Chemical Industry & Chemical Engineering Quarterly

Available on line at
Association of the Chemical Engineers of Serbia *AChE*
www.ache.org.rs/CICEQ

Chem. Ind. Chem. Eng. Q. 26 (1) 1–7 (2020) CI&CEQ

DRAGAN ŽIVANČEV[1]
BOJAN JOCKOVIĆ[1]
NOVICA MLADENOV[1]
ALEKSANDRA TORBICA[2]
MIONA BELOVIĆ[2]
BRANKA MIJIĆ[1]
JORDANA NINKOV[1]

[1]Institute of Field and Vegetable Crops, Novi Sad, Serbia
[2]University of Novi Sad, Institute of Food Technology, Novi Sad, Serbia

SCIENTIFIC PAPER

UDC

THE EFFECTS OF WHEAT CULTIVARS ON THE PRODUCTION OF DIFFERENT TYPES OF WHEAT FLOURS OF PRECISELY DEFINED MAGNESIUM CONTENT

Article Highlights

- Increase in the production of brown flour in the milling industry
- Differentiation in Mg mineral content between white and brown flours
- Daily requirements for magnesium fulfilled by consumption of brown bread

Abstract

Whole kernels of cereals are the most important source of magnesium. This mineral has several positive effects on human health. However, the human body cannot absorb 100% of magnesium from plant sources during digestion. Additionally, the wheat flour milling process usually produces refined flour with a substantially lower content of magnesium. The aim of this study was to examine the effect of milling of two wheat cultivars on total and soluble magnesium distribution in milling fractions, with the purpose of creating wheat bread with a precisely defined magnesium content. Ash content, thousand grain weight (TGW), and kernel size were analysed in five wheat cultivars. Two most statistically distinguished wheat cultivars according to these analyses (Moma and Todorka) were milled in a laboratory mill to gain as many flour fractions as possible (eleven). Magnesium was extracted from the flour and its content was measured by inductively coupled plasma. The results showed that the level of soluble magnesium in refined white flours (T-500 with ash content between 0.46-0.60d.m.%) is approximately 17% and is available for uptake in the human body. Also, by milling the Moma cultivar in an industrial mill with a capacity of 100 t per day gave 6.6 t more brown flour (T-1000 with ash content between 1.05-1.15 d.m.%) than the Todorka cultivar. Furthermore, the daily consumption of brown bread (produced from brown flour) in Serbia would satisfy about 60% of the daily magnesium requirements.

Keywords: magnesium, wheat, flour, milling process.

Cereals are known as the most important dietary source of the mineral magnesium (Mg). Several studies [1-2] hypothesised that the consumption of food rich in magnesium is linked to a decreased risk of diabetes. Moreover, this was confirmed in the endocrinological surveys of Liu *et al.* [3] and Fung *et al.* [4] who examined the influence of whole-grain food intake and the risk of diabetes mellitus type 2. Also, it is well known since the beginning of the 20th century [5] that magnesium is an effective treatment against depression. Furthermore, Wacker *et al.* [6] showed that magnesium deficiency could cause numerous neuromuscular symptoms which could be prevented by magnesium intake. Magnesium supplementation is necessary for people living in modern society where they are exposed to chronic stress. Cernak *et al.* [7] showed that chronic stress decreased free and total plasma ionized magnesium in humans.

Almost every mineral in cereal grains is complexed by phytic acid, which results in forming salt compounds known as phytates. Degradation of phytates in the human stomach is connected with calcium

Correspondence: D. Živančev, Small Grains Department, Institute of Field and Vegetable Crops, Maksima Gorkog 30, 21101 Novi Sad, Serbia.
E-mail: dragan.zivancev@ifvcns.ns.ac.rs
Paper received: 4 October, 2018
Paper revised: 19 April, 2019
Paper accepted: 3 July, 2019

https://doi.org/10.2298/CICEQ181004019Z

intake by food diet [8]. Also, according to Simpson and Wise [9] these salts could be soluble or insoluble depending on the degree of metal bonding to phosphate groups. During digestion in the stomach and the small intestine it is possible to degrade from 1/3 to 2/3 of total phytate content consumed in a plant rich diet [10,11].

Milling is the most important technological process affecting the quantity of essential mineral elements in foods obtained from wheat. One of the prime aims of the milling process is to segregate wheat endosperm from bran and germ as much as possible. Considering the fact that approximately 60% of the total mineral content of the wheat kernel is concentrated in the aleurone layer [12], it is obvious that better separation will cause lesser content of mineral elements in refined or white flour. Also, Pomeranz [13] showed the distinction in the mineral content between the inner part of wheat endosperm and the outer part of wheat endosperm. Furthermore, the kernel geometry, which depends on wheat cultivar, also affects the mineral content of the obtained final product - flour.

