

PHYSICAL CHARACTERISTICS OF FUNCTIONAL BISCUITS

Assistant Gjore Nakov, MSc

Department of Biotechnology and Food Technologies

University of Ruse "Angel Kanchev", Branch Razgrad, Bulgaria

Phone: +359894264250

E-mail: gore_nakov@hotmail.com

Abstract: *Biscuits are products that are consumed by all age groups. The physical properties of the dough and the type of biscuits depend on the method of biscuit production. During the process of baking, in the biscuits take place processes that cause changes in the dough, which lead to getting a porous, fragile and friable structure of biscuits. It reduces the amount of moisture and changes the color. This paper presents the physical properties (baking loss, volume, diameter, thickness and thickness/diameter ratio) of 16 different types of functional biscuits, produced by white flour, barley flour, einkorn flour and flaking einkorn in different ratio. The influence of the used different types of flour has been examined. Statistical processing of results was performed with help of ANOVA, Fisher's LSD-test.*

Keywords: *Biscuits, Physical characteristics, Functional Food.*

INTRODUCTION

Biscuits enter the group of food products which are very popular, who have not only nutritional benefits, but also affect the emotional status of the consumers and improve their mood. Biscuits are characterized by long shelf life and are available everywhere and at any time (Nakov, Gj., Stamatovska, V., Necinova, Lj., Ivanova, N. & Damyanova, S., 2016).

The composition of the biscuits may be different, depending on the daily need of the product, as well as the functions performed by the raw materials, which are usually prepared by flour, oil and sugar, and other components with moisture less than 4% and shelf life of more than 6 months. According to Nakov, Gj., Ivanova, N., Damyanova, S., Yordanova, L., Godjevrgova, T. & Necinova Lj. (2016). the baking time should provide:

- a) reducing the density of the biscuits and creating a porous structure;
- b) good fragility;
- c) reduced amount of moisture;
- d) changing color.

The quality characteristics of biscuits depend on the quality of the flour's chemical composition and its quality (Stamatovska, V., Kalevska, T., Menkinoska, M., Nakov, Gj., Uzunoska, Z. & Mitkova, L., 2016).

The flour used for biscuit production is usually white wheat flour (oatmeal flour, corn flour, etc.) which contains at least 27% gluten. The size of the particles in the flour should be within the limits of 50-150 µm, the larger particles help in obtaining a product with reduced volume and porosity (Dabija, A. & Paius, A. M., 2015).

In order to increase the nutritional value of the biscuits, they are prepared from fortified flour or from a mixture of different kinds of flour (Chauhan, A., Saxena, D.S. & Singh, S., 2016).

A number of studies have shown the improved nutritional value of biscuits by introducing barley flour (Gupta, M., Bawa, A. S. & Abu-Ghannam, N., 2011; Sharma, P. & Gujral, H. S., 2014) and einkorn flour (Preedy, R.V., Ross Watson, R. & Patel, B.V., 2011; Nakov, Gj., Ivanova, N., Damyanova, S., Yordanova, L., Godjevrgova, T. & Necinova Lj., 2016) in the biscuits' composition.

Compared to other cereals, Einkorn wheat flour is characterized by high imbalance of gliadin and glutenin and very low content of High Molecular Weight Glutenin Subunits (HMW-GS) (Nakov, Gj., Stamatovska, V., Ivanova, N., Damyanova, S. & Necinova Lj., 2016).

Barley as a cereal, is a good source of dietary fiber particularly beta-glucans. Marković et al., 2017. Lately, 2/3 of barley production has been used to feed animals, 1/3 for malt production, and even 2% in human diet (Baik, BK. & Ullrich, SE., 2008).

More recently, cereal flakes are becoming more popular and important in people's diet. Snowflakes are commonly used in many products for breakfast. Many of them are also used as an additive to bread and bakery products (Goudar, G. & Sathisha, GJ., 2016).

The aim of this paper is to show the physical properties (baking loss, volume, diameter, thickness and ratio of thickness and diameter) of functional biscuits produced from different types of flour in a different proportion. The total number of biscuits produced is 16.

MATERIAL AND METHODS

For production of biscuits white flour, barley flour, einkorn flour and flaking einkorn in different ratio were used.

The biscuits are produced according to AACC Method 10-50D (2000) method.

The baking losses and the volume of biscuits are determined according to the method presented by Koceva Komlenić, D., Jukić, M., Kosović, I. & Kuleš, A. (2014).

