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Texture and Sensory Profiles of New Developed Sugar-Free Sunflower Kernels Bars

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Abstract

The aim of this work was to develop a new type of sugar-free bars from sunflower kernels and assessing their texture and sensory profiles. Sugar bars were obtained following the traditional technology of Chikki bars, by studying different types of syrups based on sugar / glucose (SG) or isomalt / maltitol (IM). For both types of bars, different concentrations of syrups were used (90%, 93%, >95.5%). Measurements of hardness taken with knife TA-SB showed that sugar bars with SG >95.5% have the highest hardness, followed by IM>95.5%, while lower concentrations syrups had reduced values of hardness. The maximum value of adhesiveness was recorded in the case of samples SG93%, when measured with same device. Fracturability showed the lowest values when the syrups concentrations were low, for both probes used (i.e., knife TA-SB or ball geometry). Overall, sensory showed that the most appreciated samples were the bars based on IM syrup.

Keywords: sugar free bar, sunflower kernel, sensory, texture analysis

1. Introduction

Sunflower *(Helianthus annuus)* is one of the most important oil crops. In addition to its superior oil, sunflower kernels are also very appreciated as food [1]. Due to their high amount of proteins and significant contents of tocopherols [2], zinc, copper [3], crude fiber [4], phenols [5], kernels are used in bread making, for snack foods, biscuits. Also, sunflower seeds are consumed raw or roasted as a rich source of vitamins B, D, E and K [6].

Snack foods, can be very nutritious when made from fruits, pulses, seeds or cereals, but, due to their high levels of fat, salt, and sugar these products frequently receive criticism. They are regarding as being nutritionally damaging when eaten in excess [7]. Sugar, a common component in snacks and confectionary, is also an important contributing factor to a large number of health problems, including obesity, 2 diabetes mellitus, hypertension, cardiovascular diseases and increased dental diseases both in adults and children [8,9]. Therefore, the nutritional value of sugar-based products has been questioned, and industry is encouraged or forced to reduce sugar and fat in these products [10]. For this reason, sugar alcohols or polyols recently became widely used as sweetening agents. They often show advantages over the conventional used sugars due to their sweetness, caloric reduction and non-carcinogenicity [11,2]. Furthermore, a very recent study [13] showed that the use of polyols might open new opportunities to develop confectionery products with an attractive texture and good consumer acceptability.

Isomalt and maltitol are sugar alcohols which are used as sugar replacers in a wide variety of food products: chewing gum, chocolates, yogurt, baked goods, candies, ice cream etc. [14] Isomalt is sugar alcohol produced by reducing isomaltulose and it is

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used as a noncariogenic nutritive sweetener. Moreover, isomalt does not increase blood glucose or insulin levels [12, 15]. This polyol absorbs very little water; thus, the products containing it tend not to become sticky and show a longer shelf life. Isomalt improves the transfer of flavor in foods, as slowly dissolves in the mouth; isomalt-containing products have a longer lasting taste [14].

Maltitol is a polyol characterized with sweetness similar to that of sucrose [12]. Its high sweetness allows it to be used without other sweeteners. Similarly to isomalt, maltitol does not contribute to the formation of dental decay, it has a low caloric value and helps to control blood glucose [14]. Additionally to sugar replacing, it can also be used as a fat substitute [16, 17]. The objective of this study was to develop a new type of Chikki sugar-free bars from sunflower kernels and assessing their texture and sensory profiles.

2. Materials and Methods

Sugar for the experiment was obtained from SC Agrana SA Oradea, glucose from SC Amylon SA Sibiu, isomalt and maltitol syrup were purchased from Cargill. Sunflower kernels were kindly provided by SC Amylon SA Sibiu.

2.1.Sample preparation.

The product was made following the conventional technology for the preparation of the Chikki bars variety, which is a popular Indian traditional sweet snack prepared from peanut, sesame and puffed rice [18, 19]. The difference was the replacement of jaggery syrup with sugar and glucose syrups or isomalt and maltitol syrups. The regular oleaginous seed raw materials were replaced by sunflower kernels. Sunflower kernel bars samples were obtained by using different syrups concentration as it is shown in Table 1, for all samples the sunflower kernels: syrup ratio being 70:30.

