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# METHOD FOR OBTAINING A CAKE FROM MIXED FLOURS FROM RYE, OATS AND TRITICALE

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***Abstract***

*The aim of the study was to establish a method for obtaining a cake from mixes of rye, oats and triticale.*
*The physicochemical, fatty acid and mineral composition of oat flour, rye and triticale was studied. A series of attempts were made for trial laboratory baking of cake from the mixes. A technological scheme of the technological process has been established. The quality indicators of the finished product have been studied. Organoleptic evaluation and qualitative characteristics of the cake were performed. The cake contains functional ingredients such as soluble and insoluble fiber, β-glucans, macroelements, microelements, fatty acids composition. The cake is rich in oleic and linoleic acid. The finished product is rich in K, Fe and Zn.*

***Key words****: cake, oats, rye, triticale, β-glucans, macroelements, trace elements, fatty acids composition.*

## INTRODUCTION

Cereals account for about 60% of world food production, which is why science is focused on obtaining functional cereal-based foods. As foods, they are relatively cheap and at the same time are a source of β-glucans (oats), unsaturated fatty acids (oats), micro and macronutrients, B vitamins (Karadzhov, 2007).
Rye flour has advantages over wheat because it is richer in useful health fiber. Rye flour contains 8 ÷ 15% protein and fat in different varieties of rye is about 1.6% (Andon, 2008; Borisova, 2015).
Laguerre et al. (2007) in their research on the combination of maize and rye flour, they found that palmitic (C16: 0), oleic (C18: 1) and linoleic (C18: 2) acids were the main fatty acids in the various cake combinations, such as the content of C18: 2 accounts for 52% of the total fatty acids (Stabler & Allen, 2004; Laguerre et al., 2007; Mc Afee et al., 2010; Arendt, 2012). The fatty acid composition of oats consists mainly of three fatty acids - palmitic (C16: 0), oleic (C18: 1) and linoleic (C18: 2), the amount of which exceeds 95% and a small amount of fatty acids, such as stearic (C18: 0), linolenic (C18: 3) etc. (Mangova, 2003; Borisova, 2015). Triticale is one of the alternative raw materials for the production of bread, bakery and confectionery products with a higher protein and lysine content (Vangelov, 1999; Borisova, 2016). The fatty acids composition of triticale, established by Stabler & Allen (2004) includes linoleic (C18: 2) - 59.3, oleic (C18: 1) - 15.0 and palmitic acid (C16: 0) - 18.6 g/100 g fat. Morrison (1977) found total triticale fat content of 3.2 to 4.6 g/100 g fat, linoleic 57-59 g/100 g fat and linolenic acid 3 to 4 g/100 g fat. The aim of the study was to establish a method for obtaining a cake from mixes of rye, oats and triticale.

## MATERIALS AND METHODS

The flours used in this scientific work are the production of whole-grain rye-produced by the company "Techra", whole-grain oat-produced by SD "Prosperity", refined triticale variety 'Vihren' Bulgarian type, obtained on a laboratory roller mill with separation of the grass part.
Methods for determining the chemical composition of flour:
An ash content analysis was performed in Institute of Cryobiology and Food Technology, Sofia - BDS ISO 2171: 1999. An analysis

about the total protein content was performed in Institute of Cryobiology and Food Technology, Sofia - Keldal (N x 6.25). An analysis starch content was performed in Institute of Cryobiology and Food Technology, Sofia - Everst polarimetric method. An analysis about the fats content was performed in Institute of Cryobiology and Food Technology, Sofia - extraction with ether. An analisys macro- and trace elements are determined on an atomic emission photometer - AES-ICP "Varian-Liberty II" in laboratory on Bulgarian Safety Foods Agency, Sofia. An analysis about the β-glucans are determined according to ICC standard No. 166 in Institute of Cryobiology and Food Technology, Sofia. The fatty acids/ FAME/were analyzed using a Shimadzu-2010 gas chromatograph in State University, Tetovo, R.N. Macedonia (FAO/WHO, 1991; Reg. EU 1924/2006; Reg. EU 432/2012).

## RESULTS AND DISCUSSIONS

The chemical composition of the studied flours is presented in Table 1. The table shows that oatmeal and rye flour and their respective mixes have a higher ash content than wheat flour, where the content is 0.53%. The proteins and starches of rye flour and its mixtures are lower than white flour. Rye flour contains 2.10% β-glycans, oat 5%, and rye and oat mix contains 1.65%.

