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Original scientific paper

SENSORY EVALUATION OF COMMERCIAL FAT SPREADS BASED ON OILSEEDS AND WALNUT

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The main focus of this study was on the sensory evaluation of commercial oilseeds spreads, as the most significant characteristic of this type of product from the consumers' point of view. Sensory analysis was conducted by five experts using a quantitative descriptive and sensory profile test, applying a scoring method according to the standard procedure. Five different spreads were evaluated: sunflower, pumpkin, sesame, peanut, and walnut. Oil content and amounts of separated oil on the surface were determined for each spread. The results have shown that the color of spreads was very different, depending on the oilseed: gray for sunflower, brown for walnut, yellowish-brown for peanut butter, ivory for sesame and profoundly dark green for pumpkin seeds spread.

The flavor and odor of the spreads were characteristic for the raw materials used; however, the sunflower and walnut spreads had a slight rancid flavor. Generally, the spreadability of all spreads was good, but their mouth feel was not acceptable. During the consumption, all of them were sticking immensely to the roof of the mouth, which made the swallowing harder. The highest total score of 16.20 points (max. 20) was obtained for the peanut butter, while the lowest (10.38) was achieved by the sunflower butter. Oil separation (various degrees) was noticed in all spreads, which negatively influenced the appearance and entire sensorial quality of the products. The quantity of separated oil depended on the age and total amount of oil in the spreads, and was between 1.13% in the peanut butter and 12.15% in the walnut spread in reference to the net weight of the product.

KEY WORDS: fat spreads, oilseeds, walnut, sensory characteristics, oil content

INTRODUCTION

Fat-based spreads are food products with a very broad range of oil/fat content (up to 90%), and can be made without the addition of water. These are special products which include different nutrients that have a positive effect on consumers' health, so they are considered as a functional food (1, 2, 3). Although peanut butter is still the most popular

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fat-based spread with an annual consumption of about 1.4 kg per person in the USA (4), other spreads, based on oilseeds and nuts and sold as natural food, are emerging into the market as well.

Different oilseeds can be used for a commercial production of fat-based spreads, such as: sunflower, pumpkin seeds, sesame, peanut, etc., since they are rich in proteins, oil and fibers, and contain other desirable micronutrients (phytochemicals, vitamins, and minerals) (5, 6, 7). Besides oilseeds, nuts, such as walnut, hazelnut, almond, pistachios, Brazil nut, cashew, etc., can also be used as raw materials for the production of natural spreads (7, 8). Currently, these spreads are widely sold in all supermarkets in North America. Due to their nutritional composition, spreads are a very good source of energy and plant-based proteins. The development of spreads could potentially increase the food uses of oilseeds and nuts, and introduce consumers with a healthier, non-animal breakfast-type snack food.

Considering the region of our country and the availability of oilseeds and nuts, the most common raw materials for the manufacturing of fat-based spreads are sunflower and pumpkin seeds. Apart from oilseeds, research has been conducted using hull-less pumpkin oil press cake, which is a by-product in the process of manufacturing cold-pressed and roasted pumpkin oils (9, 10).

The sensorial quality of food is particularly important to the consumers. A broad spectrum of sensory characteristics, including the appearance, aroma, flavor, and texture are considered by the consumers to make the purchasing and consumption decisions related to foods. Roasting and milling (particle size reduction) are two important stages in the production of fat spreads that influence the textural, rheological characteristic and overall quality of the spreads. Color, and flavor properties of spreads play a major role in consumer appeal, buying decisions, and eventual consumption. Stability of nut spreads is influenced by its particle size (11). Besides, spreadable cream-products should have certain sensory quality characteristics - smooth and shiny surface and soft consistency, i.e. spreadability and characteristic flavor. The spreadable consistency should remain in the temperature region of 8^{o}C to 20-22^{o}C. The investigations of the rheological characteristics of commercial spreads have shown that they express a pseudo-plastic behavior (12).

There are many food products present in our market that are marked as functional food. Since domestic oilseed- and nut-based spreads are only recently available for purchase, to the best of our knowledge, there is no significant research yet conducted of their quality and shelf life. Based on this premise, this study was initiated to investigate the sensorial quality, including all relevant sensory attributes, of the available domestic fat spreads made of different raw materials.

