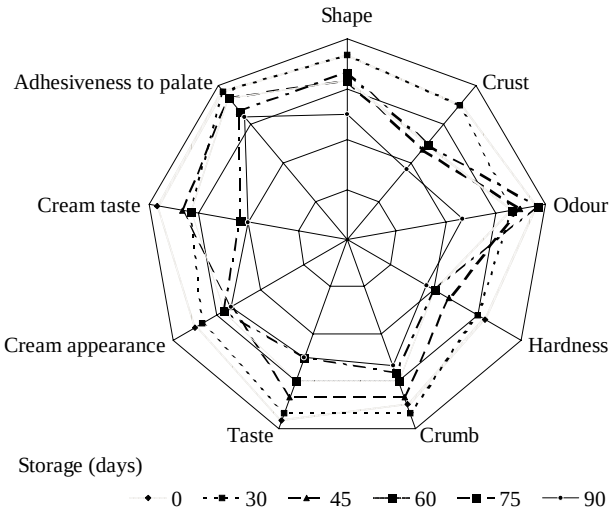

Fig. 6. Diagram of croissant sensory evaluation [Croissant dough, cream C2 (a_w = 0.82)]

level of 0.17 points (s = 0.32–0.5; s_r = 9.2–11.8%) was found. The most remarkable changes were observed in the evaluation of odour (0.5 points);

– in cream C2 (a_w = 0.82), changes were more recognizable. Odour (0.67 points), taste (0.33 points), consistency (0.5 points), colour (0.33 points) and appearance (0.17 points) varied; (s = 0.4–0.55, s_r = 8–12%);
– in cream C3 (a_w = 0.86), slight changes in the investigated parameters were observed, namely: odour (0.17 points) and taste (1 point). The sensory evaluation of taste, consistency and colour did not change during the storage (s = 0.48–0.58, s_r = 8.5–12.3%).

Considering the summarized evaluation of the creams used over the time period starting from the zero time up to the 90th day of storage, it may be concluded that the most acceptable cream – as viewed from the sensory aspect – was C1 (a_w = 0.79).

Mould and yeast counts. During the 90-day storage at laboratory temperature, no moulds or yeasts occurred in any analysed samples (products and creams contained < 10 CFU/g); consequently, they are not presented either in the tabelar or in the graphical forms.

Considering mould and yeast counts, it may confirmed that the products comply with the valid legislative re-

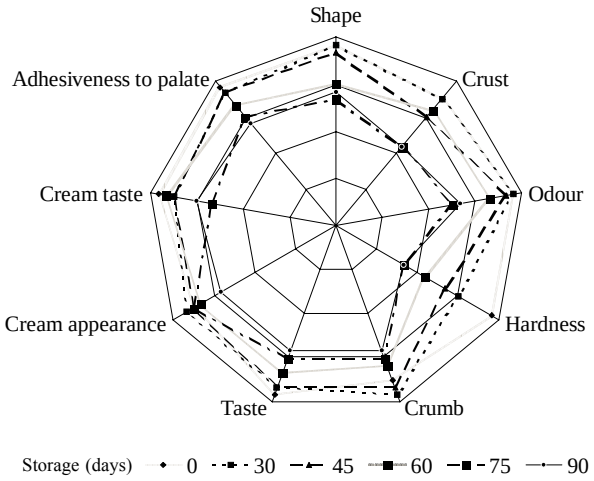

Fig. 7. Diagram of croissant sensory evaluation [Croissant dough, cream C3 (a_w = 0.86) + sorbic acid]

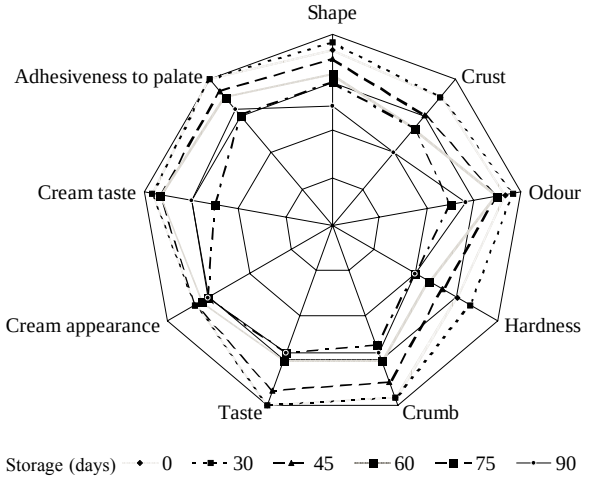

Fig. 8. Diagram of croissant sensory evaluation [Croissant dough, cream C3 (a_w = 0.86)]

quirements for this type of product (the limit for the mould count is 5×10^2/g max. in 5 analysed samples, the limit of 5×10^3/g being allowed in two of them; the yeast count is not included in the standard (Food Codex of the Slovak Republic 1998). The influence of sorbic acid (0.62%) in the spirit spray applied on to the surface of products had no marked effect on the microbiological quality and the shelf life of the finished products.

pH. The pH value was measured as a complementary index of the quality of products which is associated with the development of microflora. The pH values of the samples did not markedly change during 90-day storage (5.9–6.1), which corresponds also to the significantly unchanged microflora during the storage. In samples 6 and 9 produced from the croissant dough, the pH value was somewhat higher than that in samples 1 to 4 produced from the brioche dough, which was obviously in connection with the different recipes. The pH values of the creams were measured at the beginning (zero day) and at the end (90th day) of the storage and were approximately 6.6.

a_w value. The water activity values of 8 kinds of the "Resanka" samples were measured at regular intervals during storage; the water activity values of the corpus and cream were measured separately and on the basis of these values the average water activity of individual products was calculated. The values of the water activity of the samples as determined in the course of storage varied from 0.70 to 0.84 which may have been caused by the sample variability resulting from the unevenness of the baking process in the rotary furnace.