Table 1. Chemical composition of the starting flours and mix

| Type of Sample | Moisture, % | Ash, % | Protein, % | Starch, % | Fat, % | β-glucans, % |
|---|---|---|---|---|---|---|
| Flour Type 500 | 12.70 | 0.53 | 10.32 | 83.69 | 0.96 | - |
| Oats Flour | 11.19 | 5.00 | 17.50 | 58.00 | 8.40 | 5.00 |
| Whole grain rye flour | 9.27 | 1.74 | 8.56 | 66.20 | 1.52 | 2.10 |
| Rye flour type 1750 | 9.27 | 1.75 | 9.30 | 65.15 | 1.77 | 2.00 |
| Triticale flour, 15% oats flour, 45% rye Flour | 10.49 | 1.87 | 9.70 | 71.87 | 1.63 | 1.65 |
| Triticale flour | 13.45 | 1.23 | 9.70 | 67.06 | 1.31 | - |

The fatty acid profile of the different types of flours and mixtures is presented in Table 2. The studied flours are dominated by linoleic (C18: 2) acid from 38.70 (oatmeal) to 58.81 (triticale flour) g/100 g fat and linolenic (C18: 3) from 1.24 g/100 g fat in oats to 5.26 g/100 g fat in rye flour. In the case of a mixture, the content of linoleic and linolenic acid is 52.75 g/100 g of fat and 6.63 g/100 g of fat in rye, oat and triticale flour.

Table 1 shows the large differences in the values of ash, fat and beta-glucans in triticale flour and rye flour, but this is typical for the flours of the respective cereals.

Table 2. Fatty acid composition of oat flour variety 'Mina', rye and triticale variety 'Vihren' and a mixture of flour (g/100 g fat)

| Fatty acids Composition | Oats flour | Rye Flour | Mix rye, oats, Triticale flours | Triticale Flour |
|---|---|---|---|---|
| C-18:1c9 | 34.59 | 16.31 | 16.97 | 15.67 |
| C-18:2c9,12 | 38.70 | 48.31 | 52.75 | 58.81 |
| gC-18:3n6 | 0.00 | 0.00 | 6.63 | 0.01 |
| aC-18:3n3 | 1.24 | 5.26 | 5.19 | 4.12 |
| C-20:3n6 | 0.00 | 11.29 | 0.01 | 0.00 |
| ΣCLA | 0.01 | 0.03 | 0.01 | 0.00 |
| Σ C-18:1Trans-FA | 1.21 | 1.04 | 1.03 | 1.12 |
| Σ C-18:1Cis-FA | 34.60 | 16.33 | 16.99 | 15.78 |
| SFA | 21.01 | 16.27 | 15.76 | 19.01 |
| MUFA | 37.44 | 18.60 | 19.39 | 17.80 |
| PUFA | 40.22 | 65.07 | 64.69 | 63.14 |
| Σ n-3 | 1.30 | 5.28 | 5.20 | 4.12 |
| Σ n-6 | 38.91 | 59.77 | 59.49 | 59.08 |
| Σ n-6/Σn-3 | 29.93 | 11.32 | 11.43 | 14.35 |

The β-glucans in oats flour is 5.00%, in triticale flour have not β-glucans, in whole grain rye flour has 2.10% β-glucans. The ash in out flour is 5.00%, in triticale flour have 1.23%, in whole grain rye flour has 1.74%. The protein in out flour is 17.50%, in triticale flour have 9.70%, in whole grain rye flour has 8.56%.

The macro and trace microelement composition of the different types of flour is presented in Table 3. Of the studied samples, the highest content of calcium, magnesium and phosphorus was found in oat flour, respectively - 652 mg/kg, 1337 mg/kg and 5388 mg/kg, potassium in rye flour - 4069.5 mg/kg and sodium in triticale flour - 36.73 mg/kg. The oats flour variety 'Mina' are best supplied with copper - 7.39 mg/kg, manganese - 51.80 mg/kg and zinc - 31.90 mg/kg compared to other types of flour. Triticale flour has the highest concentration of iron - 41.24 mg/kg.