EXPERIMENTAL

Materials and methods

Five different oilseed spreads were evaluated in this study. Their label declaration names were: sunflower butter, walnut butter, peanut butter, pumpkin butter and sesame butter. All spreads were made by a single manufacturer, and were purchased randomly from

the local supermarkets. All spreads were packaged in small glass jars with a declared weight of 190 g (sesame and walnut butter) and 200 g (sunflower, peanut and pumpkin butter). The neck and the lid of jars were Pano-T type. Table 1 shows the energy value and nutritional profile of 100 g of the product as declared on the label. All spreads had a declared shelf life of one year. The recommended storage and handling instructions were to store the product after opening in a dark environment at a temperature lower than 25^{o}C.

Table 1. Energy value and nutritional profile per 100 g of spread (declared values)

Oilseed spread type	Energy value (KJ)	Protein (g)	Fat (g)	Total carbohydrates (g)
Sunflower	2589	20	58	15
Pumpkin	2450	22	52	15
Sesame	2609	19	60	14
Peanut	2768	26	51	18
Walnut	2685	17	65	14

Sensory analysis of spreads

Five experienced assessors evaluated the sensory quality of spreads (13). The appearance (color, surface gloss), flavor (odor and taste), consistency/texture (spreadability and mastication), as well as the overall sensory quality of spreads were evaluated.

The sensory evaluation was performed in a laboratory (14) at room temperature 20-22^{o}C. The samples were randomly marked (three digit number) with no indication of the spread type. Plain white bread was used to apply a small amount of the spread (about 5 g) on the bread surface with a kitchen knife. Distilled water was used between the samples to rinse the palate.

The scoring system (from 0.00 to 5.00) was applied for the sensory evaluation, with the possibility of using a half or a quarter of a point. A weight coefficient was determined for each quality characteristic (color - 0.6, surface - 0.2, odor - 0.8, flavor - 1.2, spreadability - 0.6, and mastication - 0.6) in order to correct (by multiplying) the obtained score according to the relevance of a certain attribute. The coefficients depended on the influence of certain characteristics on the overall quality and were balanced in such a manner that their sum was 20. The sum of individual «scores» (points) is a complex parameter representing the total sensory quality score. The data obtained in the investigations performed in this study were analyzed by descriptive statistics. The basic parameters of the descriptive statistics included the calculations of the arithmetic mean values and variability parameters of the investigated properties, along with the determination of the standard deviations (SD).

Determination of oil content

The oil content was determined according to the reference method (15), and the extraction with *n*-hexane lasted 8 hours.

Oil separation

The amount of separated oil on the surface was determined by decanting the oil and determining its weight. Based on this measurement and the original spread's declared weight, the quantity of separated oil was determined as follows:

$$Quantity\ of\ separated\ oil\ (\%) = \frac{m_o}{m_1} \cdot 100$$

m_o- weight of the separated oil (g); m_1- weight of the spread (g)

RESULTS AND DISCUSSION

The results given Table 2 show that there are significant differences between the sensorial quality of investigated oilseed and walnut spreads. While relatively uniform scores were obtained for the appearance and consistency/texture of the spreads, quite significant differences were noticed in their aroma.

Table 2. Sensory evaluation of spreads

Score	Oilseed spread type				
	Sunflower	**Pumpkin**	**Sesame**	**Peanut**	**Walnut**
Appearance [4]*					
- color	2.47±0.28	2.90±0.12	2.98±0.05	3.00±0.00	2.18±0.40
- surface	0.12±0.04	0.11±0.07	0.04±0.09	0.32±0.27	0.00±0.00
Aroma [10]					
- odor	1.62±0.87	3.79±0.35	3.57±0.60	3.38±0.59	2.59±1.22
- flavor	2.14±0.95	5.57±0.60	2.81±1.15	5.42±0.81	2.66±0.91
Consistency [6]					
- spreadability	2.20±0.65	2.23±0.44	2.10±0.87	2.32±0.74	2.24±0.84
- mastication	1.74±0.66	1.38±0.68	1.61±0.61	1.76±0.90	2.04±0.85
Total score [20]	10.38±1.03	15.98±1.61	13.10±0.40	16.20±1.98	11.72±1.12

