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SENSORY CHARACTERISTICS OF LOW-SUGAR GELATINE JELLIES SWEETENED WITH STEVIOL GLYCOSIDES

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Abstract: The aim of this work was to evaluate sensory quality of low-sugar gelatine lemon-flavored jellies made with steviol glycosides (E 960) as sucrose substitutes. Two series of jellies were prepared: gelatine-based and gelatine-sorbitol-based. Both the palatability and texture attributes of the jellies were evaluated by sensory method. It was found that the effect of sucrose replacement with steviol glycosides on the sensory attributes of the jellies depended on their type. In general, the jellies with the highest amount E 960 were characterized by decreased sweetness and perceptible metallic and liquorice aftertastes. The textural characteristics of the jellies were not significantly affected by the modification of their recipes. It could be concluded that there is a possibility of production of low-sugar gelatine jellies containing steviol glycosides and sucrose.
Keywords: stevia, jelly, gelatine, sucrose, sorbitol

INTRODUCTION

The most popular sweetening substances used in food production are natural saccharides, such as sucrose, glucose and fructose. In order to decrease energetic value of sweetened food products other sweetening substances substitute for the above mentioned saccharides, especially sucrose. These substances involve semi-synthetic polyols, e.g. xylitol, maltitol, sorbitol, as well as natural and synthetic intense sweeteners, e.g. aspartame, acesulfame K and sucralose.

A relatively new natural sweetening substance are steviol glycosides, which in 2010 were recognized as safe for human consumption **(EFSA Journal, 2010)** and in November 2011 were allowed to use in European Union countries as E 960 food additive **(Official Journal, 2011)**. The steviol glycosides involve: stevioside, rebaudiosides A, B, C, D, E, F, steviolbioside, rubusoside and dulcoside A **(EFSA Journal, 2010)**, however stevioside and rebaudioside A have the largest share of them. All the compounds are extracted from leaves of the *Stevia rebaudiana* Bertoni Paraguayan plant. Sweetness of the steviol glycosides is about 100-300 times greater than sucrose **(Cardello et al., 2009)**.The compounds are chemically stable over a wide range of pHs and at high temperatures. They do not ferment, as well as do not affect glucose homeostasis and do not affect blood pressure in individuals after ingestion. An established Acceptable Daily Intake (ADI) for steviol glycosides (expressed as steviol equivalents) is 4 mg/kg bw/day **(EFSA Journal, 2010)**. Stevia is used mainly for production of intense sweeteners, however it is also used as component of soft drinks, desserts, yoghurts, confectionery and others **(EFSA Journal, 2010; Lemus-Mondaca et al., 2012)**. The aim of this work was to evaluate sensory quality of gelatine lemon-flavored jellies made with steviol glycosides (E 960) as sucrose substitutes.

MATERIAL AND METHODS

The materials were gelatine lemon-flavored jellies made of the following ingredients: pork food gelatine (dr. Oetker Polska Sp. z o.o., Poland), sucrose (white sugar Diamant, Pfeifer & Langen Marketing Sp. z o.o., Poland), steviol glycosides (Reb. A, SteviJa Pure Stevia, Holland; distributor: Biome, Poland), bulking agent – sorbitol (Roquette, France),

citric acid (dr. Oetker Polska Sp. z o.o., Poland), natural lemon flavor (JAR Jaskulski, Poland), food coloring – curcumin (JAR Jaskulski, Poland) and water.

Two series of jellies were prepared: gelatine-based (the first series, abbreviated as G) and gelatine-sorbitol-based (the second series, abbreviated as G+S). In the case of the second series of jellies the amount of sorbitol was 50% of sucrose with regard to the relative sweetness of sorbitol of 0.6. Within each series of jellies the systems were prepared in which 0%, 20%, 40%, 60%, 80% and 100% of sucrose or sucrose and sorbitol was replaced with appropriate amount of steviol glycosides with regard to their sweetness (300 times greater than sucrose) in order to the jellies were characterized by the same theoretical sweetness. The above mentioned samples were respectively marked as: S0, S20, S40, S60, S80 and S100.

