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OBTAINING AND NUTRITIONAL CHARACTERISATION OF FUNCTIONAL BISCUITS WITH CEREAL GERMS AND *MOMORDICA CHARANTIA* EXTRACT

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Abstract

Because of the high content of active principles and better bioavailability of nutritional compounds, sprouted grain flours are used in functional and dietary foods composition. Using white wheat flour, germinated wheat flour in different percent and Momordica charantia extract (with hypoglycemic effect), we obtained a dietary product, the MOMGERMBISC biscuits, which was characterized in terms of nutritive and energetic contribution. Proximate composition (humidity, protein content, fat content, ash, alkalinity) was determined according SR ISO methods. Also, it was determined the carbohydrate content and energy value of biscuits. The product is distinguished by a protein and lipid content, comparable with simple biscuits, but with an increased intake of minerals. The energy value of the biscuits with the addition of germinated wheat flour falls within the range between 449.1 and 453.44 kcal. The carbohydrate content of the biscuits with the addition of M.charantia and sprouted wheat is between 67.1 and 70.61%. The content of carbohydrates and energetic value is reduced, the product being recommended in hypoglycemic diet.

Key words: *germinated cereals, Momordica charantia extract, biscuits.*

INTRODUCTION

Current trends in nutrition are oriented to functional foods consumption with an important biological role in all metabolic processes of the body. In health insurance, functional foods promotes body growth and development, optimize the metabolic processes, physiological activity of organs, immune system, cognitive performance and the defense against oxidative stress (Hurgoiu, 2004). Also called protection food, functional food can be used for a long time without causing secondary negative reactions, having cytoprotective and fortifying effects, increasing the body's natural immunity (Dawidziak et al., 2014). Cereals represent the first vegetable matrices used as functional foods. It is known the role of dietary fiber from cereals in ensuring a healthy diet (Alexa, 2009). Germination as a process of grain processing, leading to a significant increase in the content of bioactive compounds (vitamins, bioelements, enzymes) of the product, transforming it from food in functional product (Alexa et al., 2009). Germinated cereal flours have a higher bioavailability of nutritive compounds and in combination with medicinal herbs extracts permit the production of functional foods. Germinated wheat is the ideal food for a perfectly healthy diet. Given the large number of nutrients that are found in wheat germ, they bring a multitude of benefits to our health, being an important source of protein, unsaturated fats, fiber, vitamins A, B_1, B_2, B_6, D, E and K, iron, phosphorus, magnesium and zinc. Germinated wheat are recommended in treating anemia, but also helps to strengthen the immune system, protects the muscles, circulatory system, lungs and improves visual acuity. Being very rich in antioxidants, they protect our cells against free radical damage. Treatment with wheat germ is indicated for strengthening immunity being recommended for older people and children. The chemical composition of germinated cereals and their positive effect on organism have been reported in previous studies. (Donkor et al., 2012; Hidalgo et al., 2013; Bennett et al., 2013; Marton, 2010; Pandhre, 2011). Also, the positive effect of plant extracts

in alimentation was previously investigated. The seeds obtained from the fruit *Momordica charantia,* called bitter cucumber or vegetable insulin, have many health benefits. Juice of *Momordica charantia* is indicated for the relief of type 2 diabetes, metabolic syndrome and dyslipidemia (Sarandan et al., 2010). It also strengthens the immune system, especially in adolescents, people with advanced age, smoking, or who suffer from alcoholism. The aim of the research was to obtain a dietary product from white wheat flour, wheat flour germinated in different percentage and *Momordica charantia* extract (with hypoglycemic effect), nutritional and energetic characterization of the product for patients with type 2 diabetes.

MATERIALS AND METHODS

Fabrication of biscuits. The raw material used to obtain MOMGERMBISC is represented by white wheat flour, sprouted wheat flour, *Momordica charantia* extract, butter and sugar. The producing recipe is presented in Table 1. Technological stages of the product are: dosage of auxiliary raw materials according to the producing recipe, kneading of the dough, modeling of the dough into characteristic forms, baking at 180^0C, for 20 minutes, cooling and storage. (Alexa, 2004; Alexa, 2010).