*values in the brackets indicate the maximum score

Color and appearance of spreads. The visual color indicated the differences between the spreads; however the color was characteristic for each spread evaluated depending on the raw material (oilseeds). The sunflower spread was grey in color; the walnut spread was brownish (with visible darker particles); the peanut butter color was light yellowish-brown, the pumpkin seed spread was dark green, while the sesame spread was ivory co-

lor. The most attractive color, according to the majority of assessors, was of the peanut butter, which had 3 points (max. 4), while the least attractive color was indicated for the walnut spread (2.18 points). The surface of all spreads was unattractive and received the lowest score (from 0.00 to 0.32), since all of them had separated oil. Visible oil separation on the surface was marked as a very bad sensorial characteristic. However, it was noted on the label that this can occur with the explanation that the spread is a natural product with no additives. The separated oil on the surface had a profoundly negative impact on the likeness of the spreads. The largest oil separation is visually assessed in the walnut spread, and the lowest in the peanut butter. The highest score for the appearance was achieved by the peanut butter (3.32 points), while the lowest score was achieved by the sunflower spread (2.52 points), as can be seen in Figure 1.

Aroma. The most pleasant aroma was detected in the pumpkin seed spread as 9.36 points (max. 10), while the lowest score was achieved by the sunflower spread (3.75 points) (Figure 1). The odor of the spreads was characteristic for each raw material used in their respective manufacturing, with noticeable differences in their intensity. The pumpkin seed spread had the most intense odor (3.79 points), while the sunflower butter had the least intense odor (1.62 points). The pumpkin seed, sesame and peanut butter spreads had a pleasant and characteristic flavor, while the sunflower and walnut spreads had a slightly rancid taste.

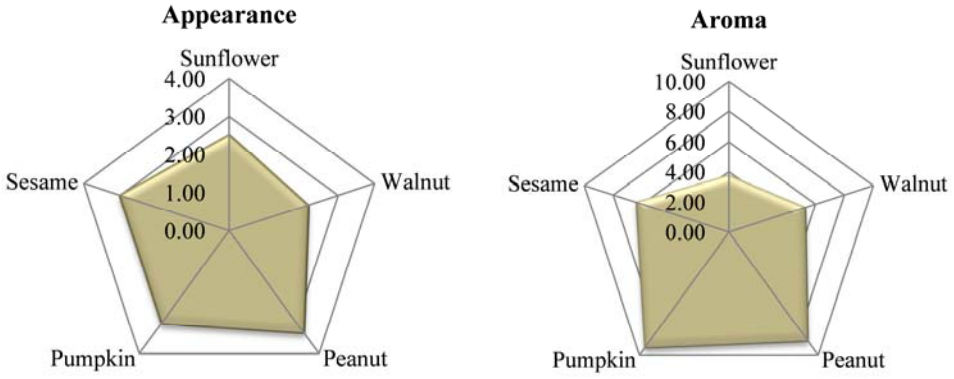

Figure 1. Appearance and aroma of the spreads

Consistency/texture. The best score for spreads consistency, based on their spreadability and mastication, was determined for the walnut spread, which received 4.28 points (max. 6); while the worst spreadability was determined for the pumpkin seed spread (3.61 points) (Figure 2).

The spreadability of the spreads was good and relatively similar for all spreads. The best spreadability was noticed for the peanut butter spread (2.32 points), while the sesame spread had the lowest score for spreadability (2.1 points). In terms of mastication/chewiness properties, all spreads were unacceptable as they were sticking to the roof of the mouth, which made swallowing difficult. The pumpkin seed spread was determined to be

the worst sample (1.36 points) for this sensory attribute, while the walnut spread was the best (2.04 points). It was determined that the mastication properties were in direct correlation with the oil content of the spreads. As is evident from Table 3, the oil content was the highest in the walnut spread (65.02 ± 2.47%), and the lowest in the pumpkin seed spread (46.32 ± 2.14%).