Therefore, the aim of this study was to examine the effect of two wheat cultivars on total and soluble magnesium distribution in milling fractions, with the purpose of creating of wheat bread with precisely defined magnesium content.

MATERIALS AND METHODS

In order to select the suitable cultivars for the analysis, five wheat cultivars (Moma, Azra, Vlajna, Efrosinija and Todorka) from the breeding program of the Institute of Field and Vegetable Crops, Novi Sad, Serbia were examined. Cultivation of these cultivars was performed at the experimental field Rimski šančevi, Novi Sad, Serbia (45°20' N, 19°51' E).

The content of water in grain was determined according to the method SRPS EN ISO 712:2012 [14] and the ash content in grain was determined according to SRPS EN ISO 2171:2012 [15]. Grain size was determined using Pfeuffer device Sortimat (Kitzingen, Germany) by sifting 100 g of clean grain sample for 1 min through three sieves with openings of 20 mm×2.8 mm, 20 mm×2.5 mm and 20 mm×2.2 mm [16]. Thousand grain weight (TGW) was determined according to SRPS EN ISO 520:2012 [17].

The moisture of chosen two grain cultivars was measured and first adjusted to 13.5% for 24 h and after that to 15.0% half an hour before milling in a Bühler pneumatic laboratory mill MLU 202 (Uzwil, Switzerland) and using a Bühler Bran Duster (Uzwil, Switzerland) (Figure 1). The 11 flour streams of the chosen wheat cultivars were gained from three break passages (B1-B3); three reduction passages (M1-M3) whereas an additional flour stream B4 and an additional flour stream M4 were derived by passing bran and shorts through a bran duster. The remaining bran obtained after using the bran duster was reground by breaking rolls of MLU 202 and all three break passages were used for making an additional flour stream B5. The remaining shorts gained after using the bran duster were reground by reduction rolls of MLU 202 and all three reduction passages were used for making and additional flour stream M5. The last

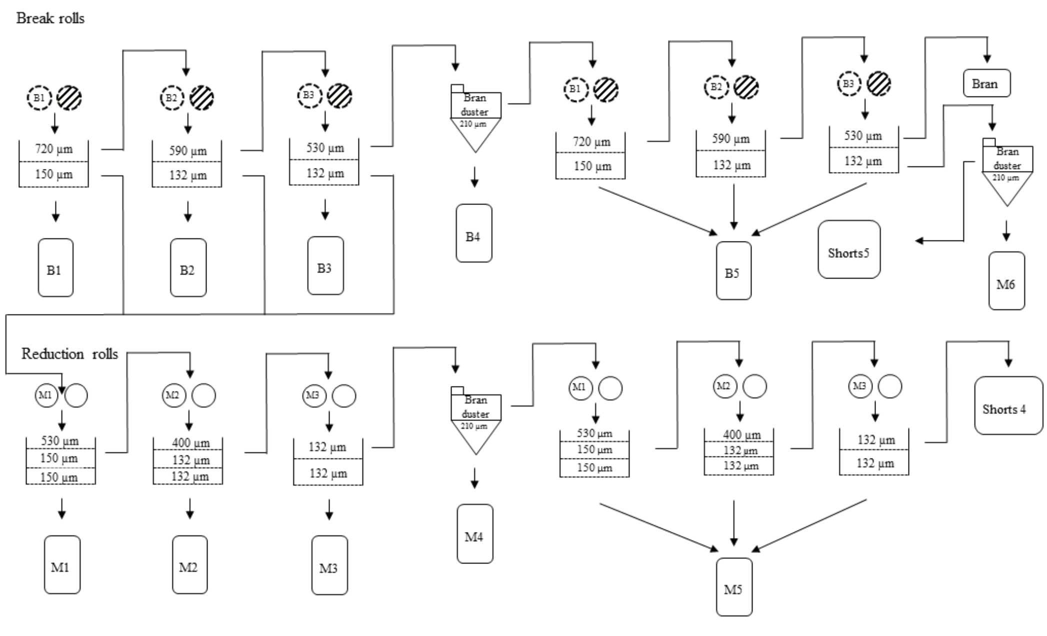

Figure 1. Flow diagram for a used Bühler laboratory mill.

flour stream M6 was gained by passing shorts obtained after bran regrinding trough the bran duster. Additionally, by using the milling scheme (Figure 2), one bran fraction and two shorts fractions (Shorts 4 and 5) were gained. All 14 streams were well mixed in a cubic mixer and prepared for further analyses.

The water and ash content in streams were determined according to the above-mentioned methods [14,15] in duplicate. The samples of ash content were made in two replicates, and the standard deviation between the repetitions was within the range of 0.0 to 2.0% of the obtained values.