The thickness of the biscuits is determined by the PowerFix profil, an electronic digital calliper, while the diameter of the biscuits is determined by the method presented by (Chopra, N., Dhillon, B. & Puri, S., 2014).

RESULTS AND DISCUSSION

Biscuits are stable products that have many advantages, low production costs and long shelf life. The physical properties of the biscuits depend on the way the dough is formed and the type of biscuits (Dogan, I.S., 2006).

In Table 1 are presented the physical characteristics (baking losses, volume, diameter, thickness, ratio of thickness / diameter) of biscuits in which as sweetener are used sucrose and glucose solution.

Table 1. Physical characteristics of functional biscuits

Type of biscuits	Baking loss (%)	Volume (cm ³)	Diameter (cm)	Thickness (mm)	Spread ratio
100% WF	6.99 ± 2.33 ^g	23.67 ± 4.62 ^g	5.33 ± 0.41	12.14 ± 0.15 ^{cd}	2.28
30% B + 70% E	13.64 ± 0.54 ^{abc}	40.33 ± 9.61 ^f	7.08 ± 0.27	10.56 ± 0.37 ^e	1.49
50% B + 50% E	11.07 ± 0.96 ^{de}	40.00 ± 0.00 ^f	6.21 ± 0.30	12.43 ± 0.78 ^{cd}	2.00
70% B + 30% E	12.28 ± 0.91 ^{bcd}	25.00 ± 5.00 ^g	5.92 ± 0.11	15.04 ± 0.22 ^a	2.54
100% B	8.40 ± 0.55 ^{fg}	62.00 ± 8.00 ^{cd}	5.38 ± 0.15	15.30 ± 0.86 ^a	2.84
30% E + 70% FE	13.03 ± 0.96 ^{abcd}	53.33 ± 5.77 ^{de}	7.23 ± 0.44	8.92 ± 0.43 ^g	1.23
50% E + 50% FE	12.98 ± 6.63 ^{abcd}	53.00 ± 1.73 ^{de}	7.04 ± 0.21	9.95 ± 0.75 ^{ef}	1.41
70% E + 30% FE	14.10 ± 3.52 ^{ab}	53.00 ± 4.18 ^{de}	7.11 ± 0.17	9.38 ± 0.37 ^{fg}	1.32
100% FE	9.54 ± 1.22 ^{ef}	51.33 ± 1.53 ^e	6.37 ± 0.09	10.66 ± 0.79 ^e	1.67
30% WF + 70% B	8.06 ± 1.08 ^{fg}	64.67 ± 0.58 ^{bc}	5.53 ± 0.14	13.05 ± 0.61 ^{bc}	2.36
50% WF + 50% B	10.95 ± 0.83 ^{de}	72.67 ± 3.06 ^{ab}	5.67 ± 0.20	15.72 ± 0.84 ^a	2.77
70% WF + 30% B	12.96 ± 0.87 ^{abcd}	74.67 ± 2.31 ^{ab}	5.61 ± 0.22	14.76 ± 0.81 ^a	2.63
30% WF + 70% E	11.49 ± 0.86 ^{cde}	72.33 ± 2.08 ^{ab}	6.04 ± 0.17	13.74 ± 0.44 ^b	2.27
50% WF + 50% E	14.31 ± 0.60 ^{ab}	71.67 ± 6.03 ^{abc}	6.65 ± 0.41	11.72 ± 0.53 ^d	1.76
70% WF + 30% E	14.56 ± 0.29 ^{ab}	62.00 ± 8.72 ^{cd}	7.22 ± 0.25	10.69 ± 0.26 ^e	1.48
100% E	15.16 ± 1.01 ^a	79.00 ± 5.00 ^a	7.95 ± 0.31	8.80 ± 0.39 ^g	1.10

* WF-Wheat flour; B-Barley flour; E-Einkorn flour; FE-Flaking Einkorn; ** The shown values are the average of 5 measured values ± standard deviation *** Values in the same column with different exponents statistically significantly different ($p < 0,05$) ANOVA, Fisher's LSD.

During the cooking process comes to an evaporation of water from the formed dough resulting in obtaining biscuits with distinctive structure. The largest baking loss was obtained in biscuits from 100% flaking einkorn ($15.16 \pm 1.01\%$), while the smallest losses we have in control biscuits produced from 100% white wheat flour ($6.99 \pm 2.33\%$). From the results shown, it can also be seen that by reducing the percentage of barley flour in the composition of biscuits, produced from white wheat flour and barley flour, the baking loss decreases. The same is noted when biscuits are produced from wheat flour and einkorn flour, ie, with increasing the percentage of einkorn flour in the composition of biscuits, losses are reduced.