2.2.Textural profile analysis

The quality of a food product, in terms of sensory, shelf life, appearance, or nutritional value, is leaded by the structure of that food [20]. In this context, food texture is an important attribute in consumer acceptance, because it assesses the mechanical properties of food products while correlating them to the way that consumers use their senses to evaluate foods [21]. Thus, the texture of the obtained samples was determined for both types of bars: bars with sugar / glucose syrup and sugar-free samples with isomalt / maltitol syrup.

Table 1. The protocol used for obtaining sunflower kernels bars samples

Syrup type	Target syrup concentration	Sample
Sugar / glucose	90%	SG90%
	93%	SG93%
	>95,5%	SG>95,5%
Isomalt / maltitol	90%	IM90%
	93%	IM93%
	>95,5%	IM>95,5%

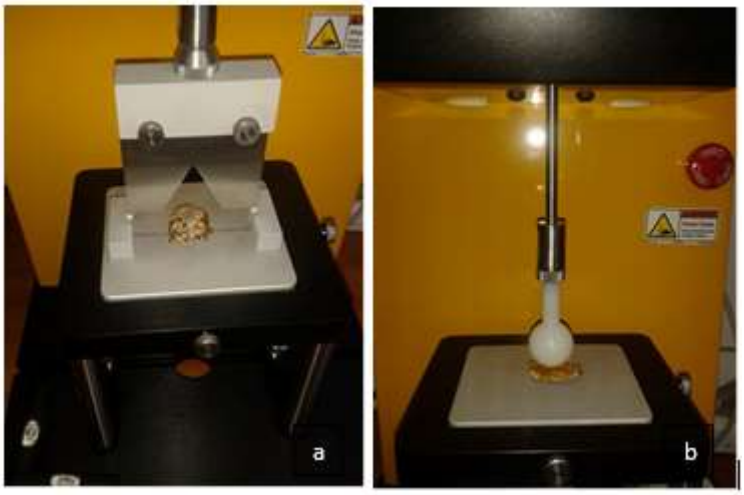

Figure 1. Knife TA-SB with shear blades (a) and the Ball probe (b)

The textural profile was obtained by using the Texture Analyzer Brookfield CT3 (Figure 1) equipped with TA-SB knife with shear blades and the TA-43 ball (for texture profile analysis). For all measurements the thickness of samples was 5 mm, same round product shape of 30 mm diameter. When using the TA-SB knife the following parameter were set: simple compression test, test speed 1 mm/s, target distance 25 mm, while in the case of TA-43 ball probe: texture profile analysis, test and return speed 0.5 mm/s, target distance 1 mm.

2.3.Sensory assessment

Sensorial characteristics of sugar bars and sugar-free bars samples were evaluated based on general hedonic rating test method. For this test a group of untrained panelists were asked to indicate how much they liked or disliked each variety of bars on a 9-point hedonic scale (9= like extremely; 1= dislike extremely) according to appearance, odor, texture, taste and aftertaste. General hedonic score was calculated as follows:

$$S=(n\cdot 9+n\cdot 8+n\cdot 7+n\cdot 6+n\cdot 5+n\cdot 4+n\cdot 3+n\cdot 2+n\cdot 1)/nt \quad \text{Eq.(1)}$$

where: *n* is the number of tasters which gave same appreciation and *nt* is the total numbers of panelists.

3. Results and Discussions

Firstly, samples were molded in rubber molds, but could not be removed with maintaining their shape hence, they have been used metal forms (Figure 2). Samples with syrup concentration higher than 95.5% were removed easier being less adhesive. Textural profile and sensorial test were recorded for following varieties of bars: SG 90%, SG 93%, SG >95.5% and IM >95.5% (samples IM 90% and 93% concentration had a very high adhesiveness which did not allow their use in texture and sensory tests).