The jellies were prepared in the following way: the flavour, food colouring and pre-weighted powdery ingredients were added to water at 95°C and well mixed. After dissolution of all the ingredients, the resulting solution was poured into polyethylene containers of 30 mL and allowed to cooling for approximately one hour at room temperature. Then the samples were stored in a refrigerator (4°C) overnight. The resulting jellies were sensory tested after one hour keeping them at room temperature.

Sensory analysis of the jellies was performed by ten trained judges. Within each series of jellies, the samples were presented in a random order and assigned product codes. Both palatability and texture were evaluated. The palatability attributes were as follows: sweetness, acidity, metallic aftertaste, cooling effect and liquorice aftertaste. These attributes were evaluated in five-point scale of sensation intensity, with the following labels: 0 – imperceptible, 1 – hardly perceptible, 2 – faintly perceptible, 3 – moderately perceptible, 4 – strongly perceptible. The texture attributes were as follows: hardness, cohesiveness, elasticity, adhesiveness, structure and melting in a mouth. The way of assessment of each texture attribute was described in the sensory evaluation sheet. The intensity of each texture attribute was evaluated in a five-point scale, which was prepared individually for each attribute. All the samples were assessed in a single session. The average values of the scores were used in the analysis. Coefficients of linear Pearson's correlation between selected parameters were computed. Reported values of correlation coefficients are significant at level $\alpha = 0.05$.

RESULTS

The results of sensory analysis of the first series of jellies showed that in average the products were characterized by "faintly perceptible" sweetness.

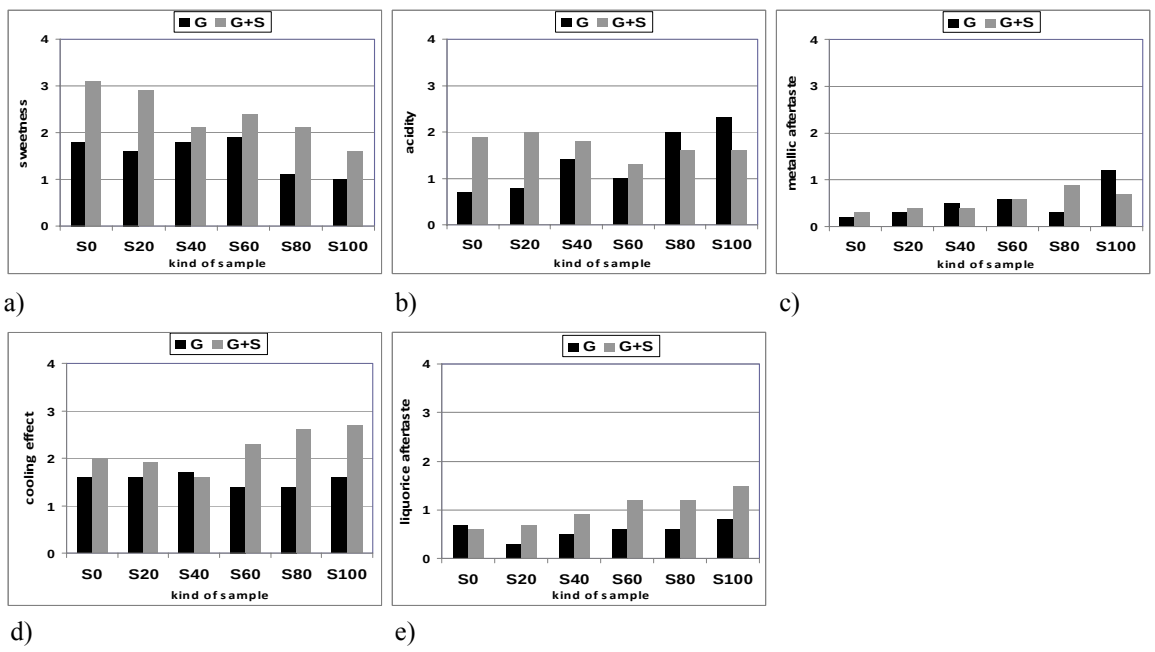

Fig. 1 Sensory attributes of palatability of gelatine jellies sweetened with steviol glycosides