Table 3. Content of macro- and trace elements in oat flour variety 'Mina', rye and triticale variety 'Vihren' and flour mixture, mg/kg

| Type of sample | Macroelements, mg/kg | | | | | Trace elements, mg/kg | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Ca | K | Mg | Na | P | B | Ba | Cu | Fe | Mn | Zn |
| Oat flour variety 'Mina' | 652 | 3309 | 1337 | 22.80 | 5388 | 3.02 | 1.12 | 7.39 | 39.60 | 51.80 | 31.90 |
| Rye flours | 350.60 | 4069.50 | - | 7.77 | - | - | - | 2.71 | 15.29 | | 13.89 |
| Mix rye, oat, triticale | 383 | 2020 | - | 17.40 | - | - | - | 3.39 | 21.7 | - | 13.7 |
| Triticale flour 'Vihren' | 324.25 | 2839 | 754.40 | 36.73 | 1808 | 4.38 | 1.84 | 1.96 | 41.24 | 24.46 | 15.05 |

Trial laboratory baking of a cakes made of mixed flours - rye, oats and triticale.

Prescription formula OPTION 1:

45% rye flour, 10% g oat flour, 30% triticale flour, baking powder 1 packet, Baking soda 5 g, vanilla 1 packet, lecithin 1 g, sunflower oil 86 g, granulated sugar 300 g, fresh milk 250 ml, 6 fresh eggs , cocoa for decoration.

Beat the eggs with the sugar. Add fresh milk, baking powder, baking soda, vanilla, sunflower oil. Beat well with a mixer at high speed.

Add the flour in portions, stirring until a cake batter is obtained. Cocoa is added to part of the dough, which is used to decorate the cake. Bake at $200^0$C for 45 minutes. After cooling, sprinkle with powdered sugar.

Quality and sensory evaluation of the finished cake:

It is a rectangular cake with the correct shape. The upper crust has a golden to reddish tinge, normal thickness and characteristic cracking, sprinkled with powdered sugar. The color in the middle is golden to reddish hue with reddish particles and cocoa decoration. The middle is soft to the touch, baked with a small porosity. The taste is characteristic and slightly sweet. It has a pleasant aroma, typical for this type of cake (Lim et al., 2009).

Prescription formula OPTION 2:

50% rye flour, 15% g oat flour, 30% triticale flour, baking powder 1 packet, Baking soda 5 g, vanilla 1 packet, lecithin 1 g, sunflower oil 86 g, granulated sugar 300 g, fresh milk 250 ml, 6 fresh eggs , cocoa for decoration.

Beat the eggs with the sugar. Add fresh milk, baking powder, baking soda, vanilla, sunflower oil. Beat well with a mixer at high speed.

Add the flour in portions, stirring until a cake batter is obtained. Cocoa is added to part of the dough, which is used to decorate the cake. Bake at $200^0$C for 45 minutes. After cooling, sprinkle with powdered sugar.

Quality and sensory evaluation of the finished cake:

It is a rectangular cake with the correct shape. The upper crust has a golden to reddish tinge, normal thickness and characteristic cracking, sprinkled with powdered sugar. The color in the middle is golden to reddish hue with reddish particles and cocoa decoration. The middle is soft to the touch, baked with a small porosity. The taste is characteristic and slightly sweet. It has a pleasant aroma, typical for this type of cake (Lim et al., 2009).

Prescription formula OPTION 3:

55% rye flour, 25% g oat flour, 30% triticale flour, baking powder 1 packet , Baking soda 5 g, vanilla 1 packet, Lecithin 1 g, sunflower oil 86 g, granulated sugar 300 g, fresh milk 250 ml., 6 fresh eggs, cocoa for decoration. Beat the eggs with the sugar.

Table 4. Chemical composition of the cakes

| Type of sample Cake | β-glucans, % | Ash, % | Proteins, % | Fiber, % | Fat, % | Carbohydrates, % | Energy value, kcal/100 g product |
|---|---|---|---|---|---|---|---|
| 30% Triticale flour, 10% oats flour, 45% rye Flour | 1.65 | 1.87 | 11.70 | 7.27 | 3.48 | 32.84 | 229 |
| 30% Triticale flour, 15% oats flour, 50% rye Flour | 2.15 | 1.70 | 12.30 | 8.90 | 3.59 | 33.59 | 230 |
| 30% Triticale flour, 25% oats flour, 55% rye Flour | 3.07 | 1.75 | 13.20 | 9.67 | 3.69 | 36.18 | 230 |

Add fresh milk, baking powder, baking soda, vanilla, sunflower oil. Beat well with a mixer at high speed. Add the flour in portions, stirring until a cake batter is obtained. Cocoa is added to part of the dough, which is used to decorate the cake. Bake at 200 $^0$C for 45 minutes. After cooling, sprinkle with powdered sugar. Table 4 shows chemical composition of the cakes (option 1, option 2 and option 3). The β-glucans in option 1 is 1.65%, in option 2 has 2.15% β-glucans, in option 3 has 3.07% β-glucans. The ash in option 1 is 1.87%, in the option 2 is 1.70%, in option 3 is 1.75%.