In the statistical processing of the results with the Fisher's LSD test, statistically significant and varied ($p < 0.05$) are all types of biscuits relative to the baking loss parameter, other than biscuits made from 100% barley flour, and biscuits made from 30% white wheat flour and 70% barley flour, which are partially significant and different compared to control.

The largest volume in this group of biscuits have biscuits produced from 70% white wheat flour and 30% barley flour ($74.67 \pm 2.31 \text{ cm}^3$), while the smallest have control biscuits ($23.67 \pm 4.62 \text{ cm}^3$). From the results shown, it can be seen that the barley flour and einkorn flour biscuits with an increase in the percentage of barley flour in their composition decreases in volume; the same is evident in the biscuits produced from white wheat flour and barley flour, while in the biscuits of white wheat flour and einkorn flour with an increase in the percentage of einkorn flour, volume decreases.

In the statistical processing of results, it was found that all results were statistically significant and different ($p < 0.05$) in terms of volume compared to control.

The spread ratio is considered as one of the most important quality parameters of biscuits, because it co-relates with texture, grain finesse, bite and overall mouth feel of the biscuits. (Jothi et al., 2014)

The smallest diameter has control biscuits ($5.33 \pm 0.41 \text{ cm}$), while the largest diameter have biscuits produced from 100% einkorn flour ($7.95 \pm 0.31 \text{ cm}$). From the results presented it is shown that the biscuits produced from barley flour and einkorn flour by reducing the quantity of einkorn flour in the biscuits, their diameter decreases.

Kaur, J., Nagi, P.S., Sharma, S. & Dar, B.N. (2012) in their studies on biscuits fortified with barley flour, found that the enrichment of biscuits with 0, 5, 10, 15 and 20% of barley flour did not affect the diameter of the biscuits.

The thickness of biscuits is another physical parameter that has been examined. It determined that the minimum thickness of a biscuit made of 100% einkorn flour ($8.80 \pm 0.39 \text{ mm}$), and the greatest thickness had biscuits produced from white wheat flour and barley flour in ratio 50:50 ($15.72 \pm 0.84 \text{ mm}$). It is established that in biscuits of barley flour and einkorn flour the thickness increases by increasing the percentage of barley flour, and it is also found in biscuits of white wheat flour and barley flour. By reducing the percentage of einkorn flour in the composition of biscuits from white wheat flour and einkorn flour, the thickness decreases.

Chopra, N., Dhillon, B. & Puri, S. (2014) reported that when fortifying biscuits with flour from buckwheat the thickness of the biscuits increases. The increase in thickness may be due to a decrease in the diameter of the biscuits. Changes in diameter and thickness of biscuits are reflected on the volume of biscuits.

Gurung, B., Ojha, P. & Subba, D. (2016) in their studies on biscuits fortified with pumpkin flour, state that fortifying the biscuits leads to an increase in the diameter and thickness of the biscuits, which on the other hand lead to increasing in volume. Good quality cookies or biscuits should have a high spread ratio (Divyashree, K., Ashwath Kumar, K., Sharma G.K., Semwal, A.D and Umesha, 2016).

CONCLUSION

In this paper, the physical characteristics of 16 types of functional biscuits are determined. In control (100% white wheat flour), the lowest baking losses, volumes and diameters are found. It has

been established that when increasing the quantity of barley flour in white wheat flour and barley flour biscuits, the baking loss decreases, and the volume and thickness of the biscuits also decreases. On the other hand, in white wheat flour biscuits and einkorn flour biscuits, when increasing the amount of einkorn flour in the formulation, the baking loss decreases, and the volume and thickness of the biscuits increase.

