

Sensory Evaluation of Shelf-stable Cereal Amaranth-based Products during Storage

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Summary

At one-month intervals during the four-month storage (20 ± 2 °C) changes in the organoleptic properties (scoring evaluation of shape, surface, colour, consistency, odour, taste and profiling of tastiness) and a_w values of amaranth-based snacks and crackers were investigated. The changes observed during storage in the surface, colour and consistency of snacks (score 0.1–0.3 out of 5) and in the odour of crackers (score 0.2–0.3 out of 4) were insignificant. The taste harmonized in both samples having as a result higher scores with regard to the starting values. Although the a_w values of products during storage varied to some extent (from 0.15 to 0.34), they did not influence the important sensory parameters (snacks crispness, crackers crunchiness).

Keywords: cereal Amaranth-based products, organoleptic properties, sensory evaluation

Introduction

In recent years, an increased concern in the industrial utilization of amaranth (*Amaranthus*) has been raised throughout the world. This universal plant belonging among pseudocereals can be used as a vegetable (leaves), the whole plant as a feedstuff, or as a grain for processing in the baker's industry. Owing to its nutritional value, amaranth represents an alternative source of nourishment because of the content of proteins, amino acids, mainly lysine, saccharides, B-group vitamins, fibres, etc.; moreover, it is important also from the dietary point of view (absence of gluten). The amaranth flour mixed with other sorts, particularly with wheat and soya flours (substitution of 5, 10, 15 and even 20%) is suitable for the production of bread, egg-free pastries, and shelf-stable baked products (rusks, biscuits, sponge-biscuits, extruded products) which were referred to in more detail in our previous paper (1). Nowadays, a number of scientific studies comprising numerous analyses are aimed mostly at the investigation of physicochemical characteristics affecting the qualitative properties of grain and amaranth flour (2–5) as well as at the testing of methods designed for the production of confectionary products such as sponge-biscuits (6) and amaranth bars with walnuts (18%) (7); in the literature, a description of the sensory evaluation which is also an inseparable part of the evaluation of the total products quality is rarely found.

The aim of this paper was to observe changes in the sensory quality of gluten-free extruded crackers and

snacks based on the whole-grain amaranth-seed flour during the four-month storage at room temperature. As a complementary factor the a_w value was measured. The results obtained enabled us to assess in wider aspects the storage stability of non-traditional cereal products during the time of guarantee declared by the producer on the packaging.

Materials and Methods

The sensory quality and a_w were evaluated in samples of: *Snacks* (250 g) – composition: wheat flour, amaranth flour (20%), sugar, fat, eggs, aromatic compounds. *Crackers* (75 g) – composition: corn meal, salt, whole-grain amaranth flour.

The samples were obtained from the BOHEMIA AMARANTH Ltd., Olomouc, Czech Republic.

Sensory Evaluation

For the evaluation of the sensory attributes of amaranth snacks a five-point scale was used and for those of amaranth crackers a four-point scale. The six quality attributes were evaluated in such a way that the highest degree of the evaluation marked 5 or 4 corresponded to the fulfilment of all claims for organoleptic properties

and the lowest degree of evaluation marked 1 implied major qualitative deficiencies of the product.

For the profiling of tastiness the five-point scoring scale was used for both samples. In evaluating five descriptors the highest number of points, i.e. 4, implied an expressive feeling and 0 points referred to an unperceivable one. In order to express the results obtained, a polar diagram in which each arm represented one descriptor was used. The perception intensity was plotted in the direction from the centre up to top of the arm. By interconnecting the points of intensity a lucid polygon (9) was obtained. The evaluation panel consisted of six trained assessors.

Statistical Evaluation

The following statistical parameters were analysed: means (\bar{x}), standard deviations (s) and coefficients of variation (s_r) (10).

