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SENSORY CHARACTERISTICS OF PEACH AND PLUM JAMS WITH DIFFERENT SWEETENERS

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Abstract: *Sensory characteristics are of great significance for all food products. These are features which every consumer evaluates on a daily basis and based on that assessment decides whether to buy or not a product.The aim of this paper is to examine the sensory characteristics of peach and plum jams, prepared with different sweeteners (sucrose, fructose, sorbitol and agave syrup) and determine which of them is the most acceptable one for consumers. Sensory analysis was conducted by applying the scoring system, which assessed individual quality criteria (smell, taste, color and consistency). The results of analysis showed that the color, smell, taste and consistency of tested jams are acceptable. Jams with sorbitol, assessed with the highest average total grade have better sensory characteristics as compared with jams prepared with other sweeteners.*

Keywords: sensory analysis, jams, different sweeteners, peach, plum

1. Introduction

Sensory charactarestics of the food products (appearance, taste, color, consistency, smell) play a significant role in consumers' afinity to use certain food product [1, 2]. For these reasons, the sensory properties of the products are regulary tested either by potential consumers (the food is estimated as delicious, tasteful, aromatic etc.) or by a highly- qualified team [3].
Some disadvantages of aesthetic character, can reduce product quality in the eyes of the consumer despite the fact that its nutritional value is at a satisfactory level [1]. The perception of sensory characteristics is rather subjective and preconditioned by nutritional education, current trends, age, health, religion etc. In order to minimize these factors and obtain relevant statistical information, various procedures were developed [3].
The jam belongs to the group of products based on pectin gel. It is made by boiling fresh, frozen or semi processed fruit or fruit pieces, with a corresponding amount of sugar, pectin and acid. Sugar and pectin form a network which gives certain texture to each product [4, 5].
Consumers who want to control the level of blood sugar are not allowed to use traditional jams because of the extra amount of sucrose (Sucr). According to Parsayee *et al.* [6], the high content of sucrose in jams, contributes to excessive weight and health problems such as diabetes and hyperglycemia.

There is a great interest for jam production with reduced energy value i.e with a lower amount of sucrose or with another type of sweetener replacement.

Recently, there is a high tendency of various sweeteners usage as a replacement for sucrose [7]. It was found [8-10] that sweeteners like fructose (Fru), sorbitol (Sorb), honey, maple syrup, agave syrup (Ag), stevia and etc. did not affect the nutritional and sensory quality of the products. Therefore, it was suggested that these sweeteners can be a suitable replacement for sucrose [8-10].

Fructose is a natural low-calorie sweetener which has a positive impact on human health initiating a lower concentration of glucose in the blood which protects the blood vessels and the myocard from atherosclerosis preventing hypertension, diabetes, obesity, teeth disease and higher appetite [11]. Sorbitol is a sugar alcohol (polyol), being applied in a low-calorie and diabetic products, and like other polyols it does not stimulate an increase in blood glucose on ingestion. However, frequent sorbitol usage can induce diarrhea [10].

Agave syrup is a very popular and frequently used sugar substituent because of its low glycemic index compared to other sweeteners or to honey [12, 13], with antioxidative [14] and probiotic capacity [13]. Low-energy jams and marmalades from: raspberry, blackberry, strawberry and red- currant obtained by Tepić et al. [15] using fructose, sorbitol, cyclamate and saccharin as sweeteners are an adequate example of high quality jams with good sensory characteristics.

The aim of this study was to determine which of three sweeteners would be the best substitute of sucrose in plum and peach jam in terms of the best evaluated sensory characteristics.