REFERENCES

- AACC Method 10-50D (2000). Baking Quality of Cookie Flour, *Approved Method of the American Association of Cereal Chemists*, 10th ed. AACC, ST. Paul.
- Baik, BK & Ullrich, SE. (2008). Barley for food: Characteristics, improvement, and renewed interest. *Journal of Cereal Science*, 48 pp: 233 – 242.
- Chauhan, A., Saxena, D.S. & Singh, S.(2016). Physical, textural, and sensory characteristics of wheat and amaranth flour blend cookies. *Cogent Food & Agriculture*, 2: 1125773.
- Chopra, N., Dhillon, B. & Puri, S. (2014). Formulation of Buckwheat Cookies and their Nutritional, Physical, Sensory and Microbiological Analysis. *International Journal of Advanced Biotechnology and Research*, Vol 5 (3) pp: 381 - 387.
- Dabija, A. & Paius, A.M. (2015). Study on Flour Quality Assessment Designed to obtain Biscuits, *Journal of Faculty of Food Engineering Stefan cel Mare University of Suceava Romania*, Vol XIV, Issue-2, pp: 218 - 222.
- Divyashree, K., Ashwath Kumar, K., Sharma G.K., Semwal, A.D & Umesha (2016). Development and Storage Stability of Buckwheat - Chia Seeds Fortified Biscuits, *Intl. J. Food. Ferment. Technol.* 6(1) pp: 95 – 106.
- Dogan, I.S. (2006). Effect of Oven Types on the Characteristics of Biscuits Made from Refrigerated and Frozen Doughs, *Food Technology and Biotechnology*, 44 (1), pp: 117 - 122.
- Goudar G. & Sathisha, GJ. (2016). Effect of extrusion and flaking on the retention of nutrients and phenolic compounds in millet grains, *International Journal of Food Science and Nutrition*, Vol. 1(4), pp: 08-11.
- Gupta, M., Bawa, A. S. & Abu-Ghannam, N. (2011). Effect of barley flour and freeze thaw cycles on textural nutritional and functional properties of cookies. *Food Bioproducts Processing*, 89, pp: 520 – 527.
- Gurung, B., Ojha, P. & Subba, D. (2016). Effect of Mixing Pumpkin Pure with Wheat Flour of Physical, Nutritional and Sensory Characteristics of Biscuits. *J. Food Sci. Technol*, Nepal Vol.9 pp: 85 - 89.
- Jothi, J., Hashem, S., Rana, M., Rahman, M.R.T. & Shams-Ud-Din, M. (2014). Effect of Gluten-free Composite Flour on Physico-chemical and Sensory Properties of Cracker Biscuits. *Journal of Scientific Research* 6 (3). pp: 521 - 530.
- Kaur, J., Nagi, P.S., Sharma, S. & Dar, B.N. (2012). Physico-Chemical and Sensory Quality of Cereal Bran Enriched Biscuits. *J. Dairying, Foods & H.S.* 31(3) pp:176-183.
- Koceva Komlenić, D., Jukić, M., Kosović, I. & Kuleš, A. (2014). Tehnologija proizvodnje i prerade brašna, *Prehrambeno-tehnološki fakultet Osijek* (upute za laboratorijske vježbe).
- Marković, S. M., Đukić, N. H., Knežević, D. & Leković, S. V. (2017). Divergence of barley and oat varieties according to the content of β -glucan. *Journal of the Serbian Chemical Society*, doi: 10.2298/JSC1610310010M.
- Nakov, Gj., Ivanova, N., Damyanova, S., Yordanova, L., Godjevrgova, T. & Necinova Lj. (2016). Production and analysis of biscuits fortified with einkorn flour. *I International scientific and practical internet-conference Biotechnology: experience, traditions and innovations*, Kyiv, NUFT, Ukraine, pp: 80 – 85.
- Nakov, Gj., Stamatovska, V., Ivanova, N., Damyanova, S. & Necinova, Lj. (2016). Nutritional Properties of Einkorn Wheat (*Triticum monococcum* L) - Review. *55th Science Conference of Ruse University*, Bulgaria, pp: 381 – 384.

Nakov, Gj., Stamatovska, V., Necinova, Lj., Ivanova, N. & Damyanova, S. (2016c). Sensor analysis of functional biscuits. *Ukrainian Food Journal*, No 5, pp: 56-62.

Preedy, R.V., Ross Watson, R. & Patel, B.V. (2011). Flour and Breads and their fortification in health and disease prevention, *Elsevier*, pp.85-87.

Sharma, P. & Gujral, H. S. (2014). Cookie making behavior of wheat barley flour blends and effects on antioxidant properties. *LWT - Food Science and Technology*, 55 pp: 301 – 307.

Stamatovska, V., Kalevska, T., Menkinoska, M., Nakov, Gj., Uzunoska, Z. & Mitkova, L. (2016). Correlations between quality of flour t-500 characteristics and bread volume. *Journal of Faculty of Food Engineering, Ștefan cel Mare University of Suceava, Romania*, No XV, pp: 46-56.