Table 1. Scale of the sensory scoring evaluation of snacks

Attribute	Characteristics
Shape and size	
5	compact, according to the form, sufficiently high
4	slightly incompact, according to the form, sufficiently high
3	slightly deformed, sufficiently high
2	deformed, insufficiently high
1	flat, incompleted
Surface appearance	
5	smooth, expressive design, uncracked
4	smooth, slightly damaged design, uncracked
3	slightly damaged design, cracked
2	cracked, considerably damaged design
1	without design
Colour and cut appearance	
5	light-brown, uniform colouring
4	light-brown, uniform colouring
3	light-brown, with a strange colour shade
2	stronger strange colour shade
1	pronounced colour differences (slightly burnt, slack-baked)
Consistency	
5	crisp, without residues of the undermixed dough
4	crisp, residues of the undermixed dough
3	very crips, even crumbly, residues of the undermixed dough
2	tough, undermixed raw-materials
1	slightly burnt or slack-baked
Odour	
5	agreeable, harmonizing with applied raw-materials
4	agreeable, with a mild prevalence of some of the applied raw-materials, less pronounced
3	agreeable, with a weaker strange odour, suitable
2	inexpressive, with a weaker strange odour
1	inexpressive, strange odour
Taste	
5	agreeable, harmonizing with applied raw-materials, sweet, without a strange smack
4	agreeable, with a moderate prevalence of some of the taste components (for example after the baking powder), less sweet
3	less sweet, weaker strange smack
2	less sweet, untypical taste
1	untypical, strange smack

The a_w value

Measurements were carried out by means of the apparatus AWX 3001/AWS 3000 (Thermoconstanter-Defensor AG-Novasina, Switzerland) with a standard $MgCl_2$ solution having the $a_w = 0.329$, $t = 25$ °C. After the apparatus had been calibrated, the a_w of homogenized samples was measured in the same conditions (11).

Results and Discussion

Changes in the organoleptic properties (scoring evaluation) were evaluated at thirty-day intervals during the four-month storage. The following sensory parameters were examined: shape and size, surface appearance, colour and cut appearance, consistency, odour and taste of products (Tables 1–2). Both the average results of the sensory scoring evaluation of snacks and crackers and those of the statistical evaluation are demonstrated in Tables 3 and 4.

The profiling of tastiness was accomplished only at the beginning (after the production of samples) and at the end of storage. The descriptors used for both samples are listed in Table 5. The results of the profiling of tastiness are graphically illustrated in Figs. 1 and 2.

Table 2. Scale of the sensory scoring evaluation of crackers

Attribute	Characteristics
Shape and size	
4	sufficiently swollen, oval
3	slightly deformed, sufficiently swollen
2	slightly deformed, incomplete shape
1	untypical
Surface appearance	
4	compact, smooth
3	slightly porous
2	very porous
1	untypical
Colour	
4	light-brown, even cream-coloured, applied raw-materials
3	pale
2	very pale
1	different
Consistency	
4	crunchy, crips, without residues of undermixed raw-materials
3	less crunchy, without residues of undermixed raw-materials
2	tough, slightly humid, residues of undermixed raw-materials
1	rubber-like, unsuitable
Odour	
4	neutral, agreeable
3	corn
2	slightly strange, suitable
1	undesirable
Taste	
4	amaranth and like applied raw-materials
3	like slightly strange admixtures
2	musty, like strange admixtures
1	undesirable

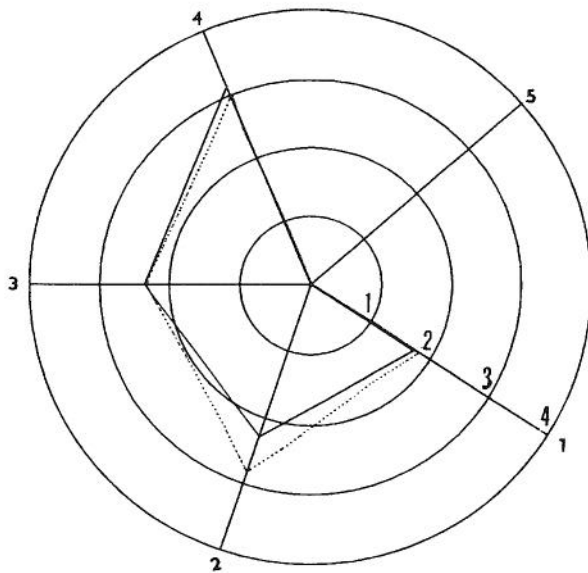


Fig. 1. Diagram of profiling the snacks tastiness at the beginning and at the end of storage
 Descriptor: 1 – vanillic, 2 – cocoa, 3 – amaranthy, 4 – sweet, 5 – strange
 — beginning of storage
 end of storage