Table 1. Production recipes

Biscuits with added	MOMGERMBISC I	MOMGERMBISC II	MOMGERMBISC III
Wheat flour	500 g	500 g	500 g
Butter	250 g	250 g	250 g
Germinated wheat flour	40 g	65 g	90 g
Momordica extract	10 g	10g	10 g
Egg yolk	16 g	16 g	16 g
Honey	50 g	50 g	50 g
Baking powder	1 g	1 g	1 g

Chemical and nutritional characterization. Proximate composition was determined according SR ISO methods: humidity SR ISO 6496/2001, protein content SR EN ISO 5983-1/2006/AC: 2009, fat content SR ISO 6492/2001, ash SR ISO 5984. Determination of biscuits alkalinity was done according SR ISO 1227/3-90. All analyses are performed in triplicate and the reported value represents the average. The carbohydrate content was determined by difference.

Energy value, respectively caloric intake was calculated by summing of caloric intake given by fats, carbohydrates and proteins, considering the following: 1 g fat = 9 kcal, 1 g protein = 4 kcal, 1 g carbohydrate = 4 kcal.

Statistical data analysis. Data processing was performed by analysis of variance and *t*-test (Ciulca, 2006).

RESULTS AND DISCUSSIONS

Figure 1 presents images with obtained biscuits. Figure 2 shows the proximate composition (moisture, fat, protein, ash) and in figure 3 carbohydrates content and energetic value of MOMORGERM biscuits are presented.

Figure 1. *Biscuits with wheat germ and Momordica charantia extract*

By comparing the obtained humidity quality with standards of quality for biscuits is observed that they fall within the limits of admissibility for all samples, so humidity is less than 9% (Figure 2).

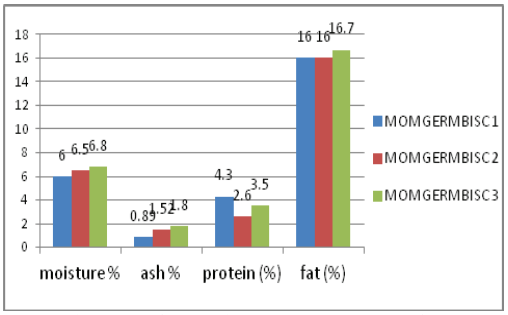


Figure 2. The proximate composition of the MOMGERMBISC biscuits

The ash content of the biscuits with the addition of *M.charantia* and germinated wheat is superior to ordinary gluten biscuits (0.22%) or sugar biscuits (0.42%) reported in literature, contributing to the high nutritional value of the

finished product. Mineral food supplement is due to the addition of bitter cucumber (*M.charantia*) representing a matrix rich in micro- and macroelements. Maximum mineral content is at the addition of 20% mixture. Proteic content of biscuits with germinated wheat and *M.charantia* added is low, but it is within the limits of admissibility reported for gluten and sugar biscuits (Figure 2). The fat content of simple biscuits varies in restricted limits (16 to 16.7%). Lipid contribution is given by animal fat (butter) introduced in the formulation which, used vegetable matrices having a low fat (Figure 2). The product obtained has high lipid content and its use is not recommended in the diet of the population with metabolic disorders, cardiovascular or indications for a hypolipidic diet.

The carbohydrate content of the biscuits with the addition of *M.charantia* and sprouted wheat (Figure 3) is between 67.1 and 70.61%. The addition of *M. charantia* leads to a reduction in carbohydrate content, which recommends these products for use in hypoglucidic diet.

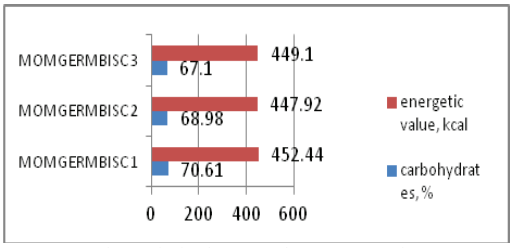


Figure 3. The carbohydrates and energetic value content of MOMGERMBISC biscuits

From the results of the Table 1 it is observed that MOMGERMBISC 1 biscuits associate highest values for protein and carbohydrate content and MOMGERMBISC 3 associates moisture, minerals and fat content. MOMGERMBISC 2 shows the mean values except protein content which is the lowest of all three types of biscuits analyzed. Also, the fat content has the same value as biscuits MOMGERMBISC 1.