Quality and sensory evaluation of the finished cake:

It is a rectangular cake with the correct shape. The upper crust has a golden to reddish tinge, normal thickness and characteristic cracking, sprinkled with powdered sugar. The color in the middle is golden to reddish hue with reddish particles and cocoa decoration. The middle is soft to the touch, baked with a small porosity. The taste is characteristic and slightly sweet. It has a pleasant aroma, typical for this type of cake (Lim et al., 2009).

The protein in option 3 is the most 13.20%. The fiber in option 3 is the most 9.67%.

Carbohydrates = 100-(moisture + fats + proteins + ash + fibers) %

Energy value = (proteins x 4.1 + % carbohydrates x 4.1 + % fats x 9.1 + % fibers x 2) = kcal/100 g product

In a mixture, the linoleic and linolenic acid content is 52.75 g/100 g fat in option 2 and 6.63 g/100 g fat, respectively. In a mixture, the linoleic and linolenic acid content is 52.70 g/100 g fat in option 1 and 5.45 g/100 g fat, respectively. In a mixture, the linoleic and linolenic acid content is 52.78 g/100 g fat in option 3 and 6.60 g/100 g fat, respectively (Table 5).

Table 6 shows the qualitative assessment of the cakes options 1, 2, 3. They are with a small differences in mass, volume, moisture and acidity.

The option 3 has most mass and acidity.

Table 5. Fatty acids composition of the cakes, g/100 g fat

| Type of sample Cake | Mass, g | Volume, sm$^3$ | L, Mm | H, mm | W, mm | Moisture, % | Acidity, ◦H |
|---|---|---|---|---|---|---|---|
| 30% Triticale flour, 10% oats flour, 45% rye Flour | 218 | 625 | 120 | 70 | 81 | 42.84 | 4.9 |
| 30% Triticale flour, 15% oats flour, 50% rye Flour | 219 | 630 | 120 | 70 | 81 | 40.50 | 5.1 |
| 30% Triticale flour, 25% oats flour, 55% rye Flour | 220 | 630 | 120 | 70 | 81 | 41.50 | 5.2 |

Table 6. Qualitative assessment of the cakes

| FA | Option 1 | Option 2 | Option 3 |
|---|---|---|---|
| C-18:1c9 | 17.48 | 16.97 | 17.34 |
| C-18:2c9,12 | 52.70 | 52.75 | 52.78 |
| gC-18:3n6 | 5.45 | 6.63 | 6.60 |
| aC-18:3n3 | 6.12 | 5.19 | 5.20 |
| C-20:3n6 | 0.01 | 0.01 | 0.01 |
| ΣCLA | 0.01 | 0.01 | 0.01 |
| Σ C-18:1Trans-FA | 1.00 | 1.03 | 1.01 |
| Σ C-18:1Cis-Fa | 17.03 | 16.99 | 17.03 |
| SFA | 15.73 | 15.76 | 15.74 |
| MUFA | 19.45 | 19.39 | 19.38 |
| PUFA | 63.56 | 64.69 | 64.73 |
| Σ n-3 | 5.30 | 5.20 | 5.39 |
| Σ n-6 | 57.19 | 59.49 | 58.19 |
| Σ n-6/Σn-3 | 11.45 | 11.43 | 11.59 |

Figure 1. Cake cut option 3

The macro and trace elements composition of the cakes is presented on the Table 7.
The finished products are rich in K, Fe, and Zn. Na and Cu are in smaller quantities.
The mineral composition of triticale, established by Mihalkova et al. (2014) of bread is Fe 11.80 mg/kg, Zn 10.60 mg/kg.