Replacement of 80% and 100% sucrose with steviol glycosides resulted in decrease in perceived intensity of sweetness, in average to “hardly perceptible” (Fig. 1a).
The jellies from S0 to S60 showed a similar acidity that was assessed as “hardly perceptible”, whereas acidity sensation for the jellies with higher share of steviol glycosides, i.e. S80 and S100, was more intensive since in average it was assessed as “faintly perceptible” (Fig. 1b). That effect could result from weakened sensation of sweetness perceived in these two jellies. Presence of food additive E 960 in the jellies did not contribute to the emergence of metallic aftertaste, only the sample with the highest amount of steviol glycosides was characterized by slightly perceptible metallic aftertaste (Fig. 1c). The sensation of cooling effect was similar in each jelly (Fig. 1d). There was no correlation between the amount of steviol glycosides and liquorice aftertaste, which was imperceptible for most of the assessors (Fig. 1e).

Hardness and cohesiveness of the jellies, as assessed by the sensory test, did not change significantly as a result of decreasing amount of sucrose (Figs. 2a,b). The jellies were assessed as medium hard and retaining their shape after removal from the container. It was also found that they were slightly diversified in respect of elasticity and adhesiveness (Figs. 2c,d). In the assessment of elasticity of jellies that relied on crushing the sample with teaspoon to half its height and measuring the degree of return to the original height it was stated that they were high elastic. Adhesiveness was tested against teaspoon, and the jellies showed a high degree of adhesiveness, with slightly lower degree of adhesiveness found for S80 and S100 samples. Structure of the jellies was assessed in respect of its smoothness. The samples were characterized by smooth or very smooth structure, and only in the case of S100 there were two opinions about somewhat floury structure, which resulted in slightly lower final note as compared to other jellies (Fig. 2e). Contrary to the other texture parameters there was a diversity of the jellies in respect of melting in a mouth (Fig. 2f).

