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EFFECT OF SUGAR ADDITION ON TEXTURAL PROPERTIES OF THE HALF-SHORT CAKE

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Key words: half-short cake, texture, moisture content, sensory assessment

The paper presents results concerning textural parameters (hardness, cohesion, elasticity and chewing ability) and moisture content of half-short cake after different levels of sugar addition. The sensory assessment was conducted as well. The results of the study enable determining the optimum sugar addition.

INTRODUCTION

Intensified health problems of the society resulted in a change of human attitude to the quality of consumed products. Within the last few years the interest in "safe food" has increased significantly. In many diets the contents of sugar, honey, jam, ice cream and sweet cakes were reduced to minimum [Baik *et al*., 2000; Booth *et al*., 2000; Brown *et al*., 1996; Mojet *et al*., 2002].

Cake is a product obtained from flour, liquid and auxiliary raw materials through kneading the dough, fluffing, forming and baking in an oven. A series of chemical and physical changes occur in the dough during baking which make the final product easy available to a human organism, tasty and durable enough. In pastry-cooking the cakes are a numerous group of products. Their raw material composition is very rich and diversified. Depending on the quantity and kind of raw materials entering into composition of the short cake as well as on the technological procedure, the following cakes may be distinguished: short, half-short, French and half-French. The cooked cake may also be included herein [Zalewski, 1997].

The half- short cakes are similar to the short cakes; the difference between them consists in a lower content of fat in relation to flour (12 – 35%) and chemical fluffing of the first ones. The technique of half-short cake preparation is the same as in the case of the short cake [Dojutrek *et al*., 1985; Zalewski, 1997].

The consumers are interested in the quality of cakes which depends not only on the taste and appearance, but also on the texture [Rutkowski, 1993; Bergier, 1987]. The texture is very important for the procedures, too. It affects to a large extent our nourishment habits, creates preferences and indicates freshness. It is also substantial for transport and processing as it determines the manner of handling the products. Texture affects the health of oral cavity [Szcześniak, 1990]. Practically, the full assessment of quality may be obtained by textural analysis. That enables getting a complex sensory characteristics of the food product considering its mechanical and geometrical properties [Brandt *et al*., 1963]. Mechanical properties (*i.e.* the hardness, cohesion, viscosity, elasticity, adhesion, brittleness, chewing ability and gumminess) may also be determined by instrumental methods which are widely applied in the case of preparing new products [Blair, 1958; Szcześniak, 1968, 1972].

The study was aimed at assessing half-short cake depending on the quantity of added sugar. The investigations included the test of double compression and evaluation of the texture parameters, such as hardness, cohesion, elasticity and chewing ability. Moreover, the moisture content of cake was determined and the sensory assessment based on the five-score scale was conducted.

MATERIAL AND METHODS

The half-short cakes based on own recipes were used as experimental material. The components of cakes included: luxurious flour (500 g), potato meal (500 g), sugar (of differentiated content: 200, 400, 600, 800, 1000 g), butter (250 g), eggs (400 g – 8 pieces), baking powder (20 g) and vanilla sugar (20 g). Preparation of the dough consisted in sifting the wheat and potato flours, addition of baking powder, mixing and joining the mixture with the other ingredients. The dough put into fat-greased moulds was baked in a laboratory oven provided to experimental baking, at a temperature of 200°C for 30 min. Next, it was cooled at the ambient temperature, seasoned for 24 h and subjected to tests.

The product processed in such a way was tested for the moisture content using an oven method (according to Pol-

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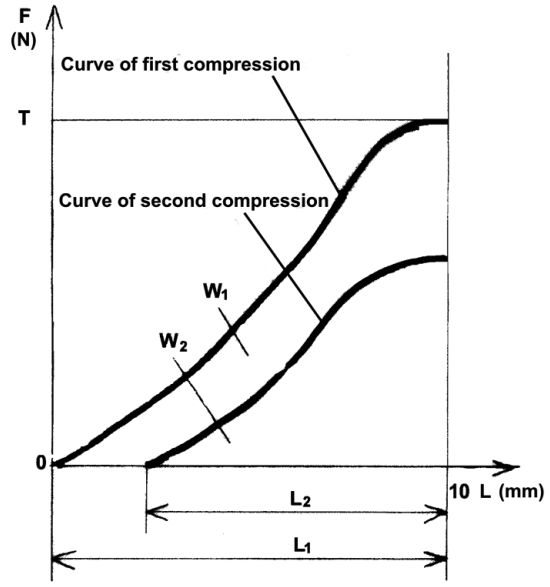

FIGURE 1. An exemplary course of curves during tests of c\double compression for half-short cake.

ish Standard [PN-A-74252:1988]), and subjected to instrumental texture measurements in an Instron 4302 apparatus. Double-compression test was applied. Ten cubic samples of 20 mm side were taken from each cake. The samples were axially compressed at 50 mm/min velocity to achieve the thickness of 10 mm (by 50%). The forces acting on mandrel and displacement of a working element were continuously recorded during tests. The courses of curves for first and second compressions are shown on an exemplary texturogram (Figure 1). On that basis four textural parameters were evaluated: (1) hardness T (N) characterised by the maximum force on the curve of first compression; (2) cohesion (-), expressed as the proportion of energy necessary to second compression (W_2 (J)) and the first compression (W_1 (J)); (3) elasticity (-), being a quotient of sample strain during second compression (L_2 (mm)) and during the first compression (W_2 (mm)); and (4) chewing ability (N) that represents the force (energy) required during chewing to get the disintegration of solid products making their swallowing possible; in instrumental measurements it is a product of hardness, cohesion and elasticity.