3.1 Hardness

Hardness represents the firmness of the object when it is under compression [21]. Measurements were taken for each sample by using both accessories described on method section, the results being presented in Figure 3. The highest hardness value of 7438g was recorded in the case of bars with sugar and glucose syrup with a concentration higher than 95.5%; when using the ball accessory, the maximum value of 7142g was obtained for sample with isomalt and maltitol syrup, with a concentration higher than 95.5%. As the syrup was less concentrated, the hardness had lower value, for both syrups used, sugar / glucose syrup and isomalt / maltitol syrup.

Figure 2. Sunflower kernel bars obtained in rubber (a), and metal molds (b and c); sugar / glucose syrup (b) and isomalt / maltitol syrup (c)

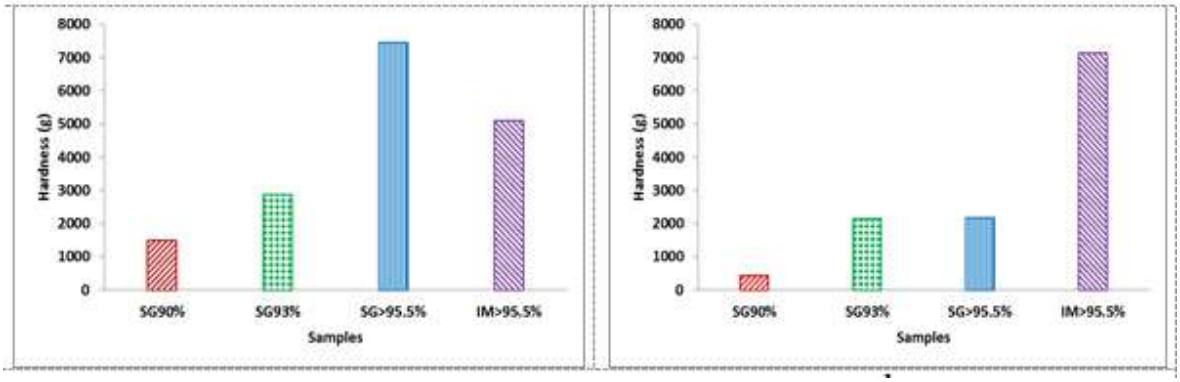

Figure 3. Hardness values of sunflower bars when using the knife TA-SB (a) and the ball accessory (b) (Abbreviations are described on Table 1)

3.1.1.Adhesiveness

Adhesiveness is the force required to remove food that adheres to the intern walls of mouth during chewing. It is described by the terms of sticky and gummy [22]. When the measurements were carried out with the knife TA-SB, the maximum value of adhesiveness was recorded in the case of the samples with 93% concentration (sugar / glucose), while it seems that when lower concentration are used (i.e., 90%), the instrument probe can be easily removed from the sample, the product being somehow more fluid (more watery). On the other hand when concentrations higher than 95.5% are used, no matter the syrup type (sugar/glucose or isomalt/maltitol), the samples are more brittle and less adhesive (Figure 4). In the case of the ball accessory TA-43, all adhesiveness values were lower than 0.3mJ (data not shown), probably caused by the geometry surface (sphere), which seems to detach very easily when returning from the product.

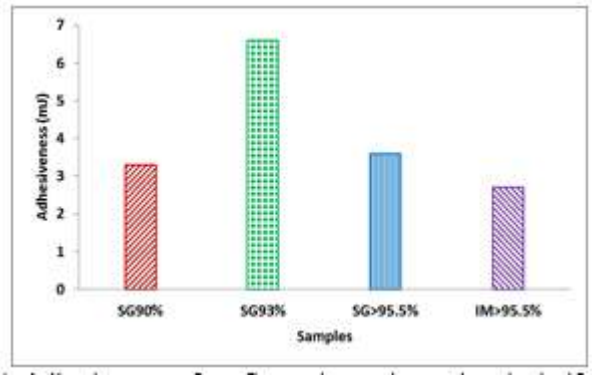

Figure 4. Adhesiveness of sunflower bars when using the knife TA-SB
(Abbreviations are described on Table 1)

3.1.2.Fracturability

The necessary force to shatter a food product is called friability, which it is described by the terms friable and crumbly [22]. As expected, fracturability of sugar and sugar-free bars increased proportionally with increasing syrups concentration (Figure 5), this phenomenon being noticed for both tests performed (i.e., simple compression test with knife TA-SB and texture profile analysis when using a ball accessory). Fracturability is a common feature of this type of products, the consumers associating to conventional sugar bars a brittle, friable and crumbly texture.