2. Materials and methods

Peach and plum dietetic jams were used as a material for sensory testing. Dietetic jams were manufactured according to the recopies and long experience of the factory "Vitalia Nikola" - LLC Skopje, which comply with the Regulations of the Republic of Macedonia [16]. The Regulations recommend that the standard jam should contain 60% of dry materia. However, dietetic jam contained 30% lower amount of sugar compared to standard jam, so the final dry materia content was 42% (+/- 2%). During the preparation of each type of jam, the ratio between dry materia of the sweetener and the fruit was applied according to the recommendation of the raw material producers and the experience of the factory. During the production: sucrose (a low amount), fructose, sorbitol and agave syrup were used as sweeteners. Technological process of jams production covered the following operations: reception and storage of fruits, preparation of fruits (washing, cutting, inspection), measurement, heat treatment in open stainless steel vats on direct fire, at temperature of ≈ 100 °C, for 15 minutes (boiling with adding suitable sweetener with constant stirring, adding pectin, calcium citrate and acid, boiling with stirring) packaging in jars, closing, cooling and storage. The sensory analysis of jams was performed by scoring method for jelly products assesment [1]. The sensory characteristics (smell, taste, color and consistency) were assessed by highly experienced 10 testers, using a different number of points: for color 0-4, for smell 0-2, for taste 0-8, and consistency 0-6 and their maximum sum was 20. Evaluations were performed in the laboratory for fruit and vegetables processing at the Faculty of Agricultural Sciences and Food in Skopje (Fig. 1). The tests were repeated three times over a three-year period (2011, 2012, 2013).

Fig. 1. Preparation jam samples for sensory evaluation

The results of the research were presented, analyzed and statistically processed by using Microsoft Excel and statistical package SPSS Statistics Version 19.

3. Results and discussion

The obtained data by sensory analysis of jams produced in three different years (2011, 2012, 2013) are shown in Tables 1 and 2. The differences between the jams with different sweeteners in each of the productive years were statistically processed and their significance was determined.

Table 1.

The results obtained by sensory analysis of the peach jams with different sweeteners

Year	Peach jam	Color (0-4) $\bar{x}$±SD	Smell (0-2) $\bar{x}$± SD	Taste (0-8) $\bar{x}$± SD	Consistency /texture (0-6) $\bar{x}$± SD	Total points (0-20) $\bar{x}$± SD
2011	Sucr	3.93±0.16B	1.93±0.16B	7.90±0.21B	5.95±0.16B	19.71±0.23B
	Fru	3.93±0.16B	1.88±0.19 B	7.72±0.40B	5.93±0.16B	19.46±0.45B
	Sorb	3.95±0.16B	1.98±0.06 B	7.79±0.38B	5.89±0.17B	19.61±0.43B
	Ag	3.17±0.53A	1.44±0.42 A	6.12±1.03A	5.52±0.46A	16.25±1.66A
2012	Sucr	3.53±0.82ab	1.85±0.34	7.10±1.10	5.65±0.41ab B	18.13±2.32b AB
	Fru	3.70±0.42ab	1.90±0.32	7.25±0.82	5.65±0.47ab B	18.50±1.65b AB
	Sorb	3.95±0.16b	1.95±0.16	7.20±1.01	5.60±0.57b AB	18.70±1.60ab B
	Ag	3.39±0.50a	1.80±0.42	6.30±1.25	4.80±1.03a A	16.29±2.25aA
2013	Sucr	3.80±0.42B	2,00±0,00b	7.60±0.52B	6.00±0.00B	19.40±0.70ab B
	Fru	3.70±0.48B	1.90±0.32ab	7.50±0.71B	5.50±0.71AB	18.60±0.84b B
	Sorb	3.90±0.32B	2.00±0.00b	7.80±0.42B	5.90±0.32B	19.60±0.52a B
	Ag	2.90±0.74A	1.70±0.48a	6.40±0.84A	5.10±0.57A	16.10±1.79ab A
2011-2013	Sucr	3.75± 0.20	1,93± 0,08	7.53± 0.40	5.87± 0.19	19.08± 0.84
	Fru	3.78±0.13	1.89±0.01	7.49±0.24	5.69±0.22	18.85±0.53
	Sorb	3.93± 0.03	1.98± 0.03	7.50± 0.30	5.80± 0.17	19.30± 0.52
	Ag	3.15±0.25	1.65±0.19	6.27±0.14	5.14±0.36	16.21±0.10

*$\bar{x}$ - average value; SD - standard deviation; a, b – values in the same column with no common superscript differ significantly (p<0.05); A,B – values in the same column with no common superscript differ significantly (p<0.01).
Sucr-sucrose, Fru-fructose, Sorb-sorbitol, Ag-agave syrup

Color evaluation. The term color implies the presence of colored substances in the products. The intensity of color depends on pigment content in the product. It is very important for color to be the same in all parts of the product. Color quality depends mostly on raw material and the loss of color intensity depends on the conducting of the technological process of production. Basic standard for sensory assessment product's color is a comparison with the natural color of the raw material, so it is required to make the deviation from raw material's natural color as small as possible, according to hue and intensity [1].