The a_w values of creams (zero and 90th day) ranged according to the above-indicated specification (C1, C2

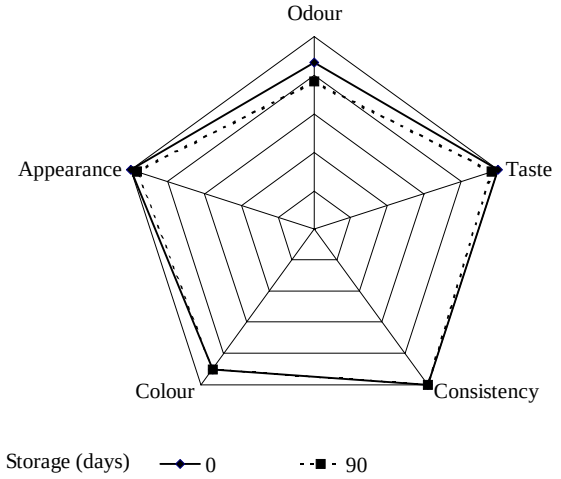

Fig. 9. Diagram of cream C1 (a_w = 0.79) sensory evaluation

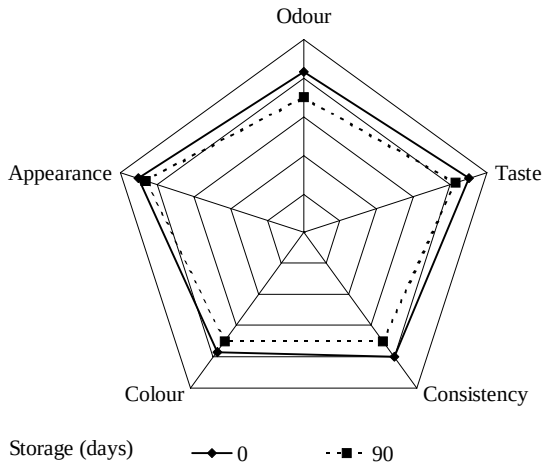

Fig. 10. Diagram of cream C2 (a_w = 0.79) sensory evaluation

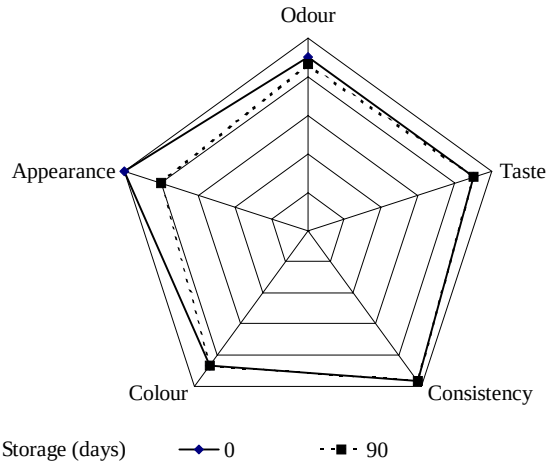

Fig. 11. Diagram of cream C3 (a_w = 0.86) sensory evaluation

and C3) from 0.79 to 0.86. They did not change in the course of storage and, consequently, they are not demonstrated in a tabular form.

Conclusions

The results given in this paper enable to conclude that health-beneficial and taste-attractive products with a long shelf life and utilization at the consumer's market can be obtained by:

– a strict observation of the hygienic regulations for the prevention of the danger of contamination by analysing the risks (HACCP)
– a strict observation of the baking process
– preferring the brioche dough to the croissant dough
– a careful consideration of the use of sorbic acid (in view of the spectrum of its action).

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Súhrn

HOZOVÁ B., KUKUROVÁ I., TURICOVÁ R., DODOK L. (2002): **Senzorická akosť skladovaných pekárskych výrobkov typu croissant**. Czech J. Food Sci., **20**: 105–112.

Hodnotili jsme senzorickú akosť (tvar, vôňa, farba, chuť, konzistencia, kôrka, striedka atď.), množstvo plesní a kvasiniek, hodnoty a_w a pH počas 90-dňového skladovania (0, 30, 45, 60, 75 a 90 dní) v laboratórnych podmienkach pri 20 ± 2 °C v 8 typoch pekárskych výrobkov typu croissant s nugátovým krémom, odlišujúcich sa typom cesta (briož, croissant), a_w hodnotou krému a prídavkom alebo bez prídavku kyseliny sorbovej v postreku liehu na povrch výrobkov. Uvedené parametre boli stanovené tiež vo vzorkách nugátových krémov (0. a 90. deň skladovania). Zvolené parametre umožnili posúdiť čas trvanlivosti výrobkov v závislosti od rôznych technologických podmienok (kyselina sorbová, receptúra, a_w).

Kľúčové slová: croissant; senzorické hodnotenie; plesne a kvasinky; a_w; pH; kyselina sorbová

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