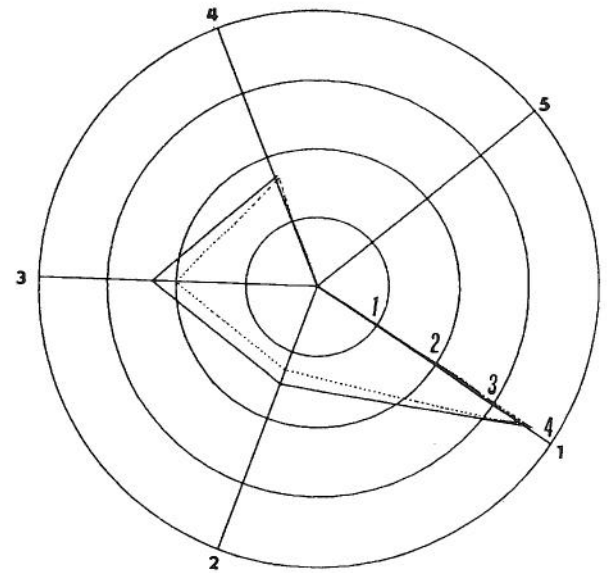


Fig. 2. Diagram of profiling the crackers tastines at the beginning and at the end of storage
 Descriptor: 1 – corn, 2 – amaranthy, 3 – spicy, 4 – salty, 5 – strange
 — beginning of storage
 end of storage

Table 3. Sensory scoring evaluation of snacks during the storage (5 = maximum)

Sensory parameter	Storage/month											
	0			1			2			3		
	\bar{x}	<i>s</i>	<i>s_r</i> /%	\bar{x}	<i>s</i>	<i>s_r</i> /%	\bar{x}	<i>s</i>	<i>s_r</i> /%	\bar{x}	<i>s</i>	<i>s_r</i> /%
Shape	3.8	0.75	19.8	3.8	0.75	19.8	4.0	0.89	22.4	3.8	0.98	25.9
Surface	4.2	0.75	17.9	4.0	0.89	22.4	4.0	0.89	22.4	4.0	0.89	22.4
Colour	4.7	0.52	11.0	4.5	0.55	12.2	4.5	0.55	12.2	4.5	0.55	12.2
Consistency	4.8	0.41	8.5	4.7	0.52	11.0	4.5	0.84	18.6	4.5	0.84	18.6
Odour	5.0	0.00	0.0	5.0	0.00	0.0	5.0	0.00	0.0	5.0	0.00	0.0
Taste	4.3	0.52	12.0	4.7	0.52	11.0	4.7	0.32	6.8	4.7	0.32	6.8
Total	26.8			26.7			26.7			26.5		

\bar{x} – mean scores by six assessors
s – standard deviation
s_r – coefficient of variation

Table 4. Sensory scoring evaluation of crackers during the storage (4 = maximum)

Sensory parameter	Storage/month											
	0			1			2			3		
	\bar{x}	<i>s</i>	<i>s_r</i> /%	\bar{x}	<i>s</i>	<i>s_r</i> /%	\bar{x}	<i>s</i>	<i>s_r</i> /%	\bar{x}	<i>s</i>	<i>s_r</i> /%
Shape	3.8	0.41	10.7	3.7	0.52	13.9	3.8	0.41	10.7	3.8	0.41	10.7
Surface	3.3	0.52	15.6	3.3	0.52	15.6	3.3	0.52	15.6	3.3	0.52	15.6
Colour	3.7	0.52	13.9	3.7	0.52	13.9	3.7	0.52	13.9	3.7	0.52	13.9
Consistency	3.8	0.41	10.7	4.0	0.00	0.0	4.0	0.00	0.0	4.0	0.00	0.0
Odour	4.0	0.00	0.0	3.8	0.41	10.7	3.8	0.41	10.7	3.7	0.52	13.9
Taste	3.8	0.41	10.7	4.0	0.00	0.0	4.0	0.00	0.00	4.0	0.00	0.00
Total	22.4			22.5			22.6			22.5		