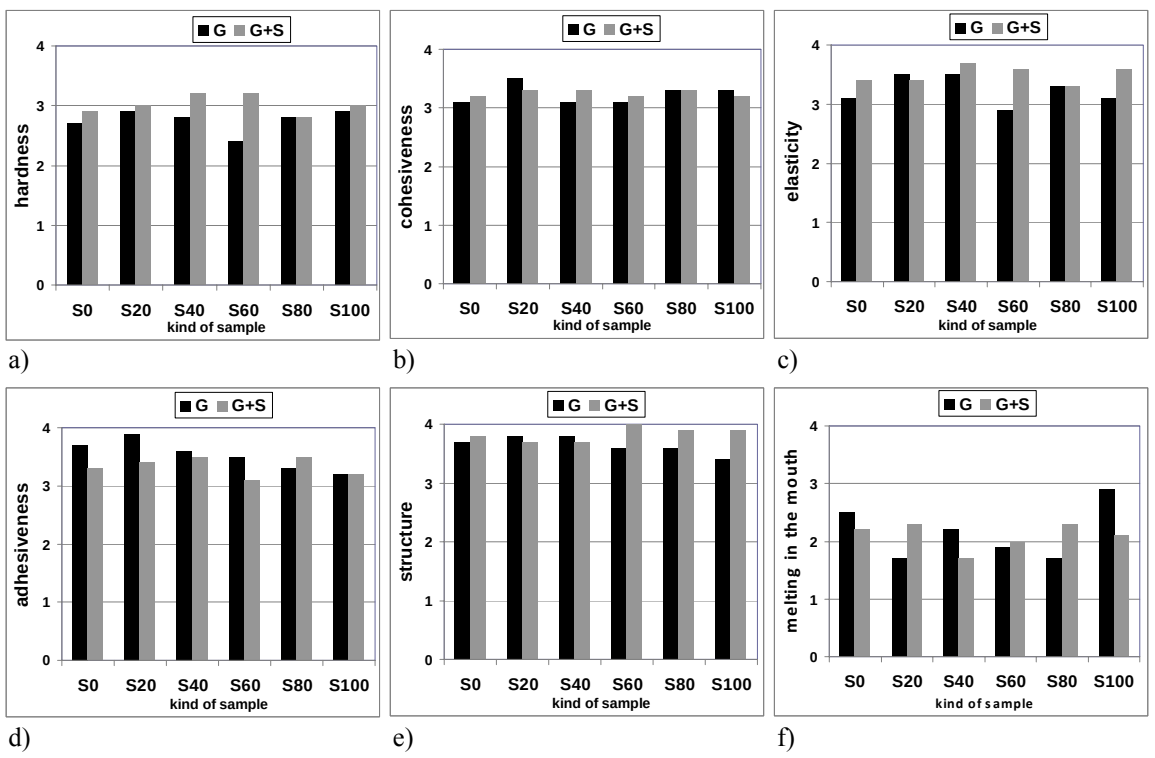

Fig. 2 Sensory attributes of texture of gelatine jellies sweetened with steviol glycosides

Assessment of that parameter was the most difficult to carry out and the perceived sensation was dependent on the temperature in the mouth, the force of pressing of the

sample to the palate, and other factors. Therefore, the notes awarded by the assessors for each jelly were in a fairly wide range of rates.

The sweetness sensation for the second series of jellies gradually decreased with increasing share of steviol glycosides in their recipes (Fig. 1a), with exception of S40 jelly. Sweetness of the jellies with sorbitol was slightly more intense than that of gelatine only jellies. The jellies with sorbitol were characterized by "hardly perceptible" or "faintly perceptible" acidity (Fig. 1b). It was found that increasing amount of E 960 additive resulted in the emergence of the metallic aftertaste (Fig. 1c), however it was only "hardly perceptible". The most perceived cooling effect characterized S80 and S100 jellies (Fig. 1d). The more steviol glycosides was present in the jelly, the more perceptible was liquorice aftertaste (Fig. 1e).

Similarly to the first series of jellies, the desserts with sorbitol did not differ between each other in hardness and cohesiveness. They were medium hard and retained their shape out of the container (Figs. 2a,b). The jellies were characterized by high elasticity, i.e. they immediately returned to their original shape after deformation (Fig. 2c), and they showed high adhesiveness against teaspoon (Fig. 2d). All the jellies had smooth structure (Fig. 2e) and moderate melting in the mouth (Fig. 2f).

For all the analysed jellies the sensation of cooling effect was significantly ($p < 0.05$) positively correlated with liquorice aftertaste ($r = 0.82$). Moreover, hardness and elasticity, as well as elasticity and structure were significantly positively correlated, with $r = 0.85$ and $r = 0.63$, respectively ($p < 0.05$).

CONCLUSIONS

In conclusion, it should be noted that as a result of replacement of sucrose with steviol glycosides (E 960) the sweetness intensity was slightly lower for the jellies with sorbitol, whereas in the jellies without this polyol the sweetness was weakened in the case of S80 and S100 samples. There is a possibility of replacement up to 60% of sucrose with steviol glycosides in the lemon-flavored jellies with no significant effect on emergence of metallic aftertaste and intensifying the cooling effect. Modification of the gelatine-based jelly recipe was not associated with changes in the intensity of the liquorice aftertaste. Replacement of sucrose with E 960 additive did not significantly affect the determined texture attributes of the jellies, therefore it can be assumed that the main texturizing agent in the assessed jellies was a gelatine or mixture of gelatine and sorbitol. Steviol glycosides (E 960) can be used in production of low-sugar jellies.

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