The energy value of the biscuits with the addition of germinated wheat flour falls within the range between 449.1 and 453.44 kcal and is comparable with values reported in the literature (Alexa, 2010).

The biscuit assortments alkalinity value obtained is less than 3%, falling within the admissibility standards.

The content of mineral substances and lipids had the highest values at the MOMGERMBISC 3 biscuits type, thus demonstrating the supplementary mineral contribution by the addition of wheat germ flour to wheat flour.

High fat content due to the addition of wheat germ flour, make a significant contribution of unsaturated fatty acids, increasing the nutritional value of the product. Protein content presented maximum values at the MOMGERMBISC 1 biscuits.

Statistical analysis of the values obtained by measurements shows that the humidity, minerals and fat content of MOMGERMBISC 3 product were significantly superior to other types of biscuits analyzed. Product MOMGERMBISC 1 showed a significantly higher value compared to other varieties in terms of protein content (Table 2).

The assortment of biscuits MOMGERMBISC 3 presented superior to average about significant values on humidity, minerals and fats and MOMGERMBISC 1 recorded significantly lower than the mean values of these attributes, but the value was significantly superior to average about protein content. MOMGERMBISC 2 shows a significant value, lower than the average in protein content. With turning to the energy, alkalinity and carbohydrate content of varieties of biscuits (Table 3), the highest values for all these qualities stand out from the assortment of biscuits MOMGERMBISC 1. It is found that the values obtained for these three qualities vary inversely with content of germinated wheat flour added to wheat flour. The lowest values were obtained from cookies MOMGERMBISC 3. For a hypoglucidic diet is recommended MOMGERMBISC 3.

The low energy value (449.10 kcal) of MOMGERMBISC 3 also determines ownership of this product diet and increased acidity in comparison with the other two types of biscuits, due to higher amounts of enzymes, which gives superior nutritional value.

Table 2. Humidity and contents of minerals, proteins and lipids of the biscuits varieties

Assortment biscuits	Humidity (%)	Minerals (%)	Proteins (%)	Lipids (%)
MOMGERMBISC 1	6,00b	0,89b	**4,30a**	16,00b
MOMGERMBISC 2	6,50ab	1,52ab	2,50b	16,00b
MOMGERMBISC 3	**6,80a**	**1,80a**	3,50ab	**16,70a**
Average	**6,43±0,23**	**1,40±0,27**	**3,43±0,52**	**16,23±0,23**
DL5%	0,64	0,73	1,42	0,64
DL1%	1,00	1,15	2,23	1,00
DL0,1%	1,70	1,96	3,79	1,70

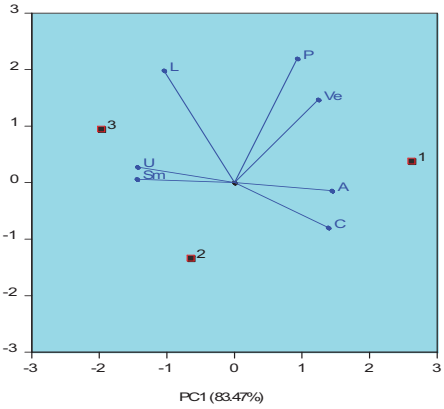
There are considered significant differences between genotypes denoted by different letters

Table 3. The energy value, alkalinity and carbohydrate content for varieties of biscuits

Assortment biscuits	Energy value (kcal)	Alkalinity	Carbohydrates (%)
MOMGERMBISC 1	**452,44a**	**2,70a**	**70,61a**
MOMGERMBISC 2	447,92a	2,50ab	68,98a
MOMGERMBISC 3	449,10a	2,40b	67,10a
Average	449,82±1,35	2,53±0,09	68,90±1,01
DL5%	4,92	7,72	13,15
DL1%	0,24	0,38	0,64
DL0,1%	3,69	5,78	9,85

There are considered significant differences between genotypes denoted by different letters

Following statistical analysis it was found that only in terms of alkalinity was no significant difference. The biscuits were worth one MOMGERMBISC significantly superior to those found in other varieties and the average. MOMGERMBISC 3 showed a significantly lower value compared to other varieties and the average.