\bar{x} – mean scores by six assessors
s – standard deviation
s_r – coefficient of variation

Table 5. a_w values of snacks and crackers during the storage

Sample	a_w			
	Storage/month			
	0	1	2	3
Snacks	0.29	0.17	0.18	0.30
Crackers	0.16	0.15	0.18	0.34

Changes in the a_w value of the two samples were measured simultaneously with the sensory evaluation at thirty-day intervals during the four-month storage. The results are summarized in Table 5.

Sensory Evaluation

The sensory scoring evaluation summarized in Table 3 showed that during the four-month storage snacks had experienced moderate negative changes in these parameters: surface (0.2), colour (0.2) and consistency (0.1–0.3). The values related to odour were unchanged and achieved the highest possible number of scores –5; the taste evaluated at the end of the storage period was scored better and more harmonic in respect to freshly produced snacks. The values assigned to the shape varied.

During the storage of crackers (Table 4) a moderate drop in the evaluation of odour (0.2–0.3) was registered; according to the latest literature data in two millet flakes samples with $a_w = 0.33–0.52$ and the storage temperature of 20 °C a marked deterioration of odour appeared as early as after two months (12). The surface and colour did not undergo any changes and the consistency and taste even improved during storage (by 0.2). The values assigned to shape showed minimal changes.

By profiling the tastiness of snacks (Fig. 1) the superiority of descriptors denoting »sweet« and »cocoa« was found. For crackers (Fig. 2) the descriptors denoting »corn« prevailed. The amaranth taste was hardly perceivable. As can be seen from Figs. 1 and 2, after the four-month storage no pronounced changes occurred in the evaluation of individual descriptors in any of the investigated products.

The a_w value

As shown in Table 5, during storage the a_w values varied. For crackers, the a_w value amounted to 0.29 at the beginning of storage, but during the next two

months much lower values ($a_w = 0.17–0.18$) were measured. At the end of storage the maximum a_w value was 0.34.

The ascertained phenomenon of the varying a_w value in equal external conditions can be accounted for by an unequal adhesion of the packaging in individual products or by a variability of individual samples. It is important that the final a_w values correspond to those that are typical of an appropriate kind of product.

Conclusion

From the overall sensory evaluation of the organoleptic properties of snacks and crackers it followed that these samples retained favourable taste properties after storage.

All six assessors regarded both types of products as very tasty and comparable to the other favourite shelf-stable baked products of similar type and of the non-amaranth nature. Therefore to extend and improve the market the use of examined amaranth products can be recommended.

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Senzorsko ocjenjivanje trajnih proizvoda od keksa na bazi amaranta tijekom skladištenja

Sažetak

Tijekom četveromjesečnog skladištenja (20 ± 2 °C) keksa i krepera na bazi amaranta svaki su mjesec ispitivane promjene organoleptičkih svojstava (utvrđivanje oblika, površine, boje, konzistencije, mirisa, okusa, i to sustavom bodovanja) te a_w – vrijednosti.

Promjene površine, boje i konzistencije keksa (0,1–0,3 od mogućih 5 bodova) te mirisa krepera (0,2–0,3 od moguća 4 boda) bile su neznatne tijekom skladištenja. Okus je bio gotovo podjednak u oba uzorka, postigavši veći broj bodova u usporedbi s početnim vrijednostima. Iako su se a_w – vrijednosti proizvoda malo promijenile (od 0,15 do 0,34), nisu bitnije utjecale na senzorske pokazatelje (prhkost keksa i drobljenje krepera).