Textual Evaluation and Formulation Research of Low-calorie Buckwheat Moon Cake Crust

Guixia Li¹,*, Congcong Huang¹, and Xiaoguang Lan²

¹College of Cereals, Oils and Food, Shandong Business Institute, 264670 Yantai, P. R.China
²Department of Grain Engineering, Dezhou Vocational and technical College, 253034 Dezhou, P. R.China

*Corresponding author: ¹email: liguixia@sdbi.edu.cn

Abstract. In this paper, nine different formulas of buckwheat moon cake crust were used as research objects, and a new type of low-calorie buckwheat crust moon cake was developed through sensory evaluation and TPA test parameters. The best formulation of moon cake crust is buckwheat flour/high gluten flour (W: W) 60:40, invert sugar 32.5%, maltitol syrup 32.5%, peanut oil 15%, gum 0.2%. Texture Profile Analysis (TPA) showed that the hardness and chewiness decreased, but the cohesiveness increased as enlarge the amount of buckwheat flour. With addition of gum, hardness decreased, but chewiness increased. With loss of peanut oil, cohesiveness decreased.

1. Introduction

Guang-style moon cakes, as a kind of traditional food, have an important position in the baking industry in China. Traditionally, Guang-style moon cakes are high in sugar and fat, which has negative effects on health. Therefore, improving the higher nutritional value and reducing the content of sugar and oil is a challenge to Guang-style moon cakes.

Buckwheat is a rich source of many nutrients, including mineral compounds, dietary fiber, and flavonoids (such as rutin and quercetin) are used in many forms[1]. Buckwheat is recognized as the most popular and promising green food in the 21st century by modern nutritionists, which has a broad market and development prospects. Buckwheat flour as the main material which can be used: noodles[2], instant noodles, steamed bread, puffed food, biscuits and so on. However, the application of buckwheat flour in moon cakes has not been reported.

TPA is mainly used in sensory evaluation and instrumental analysis of food. TPA texture analysis was established around 1967[3], many indexes can be measured, such as sample hardness, chewiness, adhesiveness, springiness, cohesiveness, gumminess and resilience.

The aim of this study was to evaluate texture and sensory of novel low-calorie buckwheat Guang-style moon cake crust using buckwheat flour, maltitol and gums as the replacement of wheat flour, sucrose and peanut oil.
2. Materials and methods

2.1. Materials

2.1.1. Ingredients
The ingredients were purchased from various companies in China, i.e., high-gluten wheat flour (Haijia Food Ltd., Zhengzhou), peanut oil (LuHua Food Ltd., Shandong), maltitol syrup (FuTian Food Ltd., Shandong), Xanthan gums (ZhongXuan Food Ltd., Tianjin), Arabic gum (RuiJingTe Food Ltd., Tianjin), “kansui” (alkali water containing sodium and potassium carbonates), (GuangYi Food Ltd., Guangdong)

2.2. Methods

2.2.1. Preparation of syrup
Process[4]: Boil 10Kg of water in a pot, add 20 Kg of sugar and stir until dissolved, and then add 0.1 kg of citric acid solution, heat until boiling and turn to slow fire (remove the foam debris during this time, keep the syrup clear and transparent) and then cook for about 30mins, when the temperature reached 110 ~ 120℃, then pour them out of the pot, set aside for 15 days for use.

2.2.2. Preparation of mixing flour
Mix buckwheat flour and high gluten flour in a mass ratio of 40:60, 60:40 and 80:20, respectively.

2.2.3. Preparation of gum
The gum mixture contained xanthan and Arabic gums at a ratio of 1:1.

2.2.4. Formulations and baking
Buckwheat moon cake crust with different formulations are shown in Table1. Firstly, put syrup and “kansui” into the flour mixer TP-101, stir them at a high speed until the slurry turned into milk-white, which means there are many small bubbles, then add the oil and the gum by high speed fully mix, then add 2/3 of the flour, stir at low speed, followed by add the rest of the flour, mix well. Let stand for 20-30min for later use.