Table 7. Macroelements and trace elements of the cake, mg/kg

| Type of sample | Macroelements, mg/kg | | | | | Trace elements, mg/kg | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Cake | Ca | K | Mg | Na | P | B | Ba | Cu | Fe | Mn | Zn |
| Option 1 | 383 | 2020 | 1.30 | 17.40 | 1.30 | 0.16 | 0.40 | 3.39 | 21.70 | 0.20 | 13.70 |
| Option 2 | 356 | 2022 | 1.30 | 18.30 | 1.50 | 0.21 | 0.34 | 3.56 | 22.40 | 0.20 | 13.70 |
| Option 3 | 378 | 2054 | 1.40 | 18.60 | 1.50 | 0.21 | 0.25 | 3.78 | 23.50 | 0.20 | 13.70 |


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## CONCLUSIONS

The productions of cakes with functional ingredients such as soluble and insoluble fiber, β-glucans, unsaturated fatty acids, minerals and vitamins can play a positive role in the health of the mass consumer if these foods are produced with the required quality and at an affordable price. In this study we found out that cakes we made have low content of with omega-6 and omega-3 fatty acids.

The cakes are richest in oleic and linoleic acid. The finished products are rich in K, Fe and Zn. According to the aim of the study, there was to establish a method for obtaining a cake from mixes of rye, oats and triticale. The best option is 3 with 30% triticale flour, 25% oats flour, 55% rye flour.

## REFERENCES


Andon, M. B., Anderson, J. W. (2008). State of the Art Reviews: The Oatmeal-Cholesterol Connection: 10 Years Later. *American J. of Lifestyle Medicine*, 2(1), 51-57.

Arendt, E. K. (2012). Applications of microbial fermentations for the production of gluten-free products and perspectives. *Applied Microbiology and Biotechnology*, 93, 473-485.

Borisova, I. (2015). Obtaining gluten-free bread with the help of hydrocolloids. Scientific Conference with International Participation "Nutrition Science, Techniques and Technologies", Plovdiv UFT, 43-48.

Borisova, I. (2016). Technological indicators for obtaining gluten-free bread intended for specific health needs. Fourteenth National-Youth Scientific and Practical Conference, Collection of Reports, National House of Science and Technique, CD-R, 140-145, Sofia.

Karadzhov, G., Vassileva, R., Nikolova, M. (2007). *Bread, Bakery and Confectionery Technology.* Sofia, Matcom Ltd.

Laguerre, M., Lecomte, J., Villeneuve, P. (2007). Evaluation of the ability of antioxidant to counteract lipid oxidation: existing methods, new trends and challenges. *Progress in Lipid Research*, 46, 244-282.

Lim, J., Wood, A. G. B. (2009). Green Derivation and evaluation of a labeled hedonic scale. *Chemical Senses*, 34, 739-751.

Mangova, M. (2003). Technological quality and nutrient value of rye. Cultiver millennium, Hrana i ishrana, 44, 1-2, 22-23.

Mc Afee, A. J., McSorley, E. M., Cuskelly, G. J., Moss, B. M., Wallace, J. M. W., Bonham, M. P., Fearon, A. M. (2010). Red meat consumption: an overview of the risks and benefits. *Meat Science*, 84, 1-13.

Mihalkova, N., Ivanova, S., Angelov, L. (2014). Obtaining bread with healthy ingredients a mixture of rye, oat and wheat flour. *Journal of Mountain of the Balkans*, 17, 5, 1200-1209.

Morrison W. R. (1977). *Cereal lipids*. Proc. Nutr. Soc., 36, 143-148.

Stabler, S. P., Allen, R. H. (2004). Vitamin B12 deficiency as a worldwide problem. *Annual Review of Nutrition*, 24, 299-326.

Vangelov, A. (1999). Raw materials for production of bread, bakery and confectionery. Sofia, Matcom, Ltd.

***Food and Agriculture Organization of the United Nations/World Health Organization (FAO/WHO), (1991). Protein quality evaluation. http://www.fao.org/docrep/013/t0501e/t0501e00.pdf.

***Regulation EU 1924/2006, (2006, December 20) No. 1924/2006 of the European parliament and of the council on nutrition and health claims made on foods. *Official Journal of the European Union*, L404, 9-25.

***Regulation EU 432/2012, (2012, May 16) Commission Regulation (EU) No. 432/2012 establishing a list of permitted health claims mad on foods, other than those referring to the reduction of disease risk and to children‘s development and health. *Official Journal of the European Union*, L136, 1-40.