The flour stream samples, shorts and bran and whole grain of two wheat cultivars, were analysed for total contents of magnesium (MgT) after microwave digesting the samples in concentrated HNO_3 and H_2O_2 (0.5 mg samples in digestion solution 10 ml HNO_3 + 2 ml H_2O_2, *Vu* = 50 ml) by stepwise heating up to 180 °C using a Milestone Vario EL III for 35 min. The concentration of magnesium was determined by inductively coupled plasma-optical emission spectroscopy (ICP-OES, Vista Pro-Axial, Varian). Quality assurance and quality control (QA/QC) were conducted by the results of successfully passed AFPS Animal Feeds PT Scheme provided by LGC and by standard reference material NIST SRM 1515 - apple leaves. The obtained results achieved analytical precision of 0.116 mg kg^{-1} Mg. The accuracy was within the interval 96.14 to 101.75%, and recovery was 98.52%. The limit of quantification (*LOQ*) in our study was 7.417 mg kg^{-1} Mg and limit of detection (*LOD*) was 2.45 mg kg^{-1} Mg, which provided adequate sensitivity to analyse.

The extraction of soluble minerals from flour fractions, shorts and bran from gained milling streams and whole grain of each grain cultivar was extracted with Tris-HCl buffer according to procedure described by Guttieri *et al.* [18] with some minor modifications. Namely, after vortexing, 70 mg of bran or 140 mg of flour was extracted with 7 mL of sterile Tris-HCl buffer (50 mM, pH 7.5) in a sterile tube at room temperature (22 °C) for 22 h with gentle shaking (100 rpm at

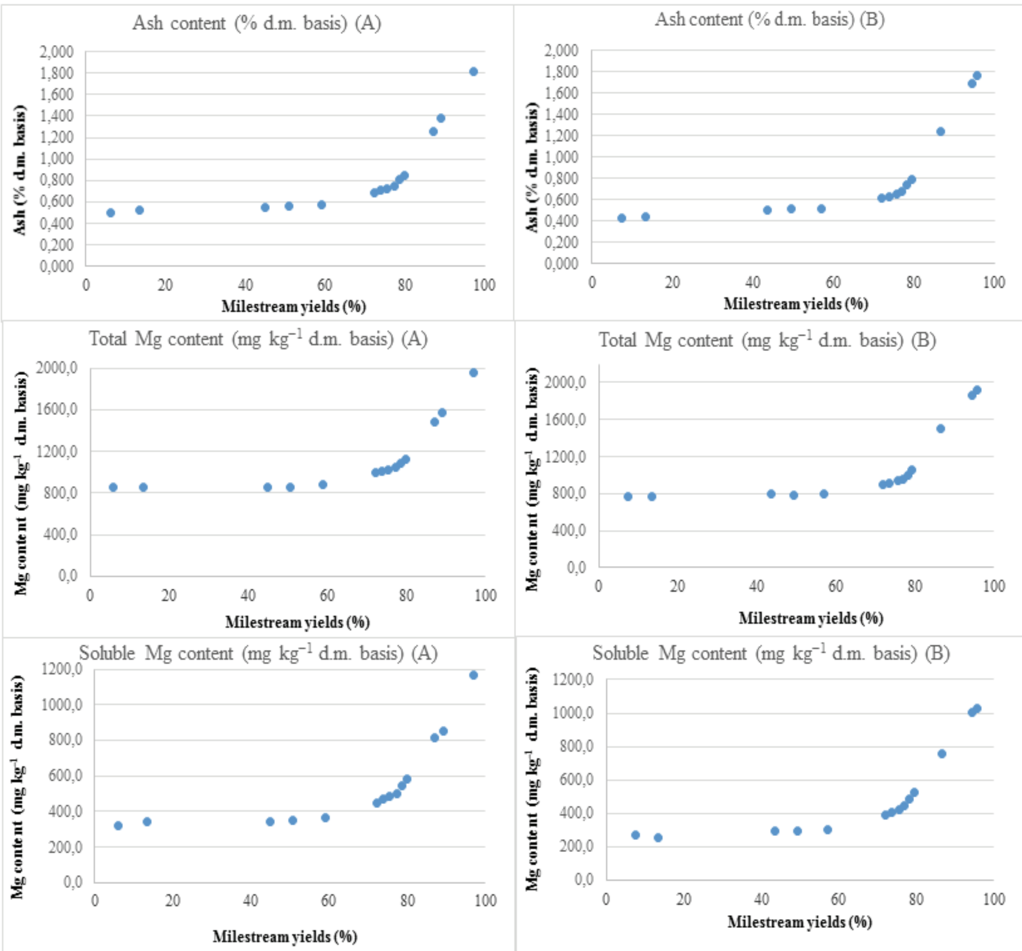

Figure 2. Cumulative mineral content curves for ash (d.m.% basis), total and soluble Mg (mg kg^{-1} d.m. basis) for wheat cultivars Moma (A) and Todorka (B).