Based on the overall sensory score (Figure 2), it can be concluded that the peanut butter had the best sensory quality (16.20 points), followed by the pumpkin seed (15.98 points), sesame (13.10 points), walnut (11.72 points), and sunflower seed spread (10.38 points). Lima and Guraya (1) analyzed the sensory quality of sunflower seed spread, which was obtained by the roasting of seeds prior to processing (grinding), to which they also added a stabilizer. They concluded that the sunflower seed spread was very similar to the peanut butter which was their control sample. Also, the taste was evaluated as mild and characteristic for the raw material used. The spreads prepared using hull-less pumpkin seed flour with hemp oil (and other ingredients), according to Radočaj (16), were scored much higher (17.0 to 17.8 points). Dreher et al. (17) evaluated the nutritional and sensory quality and physical characteristics of commercially and experimentally processed sunflower butters. They found sunflower butter to have a good overall nutritional value with a protein quality approximately equal to that of peanuts. Roasting conditions had a significant impact on nutritional and sensory quality, color and spreadability of sunflower butter. The taste panelists generally rated sunflower butter lower than peanut butter.

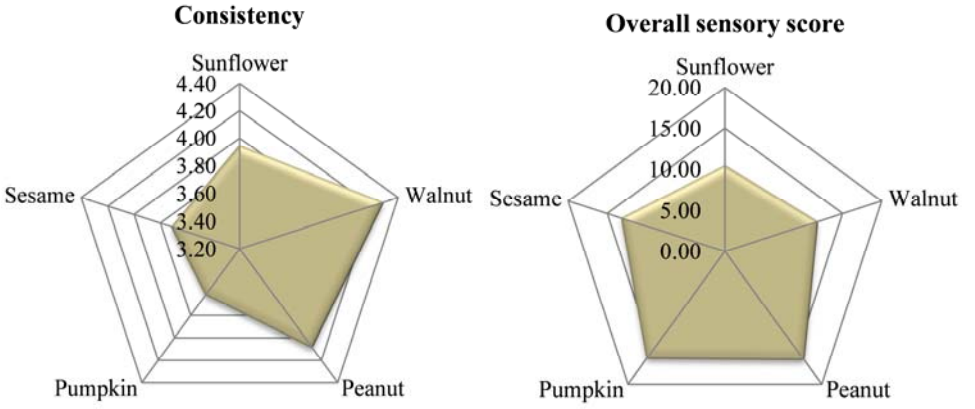

Figure 2. Consistency and overall sensory score of the spreads

Since the separated oil on the surface was considered as a significant defect of the product quality in the sensory evaluation of the spreads, its quantity was determined quantitatively (Table 3).

Table 3. Contents of separated oil in the investigated spreads

Oilseed spread type	Oil content of spread (%)	Quantity of separated oil (%)	
		A	B
Sunflower (91 days)*	54.77 ± 7.60	4.01	7.32
Pumpkin (126 days)	46.32 ± 2.14	3.66	7.90
Sesame (102 days)	57.74 ± 6.00	10.03	17.37
Peanut (53 days)	51.00 ± 1.41	1.13	2.21
Walnut (109 days)	65.02 ± 2.47	12.15	18.69

* the numbers in the brackets indicate the days from the spread manufacturing date to the evaluation date
A - In reference to the net weight of the product
B - In reference to the total amount of oil in the product

As can be seen from Table 3, the highest amount of separated oil was found in the walnut spread (12.15%), and the smallest in the peanut spread (1.13%). As indicated in Table 1, the protein content of the spreads was also significantly different, where the peanut spread had the highest amount of proteins (26 g/100g), while the walnut spread had only 17g/100g. The coefficient of correlation (R= - 0.77) indicates that there is a good correlation between the amount of proteins and oil content in spreads. It confirmed that the increase in the oil content and the decrease in the protein content corresponded to the increase in the amount of separated oil. Due to the highest amount of oil being in the walnut spread (65.02%), and the lowest amount of proteins, the poorest spreadability was expected, which is explained by the protein/carbohydrate matrix that keeps oil trapped in the cell structure, which is being released during the grinding process, when the matrix ruptured. On the other hand, the storage time also contributed to the oil separation for the same reasons, as there was no stabilizer used to keep the matrix stable. Peanut butter (51 days from the manufacturing date) had a very small amount of separated oil, only 1.13%, while the older spreads, such as pumpkin seed spread (126 days old) and walnut spread (109 days old) showed more pronounced oil separation of 3.66 and 12.15%, respectively.