Baking: before entering the oven, brush water on the surface of the cake crust to form a thin layer of water film on the surface of the cake crust. The upper fire is 200℃, the lower fire is 100℃. Bake it for another 8 to 12 minutes and then take it out of the oven. When the surface temperature of the moon cake cooled to 50-60℃, pack the moon cake in plastic bags and stored in a constant temperature of 20℃.

| Formulation | Maltitol Syrup Content (%) | Reduce the amount of peanut oil(%) | Gum Content (%) | Buckwheat flour content (%) |
|-------------|---------------------------|-----------------------------------|----------------|-----------------------------|
| S1          | 10                        | 5                                 | 0.1            | 40                          |
| S2          | 10                        | 15                                | 0.2            | 60                          |
| S3          | 10                        | 25                                | 0.3            | 80                          |
| S4          | 50                        | 5                                 | 0.2            | 80                          |
| S5          | 50                        | 15                                | 0.3            | 40                          |
| S6          | 50                        | 25                                | 0.1            | 60                          |
| S7          | 90                        | 5                                 | 0.3            | 60                          |
| S8          | 90                        | 15                                | 0.1            | 80                          |
| S9          | 90                        | 25                                | 0.2            | 40                          |
2.2.5. Sensory analysis
The sensory evaluation of the moon cake crust was conducted after stored in 20°C for three days. Taking ordinary Guang-style moon cakes as a reference, the sensory score is 100 points. Sensory assessment group (composed of 10 persons, 5 males and 5 females, aged between 20 and 30).

The quality evaluation method of buckwheat moon cake crust was sensory evaluation[5]. According to Table 2, the sensory characteristics of moon cake crust, such as the appearance, the colour the taste, the texture, and the structure were scored.

| Parameter               | Score | Specification                                                                 |
|-------------------------|-------|-------------------------------------------------------------------------------|
| Appearance              | 25    | The shape is complete and full, the surface can be slightly drum, clear edges and corners, the bottom is flat, not concave bottom, not contraction. |
| Crust                   | 10    | Soft but not crispy, without shrinkage                                         |
| Colour lustre           | 20    | Uniform color, glossy                                                        |
| Taste and texture       | 30    | Pure taste, with the varieties should have native flavor and taste            |
| Organization structure  | 15    | The filling is full, neither too hard, nor too soft                           |
| Total score             | 100   |                                                                                 |

2.2.6. Determination of TPA parameters of low calorie buckwheat crust moon cake
Considering the influence of the returning oil and softening of the moon cakes, TPA parameters were determined on the third day after the moon cakes were made. The texture characteristics of moon cakes were measured at room temperature. Two parallel samples were taken and each moon cake was continuously compressed twice, each time to 60% of the original height of the product, and the force-distance curve was recorded at a speed of 5mm/s.

3. Results and discussion

3.1. Sensory evaluation
The best formulation of low-calorie buckwheat moon cake crust is: namely the quality ratio of buckwheat flour and high gluten powder is 60/40, sucrose syrup is 32.5%, maltitol syrup is 32.5%, peanut oil is 15%, gum is 0.2%. The content of sucrose syrup decreased by 59.4% and peanut oil decreased by 37.5% compared with that of ordinary Guang-style moon cake.

The content of buckwheat flour has significant effect on the quality of moon cake crust and final products (Fig.1.). S6, S7 and S2 with 60% buckwheat flour had high scores on appearance, crust, taste and texture, organization structure, but the color was moderate. S4, S3 and S8 with 80% buckwheat flour had the worst score but the best color. This is mainly because with the increase of buckwheat flour content, the water absorption rate of the mixed flour dough decreased gradually, the formation time and stability time shortened, and the flour quality index decreased. Although the flavor of buckwheat is improved, but the dough is loose, it is hard to roll the skin, but easy to break when the filling is wrapped. As a result, samples are not full, the texture is not uniform, the taste is rough, and the sensory score is reduced.
The content of maltitol syrup also has a great effect on the color. In the case of the same content of buckwheat flour, the higher the content of maltitol syrup, the lighter the color of the sample will be. For example, the order of color score of S2, S6 and S7 with 10%, 50% and 90% maltitol syrup respectively is S2 > S6 > S7, which is the same as the order of color score of cake crust. This is mainly due to the fact that maltitol syrup will not cause Maillard reaction when heated together with amino acids and proteins, and is stable to acids and bases with almost no coloring [6].