Table 2.

Results obtained by sensory analysis of the plum jamswith different sweeteners

Year	Plum jam	Color (0-4) $\bar{x}$±SD	Smell (0-2) $\bar{x}$± SD	Taste (0-8) $\bar{x}$± SD	Consistency /texture (0-6) $\bar{x}$± SD	Total points (0-20) $\bar{x}$± SD
2011	Sucr	3.86±0.21ab B	1.86±0.21ab	7.66±0.45B	5.77±0.28a AB	19.15±0.83B
	Fru	3.91±0.19ab B	1.98±0.06b	7.90±0.18B	5.93±0.16ab B	19.72±0.28B
	Sorb	3.74±0.35b AB	1.89±0.22b	7.50±0.55B	5,80±0.27ab B	18.93±1.06B
	Ag	3.03±1.13a A	1.57±0.69a	5.55±2.23A	4.66±1.80a A	14.81±5.50A
2012	Sucr	3.85±0.34B	1.95±0.16ab	7.80±0.35B	5.75±0.42B	19.35±0.78B
	Fru	3.68±0.78B	2.00±0.00b	7.55±0.69B	5.95±0.16B	19.18±1.02B
	Sorb	4.00±0.00B	2.00±0.00b	7.95±0.16B	5.85±0.34B	19.80±0.35B
	Ag	2.89±0.72A	1.74±0.54a	5.60±1.26A	5.00±0.82A	15.23±2.51A
2013	Sucr	3.70±0.48b AB	1,90±0.32	7.20±0.63B	5.50±0.53ab	18.30±1.06B
	Fru	3.50±0.53ab AB	1.80±0.42	7.10±0.88B	5.50±0.53ab	17.90±1.10B
	Sorb	3.80±0.42 ab B	1.80±0.42	7.50±0.53B	5.80±0.42b	18.90±1.10B
	Ag	3.10±0.74a A	1.70±0.48	5.50±0.97A	5.20±0.63a	15.50±1.43A
2011-2013	Sucr	3.80± 0,09	1.90± 0.05	7.55± 0.31	5.65±0.13	18.93± 0.56
	Fru	3.70±0.21	1.93±0.11	7.52±0.40	5.79±0.25	18.93±0.93
	Sorb	3.85± 0.14	1.90± 0.10	7.65± 0.26	5.82± 0.03	19.21± 0.51
	Ag	2.98±0.16	1.67±0.09	5.55±0.05	4.95±0.27	15.18±0.35

*$\bar{x}$ - average value; SD - standard deviation; a, b – values in the same column with no common superscript differ significantly (p<0.05); A,B – values in the same column with no common superscript differ significantly (p<0.01).
Sucr-sucrose, Fru-fructose, Sorb-sorbitol, Ag-agave syrup

The results shown in Table 1 (peach jams with different sweeteners) suggested that in three different years of testing (2011, 2012, 2013), the highest average color value (3.95, 3.95 and 3.90 points respectively) were registered by the Sorb jams, and the lowest average color value (3.17, 3.39 and 2.90 points respectively) by the Ag jams. The determined differences in 2011 and 2013, between Ag and Sucr, Fru and Sorb jams were significant in terms of color (p<0.01). According to the same parameter, in the year 2012, a significant difference (p<0.05) between Ag and Sorb jams only was detected. The highest average grade for color quality during 2011-2013(3.93), was notified in Sorb jams, compared to the lowest grade for color quality (3.15) in Ag jams.

Different results were obtained when plum jams made with the above mentioned sweeteners were analyzed (Table 2). In the year 2011, the Fru jams had the highest color quality (3.91) compared to Ag jams with the lowest number of points (3.03). In the same year, a significant difference in terms of color quality between Ag jams and Sucr, Fru (p<0.01) and Sorb jams ((p<0.05) was detected. In the year 2012 and 2013, the highest number of points (4.00 v. 3.80 respectively) was assessed in Sorb jams, while the lowest number of points (2.89 v. 3.10) was detected in Ag jams.