The worst sample in terms of oil separation was the walnut spread. It had 18.69% oil separated from the total amount of oil present in the spread after 109 days of storage (from the day of production). In addition to the unpleasant appearance of the spreads with oil separated on the surface, the "free" oil can undergo oxidative changes, which may influence the stability of the spreads. This is due to the fact that oils are prone to oxidation, especially the oils with a high content of polyunsaturated fatty acids, such as sunflower and walnut oils. The products (chemical compounds) formed in the oxidation process in the separated oil have not only affected the odor and flavor, but also reduced the nutritional quality and shelf life of the products. In order to reduce the oil separation on the surface of oilseed spreads, Lima and Guraya (1) suggested the use of stabilizers. They demonstrated that by using a stabilizer, oil separation was only 0.8%. Aryana et al. (18) found that palm oil as a stabilizer improved the oil holding capacity of peanut butters, but had no effect on their adhesiveness and hardness characteristics.

CONCLUSION

Based on the sensory analysis of oil spreads it can be concluded that the color of all spreads was characteristic for the raw materials. As such, it was: gray in color for the sunflower seed spread; brownish for walnut; yellowish-brown for peanut butter; dark green for pumpkin seed and ivory for the sesame seed spread. All spreads had a pleasant, characteristic odor of the respective raw materials. The spreads of pumpkin seed, sesame, and the peanut butter spreads had a pleasant flavor; however, the sunflower and walnut spreads had a slightly rancid flavor.

The spreadability, as a sensory attribute, was good for all spreads. They were easily applied by a knife in a uniform layer. However, their mastication was not acceptable due to their strong adhesiveness to the palate and uneasy swallowing. The highest overall sensory score was achieved by the peanut butter (16.20 points out of max. 20), while the lowest score was given to the sunflower spread (10.38 points).

All spreads had visible oil separation on their surfaces, which was considered unacceptable in terms of the sensory evaluation and product quality. The amount of separated oil varied depending on the oil and protein content of the spreads. This ranged between from 1.13% (w/w) in the peanut butter to 12.15% (w/w) in the walnut spread.

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СЕНЗОРНИ КВАЛИТЕТ КОМЕРЦИЈАЛНИХ МАСНИХ НАМАЗА НА БАЗИ СЕМЕНА УЉАРИЦА И ОРАХА

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У овом раду су анализирана сензорна својства као најважнијег фактора потрошачког квалитета масних намаза на бази семена уљарица. Испитавања су извршена од стране пет искусних дегустатора према стандардној процедури, системом бодовања, на пет узорака комерцијалних намаза произведених од семена сунцокрета, тикве, сусама, кикирикија и језгра ораха. У узорцима је одређен и укупан садржај уља, као и количина издвојеног уља на површини производа. Резултати су показали

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да је боја намаза веома различита: сива за сунцокретов, браонкаста за орахов, жућкасто-браон за кикирикијев, беж за сусамов и изразито зелена за тиквин намаз. Мирис и укус су својствени изворној сировини, међутим код сунцокретовог и ораховог намаза је примећен и укус на ужегло слабијег интензитета. Мазивост узорака као сензорни атрибут је добра, међутим, мастикација им је лоша. Приликом конзумирања снажно пријањају на површину непца што отежава њихово гутање.

Највећу укупну сензорну оцену квалитета је добио кикирикијев намаз, 16,20 бодова од могућих 20, а најмању намаз од језгра сунцокрета, 10,38 бодова.

На површини свих намаза је јасно уочено издвајање одређене количине уља, што је знатно умањило изглед и укупни сензорни квалитет производа. Количина издвојеног уља је варирала у зависности од старости намаза и укупног садржаја уља и протеина, а кретала се у распону од 1,13% (на масу производа) код кикирикијевог, па до 12,15% код ораховог намаза.

Кључне речи: масни намази, семе уљарица, орах , сензорна својства, садржај уља

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