In the sensory assessment according to a five-score scale the following attributes were determined: general appearance, consistence, savouriness (palatability) and flavour, according to Polish Standards [PN-A-04020: 1966; PN-A-04021: 1965].

RESULTS AND DISCUSSION

Figures 2 – 6 present the dependence of the tested texture parameters on the quantity of sugar added per 1 kg flour. The hardness of cake rose linearly from 12.5 to 22.5 N along with the quantity of added sugar (from 200 to 1000 g per kg flour) (Figure 2). The effect of added sugar (s) on the cake hardness (H) was described by the equation:

$$H=7+3.72s \quad (1)$$

$$R^2=0.992,\ \alpha\leq 0.01$$

Cohesion (C) and elasticity of tested half-short cake were well described by polynomials of the second order:

$$C=0.176+0.118s+0.214s^2 \quad (2)$$

$$R^2=0.984,\ \alpha\leq 0.01$$

and

$$Sp=0.81+0.0091s+0.019s^2 \quad (3)$$

$$R^2=0.99,\ \alpha\leq 0.01$$

In both cases the highest values of cohesion (0.334) and elasticity (0.92) were obtained for the cake with sugar content of 600 g/kg flour. Larger and smaller additions of sugar per kg flour reduced the values of both parameters. The content of 200 g sugar per 1 kg flour decreased cohesion down to 0.275, while the addition of 1000 g sugar per kg flour produced cohesion equal to 0.225. At the same sugar quantities added the elasticity amounted to 0.88 and 0.8, respectively. Thus, the cake containing 600 g sugar per kg flour – after removal of loading force – raised to the largest extent.

Addition of sugar at the level of 200 g per kg flour enabled achieving the chewing ability of 7.12 N; thus, the force required for chewing to get the cake disintegration enough to be swallowed, was very low. Considerably higher was the force required in the case of cake containing 1000 g sugar per kg flour, that was characterised by the chewing ability equal to 15.6 N (Figure 5). The relationship between chewing ability and content of sugar is described by an exponential equation ($R^2 = 0.972$, $\alpha = 0.01$):

$$CH=5.514e^{0.197s} \quad (4)$$

The influence of sugar addition on the moisture content of the cake was presented in Figure 6. The highest (28%) was the moisture content of cake with the lowest sugar addition. Sugar addition as high as 1000 g/kg flour decreased the moisture content to 19%. The relationship between sugar addition and the moisture content of cake may be described by polynomial of the second order at $R^2 = 0.999$, $\alpha = 0.01$:

$$MC=29.1-0.87s-0.229s^2 \quad (5)$$

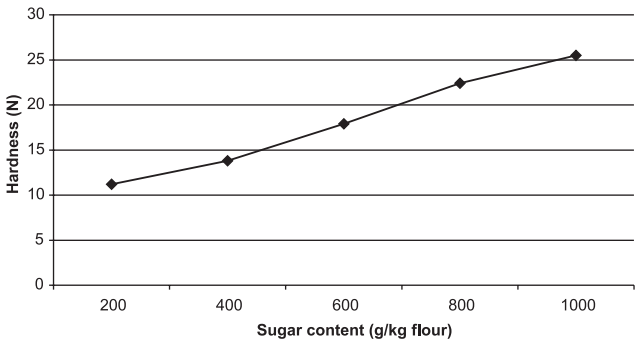

FIGURE 2. Effect of fluffing medium on the hardness of half-short cake.

TABLE 1. Sensory assessment of half-short cake (points).

Sugar content (g/kg flour)	General appearance	Consistence	Savouriness	Flavour	Sum
200	5	5	4	5	19
400	5	5	5	5	20
600	5	5	5	5	20
800	4	4	4	5	17
1000	3	3	3	4	13

Statistical analysis of the results showed that textural parameters were very closely correlated with sugar content in the cake. All the correlation coefficients exceeded the value of 0.95.

Instrumental assessment of the texture enabled determining what sugar addition advantageously affected the textural parameters of the cakes examined. The highest elasticity was found for the cake with sugar content of 600 g/kg flour. Next, the adequate chewing ability and cohesion were stated in the cake containing from 400 to 600 g sugar per kg flour. The sensory analysis is instrumental in settling the optimum addition of sugar; the results of such analysis are given in Table 1.

The highest results of the sensory assessment were achieved by the cakes containing 400 and 600 g sugar per kg flour. These cakes obtained maximum scores for general appearance, consistence, palatability, flavour and taste. According to the opinion of panelists, these cakes were of regular shape, browned a little, of the consistence typical of that kind of cakes, the palatability was also proper and strongly desired, at typical, distinct flavour. The cake containing 200 g sugar per kg flour was not sweet enough. The cakes with sugar contents of 800 and 1000 g /kg flour were evidently too hard, too sweet and too little risen. The cake with the highest sugar content adhered to the metal sheet and smelt of burned sugar.