In the year 2012, there was a significant difference in color quality value between Ag and Sucr, Fru and Sorb jams (p<0.01). In 2013, the difference between Ag and Sorb jams was significant (p<0.01) as well as between the Ag and Sucr jams (p<0.05). The same results in terms of the highest average grade for color quality during 2011-2013 as in the case of Sorb peach jams were obtained when plum Sco jams were analyzed (3.85).

The results obtained suggest strongly that the Sorb jams characterized with the highest average points in terms of color, due to the great stability of the sorbitol during the heat treatment and the low possibility of creating new compounds that would cause discoloration [17].

Kerdsup and Naknean [18] examined the impact of sorbitol on physical, chemical and sensory characteristics of low-energy mango jams and concluded that the jams produced had a color that did not deviate from the natural color of mango fruit, the results that were compatible with our results (Sorb jams had the same color with peach and plum fruit in our study).

In our study, Ag jams had the lowest average points in terms of color, due to the coloration of the agave syrup and the changes that occur during heat treatment. We also should underline the fact that the agave syrup contains mineral substances [19] that can react with anthocyanins present in fruits and thus create compounds that cause tanning [20].

Smell evaluation. The smell of the product is a multidimensional phenomenon, due to the presence of a great variety of aromatic volatile compounds (alcohols, esters, ethers, organic acids, aldehydes, ketones, etc.). The smell of the product will meet the required standards, if the smell is similar to the raw material from which it is derived, without foreign uncharacteristic smells [1].

As regards the smell analysis (Table 1), it was concluded that in three different years of testing, Sorb jams registered the highest number of points (1.98, 1.95 and 2.00 respectively) compared to Ag jams which had the lowest number of points (1.44, 1.80 and 1.70 respectively).

In 2011, a significant difference ($p<0.01$) between Ag jams and Sucr, Fru and Sorb jams in context of smell was determined**.** In the year 2012, in terms of smell there were not any significant differences between the jams ($p>0.05$) but in 2013 there was a significant difference between Ag jams and Sucr and Sorb jams *(*$p<0.05$), but not with Fru jams.

Sorb jams were assessed with the highest average grade for the whole three-year period (1.98), while Ag jams had the lowest average grade for smell (1.65).

The results from the analysis of plum jams (Table 2) suggested that Fru jams had the highest number of points (1.98) while the lowest number was detected in Ag jams (1.57) in 2011 (the difference was significant $p<0.05$). In 2012, the Fru and Sorb jams were assessed with maximum points (2.00). A significant difference between Ag and Fru and Sorb jams was detected ($p< 0.05$). In 2013, the Sucr jams had the highest number of points (1.90) and significant differences between different types of jams were not detected. Three-year average grade for smell shows the highest value in Fru jams (1.93), while Ag jams had the lowest average grade (1.67).

Our results suggest that sorbitol had the least effect on the smell of jams. However, the Ag jams registered the lowest average points in terms of smell, probably due to the possibility of creating new compounds during the heat treatment which can induce a change of smell.

Taste evaluation. In terms of food taste, it should be completely satisfactory, the consumer will disregard smaller deficiencies in terms of color, consistency etc. [1].

According to the results obtained from the sensory analysis of the peach jams (Table 1) in 2011 harvest Sucr jams had the highest number of points (7.90), whereas the Ag jams the lowest number of points (6.12). In 2012 vintage, Fru jams had the highest number of points (7.25), and the Ag jams the lowest number (6.30). In 2013 harvest, Ag jams had also the lowest number of points (6.40) in relation to the

same parameter while the highest number was detected in Sorb jams (7.80).

From the data statistical analysis obtained in terms of taste of peach jams, the years 2011 and 2013 showed significant differences (Ag jam compared to Sucr, Fru and Sorb jams, $p<0.01$) while no significat differences were found in 2012, $p>0.05$). The peach Sucr jams were assessed with the highest for 3 year harvest follow up average grade for taste (7.53), while the Ag jams with the lowest (6.27).

From the results obtained for each year and 3 years average taste value of investigation (plum jams, Table 2) it can be concluded that Ag jam showed the lowest taste values compared to 3 other types of jam.

The highest taste values in 2011 harvest was observed in Fru jams (7.90) while in the next two years Sorb jams had the highest value (7.95 v.7.50). During the three-year period the Ag jams taste values differ significantly from the other jams ($p<0.01$).