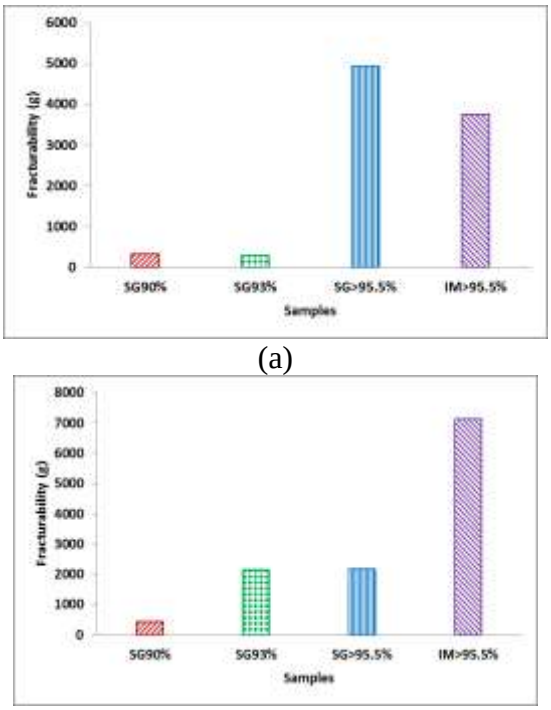

Figure 5. Fracturability of sunflower bars when using the knife TA-SB (a) and the ball accessory (b)
(Abbreviations are described on Table 1)

3.2.Sensory analysis

The general hedonic score was calculated for each bar sample, the results being presented on Figure 6. It can be noticed that the sample which registered the highest hedonic score (7.15) was sugar-free bars IM>95.5%, which means according to the hedonic scale interpretation that is positioned between "pleasant" and "very pleasant". The second ranked samples (score of 6.92) were sugar bars SG>95.5%, showing the fact that consumers appreciate similar both sunflower bars. Sunflower bars with 90% and 93% concentration obtained lower score, but somehow in the same range (5.48-5.92).

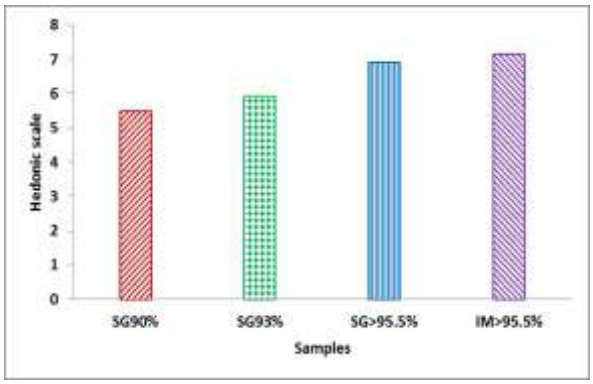

Figure 6. Sensory assessment of sugar and sugar-free bars (Abbreviations are described on Table 1)

4. Conclusions

Glucose syrup and sugar in the amounts used in the final recipe after boiling for about 20 minutes at atmospheric pressure reaches the concentration higher 95.5% as compared with isomalt and maltitol syrup, which after a 10-minute boiling in same conditions, reaches the same concentration; therefore, from the economical and technological points of view it is more profitable to use this type of syrup.

Texture analysis showed that higher concentration of syrups makes the end product more brittle, increases the hardness and lower the adhesiveness values. On the other hand the middle concentration syrup (93%) lead to a higher adhesiveness values of the bars when measuring with knife TA-SB, while in the case of TA-43 ball the adhesiveness values were considerably lower as a characteristic of this probe shape (sphere). Sensory highlighted that sugar-free bars IM>95.5% were the most appreciated by consumers. This product was brittle and had a pleasant, sweet taste.

Compliance with Ethics Requirements. Authors declare that they respect the journal's ethics requirements. Authors declare that they have no conflict of interest and all procedures involving human / or animal subjects (if exist) respect the specific regulation and standards.

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