3.2. TPA evaluation of low-calorie buckwheat moon cake crust

| Parameter of TPA | Constant Maltitol Syrup Content | Reduce the amount of peanut oil | Gum content | Buckwheat flour content |
|------------------|---------------------------------|---------------------------------|-------------|-------------------------|
| Hardness (g)     | 9046.110                        | -0.525                          | -3.407      | 2380.340**              |
| Chewiness (g)    | -481.667                        | -0.308                          | -3.234      | 695.595*                |
| Adhesiveness     | 0.564                           | -5.833E-5                       | -0.011**    | -0.010                  |

*means significant difference (P ≤ 0.05), **means extremely significant (P ≤ 0.01)

It can be seen from Table 3 that the hardness value was negatively correlated with the contents of colloid and buckwheat flour, and the regression equation reached a extremely significant level (P ≤ 0.01). The Chewiness was positively correlated with the gum content and buckwheat flour content. The Adhesiveness was negatively correlated with the reduced amount of peanut oil and the content of buckwheat flour.

According to the multiple regression equation, the addition amount of buckwheat flour, gum content and reduction amount of peanut oil in the formulation are the main factors affecting the texture of low-calorie buckwheat moon cake crust. With the increase of the amount of buckwheat flour, the hardness and adhesiveness of buckwheat cake moon cake crust decreased, and the chewiness increased. Gum mainly used to improve the fat reducing hardness increases, this may be due to the gum can keep...
moisture, increase the water activity of buckwheat moon cake crust, which reduce the hardness of moon cake products, gum can be improved by this effect to reduce the adverse effect caused by the hardness moon cake products[7]. The decrease of peanut oil content can reduce the cohesion value of moon cakes. This is in line with the analysis results of Hughes, Mullen and Troy[8].

4. Conclusion
1. The best formulation of moon cake crust was as following: the weight ratio of buckwheat flour to high gluten flour is 60/40, sucrose syrup is 32.5%, maltitol syrup is 32.5%, peanut oil is 15%, gum is 0.2%. TPA parameters were as follows: hardness value is 5966.358g, chewiness value is 349.654g, adhesiveness value is 0.216.
2. According to the linear regression analysis, the content of buckwheat flour, the amount of gum and reduce the amount of peanut oil in the formula are the main factors affecting the texture of moon cakes. As for the moon cake with buckwheat crust, with the increase of buckwheat flour content, the hardness and adhesiveness of the moon cake decreased, but the chewiness increased. The gum reduces the hardness of moon cake and increases the intensity of chewiness. The decrease of peanut oil content can decrease adhesiveness of moon cake.

Acknowledgements
We are grateful for the financial supports by latitudinal projects of Shandong Business Institute (2020HXZX062), and Campus integration development project of Yantai (2019XDRHXMPT32).

References
[1] WANG, LIM, CHENS, et al. Effects of flour dynamic viscosity on the quality properties of buckwheat noodles[J]. Carbohydrate Polymers, 2019, 207: 815-823.
[2] SUNX, LIW, HUY, etal. Comparis on of pre-gelatinization methods on physicochemical, functional and structural properties of tartary buck wheat flour and noodle quality[J]. Journal of Cereal Science, 2018, 80: 63-71.
[3] Zczeniak AS. Objective Measurements of Food Texture [J]. Food Science, 1963, 28:420-441.
[4] Haixiong WU. The production technology of Guang-style moon cake [J]. Science and Technology of Guangzhou Food Industry, 2004, (4) 20: 92-94.
[5] Jianzong Meng etal. Study on Moon Cake Filling Prepared with Trehalose[J]. Food Science, 2002, 27(7): 273-275.
[6] Ariana Saraiva etal. Maltitol: analytical determination methods, applications in the food Industry, metabolism and health impacts[J].International Journal of Environmental Research and Public Health, Volume 17, Issue 14. 2020.
[7] Rosell C M. Roias. T A. Benedito de Barber C. Inference of hydrocololloids on dough rheology and bread quality [J]. Food Hydrocolloids, 2001, 17(6): 863-869.
[8] Hughes E, Mullen A M, Troy D J. Effects of fat level, Tapioca starch and whey on Frankfurters formulated with 5% and 12% fat [J]. Meat Science, 1998, 48: 169-180.