The above results obtained, suggest that in general, Sorb jams were characterized with the highest average points in terms of taste, confirming thus the fact that sorbitol with its mild sweetness provides products with taste typical to the fruit which it originates from [7]. The results are compatible with the findings of other authors [18].

The jams with agave syrup have been assessed with the lowest average points in terms of taste, which is probably due to the properties of the agave-syrup and the changes that occur during heat treatment. Namely, the creation of new compounds during heat treatment can affect the taste of jams.

Consistency evaluation. Consistency is specific to each type of product. Jams require particular degree of jelling and presence of whole fruits or parts of the fruits preserved [1].

According to the results obtained from the sensory analysis of peach jams (Table 1), it was concluded that in all 3 years investigation, Sucr jams had the highest consistency values, but in 2012 these values were equal with Fru jams values.

The interesting observation was that the values in context of previously interpreted results for color, smell and taste, showed similar results. Namely, Ag jams showed the lowest values compared to other types of jams (significant difference was determined).

From the data presented in Table 2 (plum jams**)**, it was concluded that in the years 2011 and 2012, the Frujams had the highest number of points in terms of consistency (5.93 v. 5.95), whereas during 2013 it was found Sorb jams had the highest value as well (5.80). However, Ag jams had the lowest consistency values during the whole investigation. (4.66 v. 5.00 v. 5.20). Significant difference was noticed between the values of Ag jams compared to Fr, Sorb and Sucr jams during 2011 and 2012, and to Sorbjams only during 2013.

Our results indicated that Sorb jams had the highest average points in terms of consistency, which showed that sorbitol provided the product with the texture required, without making it too sweet [17, 21].

The Ag jams registered the lowest average points in terms of consistency, probably due to the changes occuring during heat treatment since it contains large amounts of fructose which can induce certain chemical reactions during heat treatment of the fruit, affecting the consistency of jams [19, 22, 23].

Total sensory evaluation. The total assessment of sensory characteristics of jams was obtained by adding the individual points for color, smell, taste and consistency with a possibility of maximum total point score of 20 points.

According to the total sum of points for peach jams (Table 1), it was found that

Sorb jams had the highest total average grade compared to Ag jams with the lowest total sum (19.30 v 16,21).
From the data shown in Table 2 (plum jams) it can be concluded that during the three-year period, Sorb jams had the highest total average grade compared to Ag jams with the lowest value (19.21 v. 15.18).
Our results strongly suggest that Sorbitol used as a sweetener in both types of jams was the best option for sucrose replacement, resulting in best sensory characteristics which are compatible with other researchers' findings [24, 25].

4. Conclusions

Based upon the results obtained by sensory characteristics analysis of peach and plum jams prepared with different sweeteners (fructose, sorbitol, agave syrup and a low amountof sucrose) it can be concluded that plum and peach jams with sorbitol had the highest total average score and better sensory characteristics as compared to jams where other sweeteners were used.
The Agave sweetener when added to peach and plum jams did have the weakest sensory characteristics as compared to other sweeteners used.
The results provided can help fruit producers in choosing a sweetener which can replace sucrose in jam production. The production of such fruit products is highly recommended for people who need a limited amount of sugar intake.