On the basis of measurement results dealing with the texture parameters and the sensory analysis it could be surely stated that the half-short cake containing 600 g sugar per kg flour achieved the best qualitative parameters. The cake with sugar content of 400 g/kg flour showed slightly lower quality, it was also characterised by a little less elasticity, however it contained less sugar, which could be of importance in some diets.

CONCLUSIONS

1. An increase in sugar content in half-short cake from 200 to 1000 g/kg flour linearly increased the hardness from 12.5 to 22.5 N and the chewing ability from 7.2 to 15.6 N.

2. The best cohesion values (0.32; 0.334; 0.312) were obtained at sugar contents in cakes ranging from 400 to 800 g/kg flour.

3. The highest elasticity (0.92) showed the cake containing 600 g sugar per kg flour.

4. An increase of sugar addition within the tested range caused a drop of cake moisture content from 28 to 19%.

5. On the basis of measurement results concerning texture parameters and sensory analysis it was found that the highest quality was achieved by the half-short cake at sugar content of 600 g/kg flour; slightly less qualitative features showed the cake containing 400 g sugar per kg flour; its elasticity was slightly worse.

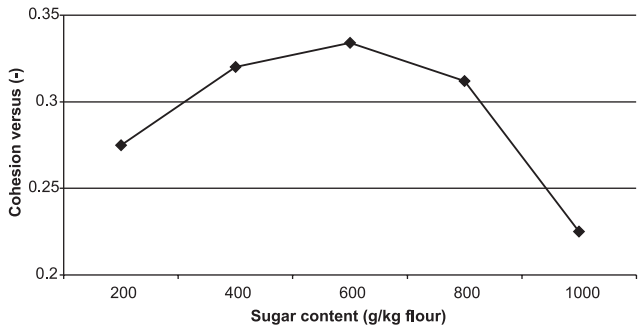

FIGURE 3. Effect of sugar addition on the cohesion of half-short cake.

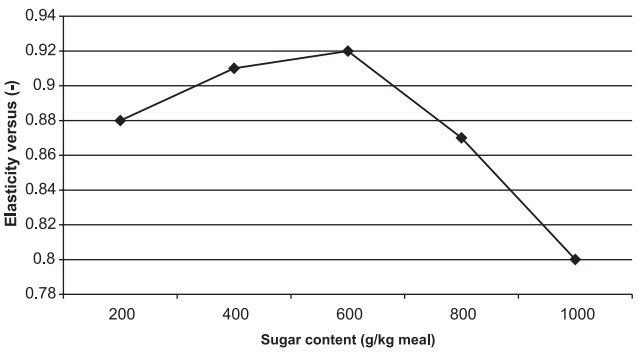

FIGURE 4. Effect of sugar addition on elasticity of half-short cake.

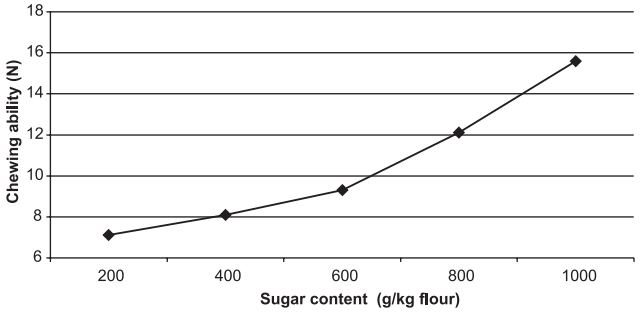

FIGURE 5. Effect of sugar addition on chewing ability of half-short cake.

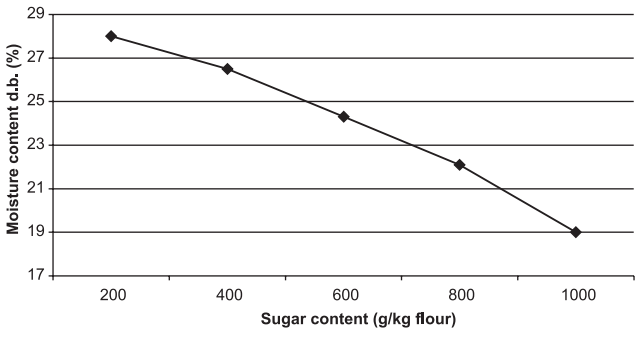

FIGURE 6. Effect of sugar addition on the moisture content (dry basis) of half-short cake.

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WPŁYW DODATKU CUKRU NA WYBRANE PARAMETRY TEKSTURY CIASTA PÓŁKRUCHEGO

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W pracy przedstawiono wyniki badań parametrów tekstury (twardości, spójności, sprężystości i żujności) oraz wilgotności ciasta półkruchego w zależności od dodatku cukru. Przeprowadzono ocenę organoleptyczną. Wyniki badań umożliwiły wybór optymalnego dodatku cukru.