U-Humidity; Sm-Minerals; P-Proteins; L-Lipids; Ve-Energetic value; A-Alkalinity; C-Carbohydrates.

Figure 4. Biplot for biochemical features of different biscuits types

Biplot representing the biochemical characterristics of varieties of biscuits (Figure 8) shows that MOMGERMBISC 1 associates the values significantly higher of carbohydrate content, acidity, energy and protein compared to the average. MOMGERMBISC 3 relates signifycantly superior values of fat content, minerals and moisture.

CONCLUSIONS

Biscuits with added germinated wheat flour and *Momordica charantia* extract represents a functional product with hypoglycemic value and additional contribution of macro- and microelements, which contributes to improving the health of the population segment that uses this type of product.

Momordica charantia addition ensure faster and easier metabolizing of carbohydrates (due to hypoglycemic active principles), which recommends the product in the diet of patients with type 2 diabetes (noninsulinodependent).

The protein content is low, but the lipid content is high, so that the product is not recommended in the diet of patients with metabolic diseases, cardiovascular or indications for hypolipidic diet.

REFERENCES

Alexa, E. (2004). *Tehnologia alimentelor făinoase*, Ed. Eurobit;

Alexa, E. (2009). Dietetic flouring supplies for children nourishment, *Journal of Agroalimentary Processes and Technologies*, Timişoara, XIII(1), 163-168;

Alexa, E. (2010). *Alimente făinoase dietetice. Materii prime, caracterizare, tehnologii de obţinere*, Ed. Eurobit, Timişoara;

Alexa, E., Voica, V.D., Stoin, D., Pop, G., Rosu, I., Negrea, M. (2009). Reserches concerning the physical-chemical and rheological properties of ecological flours, *Analele Universitatii din Oradea - Fascicula Chimie XVI*, ISSN 1224-7626, 19-24;

Bennett, R., De Vasconcelos, M.C.B.M., Castro, C., Cardoso, P., Saavedra, M.J., Rosa, E.A. (2013). Study of composition, stabilization and processing of wheat germ and maize industrial by-products, *Industrial Crops and Products,* 42, 292–298;

Ciulca, S., (2006). Metodologii de experimentare în agricultură şi biologie, Timişoara, România: Agroprint;

Dawidziak, M., Piasecka, Kwiatkowska, D., Warchalewski, J.R., Makowska, A., Gawlak, M., Nawrot, J. (2014). Sprouted wheat grain with ferritin overexpression as a potential source of iron for cereal product fortification, *Eur. Food Res. Technol.,* 238, 829-835;

Donkor O.N., L. Stojanovska, P. Ginn, J. Ashton, T. Vasiljevic, (2012). Germinated grains – Sources of bioactive compounds, Food Chemistry, Volume 135, Issue 3, 1 December, pp. 950-959;

Hidalgo, A., Brusco, M., Plizzari, L., Brandolini, A. (2013). Polyphenol oxidase, alpha-amylase and beta-amylase activities of Triticum monococcum, Triticum turgidum and Triticum aestivum: A two-year study, *Journal of Cereal Science*, 58(1), 51–58;

Hurgoiu, V. (2004). *Alimente funcţionale*, Casa Cărţii de ştiinţă, Cluj –Napoca;

Marton, M., Mandoki, Z., Csapo, K.Z. (2010). The role of sprouts in human nutrition. *Alimentaria*, 3, 81-117;

Pandhre, G.R., Satwase, A.N., Syed Imran, H. (2011). Studies on drying characteristics and nutritional composition of sprouted wheat and finger millets, *International Journal of Current Research,* 3(7), 218-221;

Sarandan, H., Botau, D., Ianculov, I., Radu, F., Rada, O., Morar, D., Sărăndan, M., Serb, M., Anghel, A. (2010). The hypoglicemic effect of *Momordica charantia* Linn in normal and alloxan-induced diabetic rabbits, *Anim. Sci. Biotechnol.*, 43, 516–518.

*** SR ISO 6496/2001 Determination of humidity from cereals.

*** SR EN ISO 5983-1/2006/AC: 2009 Determination of protein content from cereals.

*** SR ISO 6492/2001 Determination of fat content.

*** SR ISO 5984/2001 Determination of ash.

*** SR ISO 1227/3-90 Determination of biscuits alkalinity.