5. References

[1]. VRAČAR O.LJ., Manual for quality control of fresh and processed fruits, vegetables and mushrooms and refreshing soft drinks, Faculty of Technology, Novi Sad, (2001).
[2]. KOPRIVNJAK O., The quality, safety and preservation of food, Textbook „Introduction to Food Technology" for students of sanitary engineering, Rijeka, (2014).
[3]. GULABOSKI R., Chemical control of the quality of the products, Agricultural Faculty -Štip, University Goce Delčev - Štip, (2010).
[4]. FIGUEROLA E.F., Chapter 13: Berry jams and jellies, Part III Processing technologies for developing value-added berry fruit products, In: Berry Fruit: Value - Added Products for Health Promotion (Ed. Zhao Y.), CRC Press, Boca Raton, FL, 367-387, (2007).
[5]. LEVAJ B., Technology of fruit and vegetables, II part, Faculty of Food Technology and Biotechnology, Zagreb, (2013).
[6]. PARSAYEE A.S., ZONUZ A.A., ZADEH G.B., AYASE A., Low calorie sour cherry jam: optimization of ingredient levels using response surface methodology, *International Journal of Applied Sciences and Engineering Research*, 2(1): 35–43, (2013).
[7]. MALČEV E., MOLLOV P., Technology canning of fruits and vegetables - concentrates and fruit sugar products, Second edition, "Kontrast", Stara Zagora, (2008).
[8]. CHETANA R., Studies on the use of sucrose alternatives in traditional sweetmeats, Thesis, University of Musore, India, (2004).
[9]. ASIF M., Low caloric sweeteners for diabetes and obesity care and their clinical inferences for tackle the prevalence, *Journal Pharm Care*, 1(3): 104-113, (2013).
[10]. GWINN R., Technology and ingredients to assist with the reduction of sugar in food and drink. FHIS, Campden BRI, (2013).
[11]. GAŁKOWSKA D., FORTUNA T., PROCHWICZ-ZAGÓRSKA W., *Physicochemical quality of selected strawberry jams with fructose*, *Potravinárstvo, ročnik,* 4(2): 22-24, (2010).
[12]. FOSTER-POWELL K., HOLT H.A.S., BRAND-MILLER C., International table of glycemic index and glycemic load values: 2002, *The American Journal of Clinical Nutrition*, 76: 5–56, (2002).
[13]. MELLADO-MOJICA E., LÓPEZ-PÉREZ G.M., Comparative analysis between blue agave syrup (*Agave tequilana* Weber var. azul) and other natural syrups, *Agrocoencia*, 47(3): 233-244, (2013).
[14]. PHILLIPS M.K., CARLSEN H.M., BLOMHOFF R., Total antioxidant content of alternatives to refined sugar, *Journal of the American Dietetic Association*, 109 (1): 64–71, (2009).
[15]. TEPIĆ N.A., VUJIČIĆ L.B., DIMIĆ P.N., POPOV-RALIĆ V.J., The quality of dietetic jelly products, *Acta Periodica Technologic*a, 32: 33-38, (2001).

[16]. Regulation for special security requirements of fruitjams, jellies, marmalades and sweetened chestnutpurée (Republic ofMacedonia Official Gazette No. 3/2007).
[17]. BEMILLER N.J., Carbohydrate chemistry for food scientists. AACC International, Prevod na deloto: Ars Lamina, 2011, Skopje, (2007).
[18]. KERDSUP P., NAKNEAN P., Effect of sorbitol substitution on physical, chemical and sensory properties of low-sugar mango jam, *Proceeding - Science and Engineering,* 12-16, (2013).
[19]. CONIS E., Agave syrup's benefits are in debate, Los Angeles Times, (2009), Online source, accessed in 04.02.2017: http://articles.latimes.com/2009/mar/30/health/he-nutrition30.
[20]. TEPIĆ A., Colored matter fruits and vegetables, University of Novi Sad, Faculty of Technology, Novi Sad, Serbia, (2012).
[21]. WALTERS D. E., All about sweeteners, (2008), Online source, accessed in 04.02.2017: http://www.sweetenerbook.com/neodhc.html.
[22]. BARCLAY T., GINIC-MARKOVICA M., COOPER D. P., PETROVSKY N., The chemistry and sources of fructose and their effect on its utility and health implications, *J. Excipients and Food Chem.*, 3(2): 67-82, (2012).
[23]. QUINTAS A. C. M., FUNDO F. J., SILVA L. M. C., Sucrose in the concentrated solution or the supercooled ‘‘State’’: A review of caramelisation reactions and physical behaviour, *Food Engineering Reviews*, 2 (3): 204-215, (2010).
[24]. KARAKASHOVA LJ., STAMATOVSKA V., BABANOVSKA-MILENKOVSKA F., The quality properties of raspberry jams with different sweeteners, *Symposium proceeding*, International symposium for agriculture and food, Skopje, 12-14 December 2012, Volume II, 848-855, (2013).
[25]. SAVESKI A., STAMATOVSKA V., PAVLOVA V., KALEVSKA T., VASKOSKA S. R., Sensory analysis of raspberry jam with different sweeteners, *Scientific works of University of Food Technologies*, LXII(LXII): 294-297, (2015).