orbital shaker PSI-10i, Boeco, Germany). Samples were again vortexed and then centrifuged (15000 g, 20 min) at Eppendorf centrifuge 5804 R, Hamburg, Germany. An aliquot of the supernatant was removed and stored at -20 °C prior to analysis. Supernatants were filtered through 0.2 µm cellulose acetate syringe filters (VWR International) and diluted in an equal volume of 10% nitric acid for analysis by ICP. Magnesium concentrations were measured with duplicate instrumental analyses of two technical replicates. Immediately prior to detection, the samples were filtered once again and the concentration of soluble Mg was determined by ICP-OES (Vista Pro-Axial, Varian). The samples of total and soluble magnesium were made in two replicates, and the standard deviation between the repetitions was within the range of 0.45 to 9.31% of the obtained values.

The results of ash content, TGW and grain size were statistically processed by analysis of variance (ANOVA). The statistical analyses were performed by InfoStat (Info Stat Student, Version 2016e) software [19]. Cumulative curves of ash, total and soluble magnesium of wheat cultivars were calculated on a dry matter basis (d.m. basis), following closely the procedure described by Fišteš and Tanović [20] for calculation of the cumulative flour ash curves.

RESULTS AND DISCUSSION

In order to select wheat cultivars which will be milled according to flow diagram (Figure 1) ash content, TGW and grain sizes of five wheat cultivars were examined (Table 1). The one-way ANOVA showed that Moma wheat cultivar possessed significantly the highest ash content and percentage of grains >2.5 mm of all cultivars, whereas Todorka cultivar possessed the smallest significant values of these two parameters. In the case of percentage of grains > 2.8 mm the two cultivars had the opposite trends. Also, the Todorka cultivar had the highest TGW value of all wheat cultivars and the Moma cultivar had the smallest TGW value. Ash content is strongly connected with the presence of aleurone cells in milling fractions [21]. On the other hand, according to Cochrane and Duffus [22] there is a positive correlation between endosperm cell number and TGW. Because of the above-mentioned results, it was assumed that there was the largest difference in quantity of aleurone layer and endosperm between these two cultivars. Therefore, they were chosen for milling and further examination of magnesium distribution in milling fractions.

The total and soluble Mg content in whole grain are reported in Table 2. Those values were in the range (1215–2165 mg kg^{-1}) reported by Zhang *et al.* (2010) [23], who examined 265 winter wheat genotypes from breeding programs in the Northern China. The soluble Mg content in wheat grains was almost three times lower than the content of total Mg.

Table 2. Content (mg/kg) of total and soluble magnesium in whole wheat grain

Wheat cultivar	Total magnesium content, mg kg^{-1}	Soluble fraction of magnesium content, mg kg^{-1}
Moma	1906.00	694.50
Todorka	1754.00	643.50

The largest fraction of flour in both cultivars was obtained from the first reduction passage M1 (31.6 and 30.2% of product yield for Moma and Todorka cultivar, respectively). Additionally, the ash content of the M1 flour stream of Moma (0.567% d. m. basis) and Todorka (0.536% d. m. basis) cultivars was slightly above the ash content of flour streams M3 and B1 (0.505 and 0.533% d.m. basis for Moma and 0.462 and 0.431% d.m. Todorka cultivar, respectively), as shown in Tables 3 and 4. Four flour streams (M3, B1, M1 and M2) obtained by milling of Moma cultivar, comprised 50.8% of total milled products. Also, the calculated ash content of mixture of these four flour streams according to the equation for cumulative flour ash curves [20] was 0.558% d.m. basis and the calculated total and soluble Mg content were 858.0 and 347.8 mg kg^{-1} d.m. basis, respectively. The calculated ash content of gained mixed flour was in the range of the refined white T-500 flour (from 0.46 to 0.60% d.m. basis) [24] which is usually used for bread production in Serbia. Milling the Todorka cultivar gained five flours streams (B1, M3, M1, M2 and

Table 1. Mean values of ash content, TGW and grain sizes of five wheat cultivars analysed by one-way ANOVA; Duncan test, different letters indicate significant difference at 0.05 probability level

Wheat cultivar	Ash content (%)	TGW (g dm. basis)	> 2.8 mm (%)	> 2.5 mm (%)	> 2.2 mm (%)	Bottom (%)
Moma	1.70^{a}	33.15^{a}	36.70^{d}	48.43^{a}	8.19^{a}	6.76^{b}
Azra	1.65^{b}	33.97^{a}	46.26^{b}	36.24^{e}	7.21^{a}	10.33^{a}
Vlajna	1.63^{bc}	33.99^{a}	39.80^{c}	42.11^{c}	7.98^{a}	10.11^{a}
Efrosinija	1.60^{cd}	34.39^{a}	37.73^{cd}	45.21^{b}	7.66^{a}	9.37^{a}
Todorka	1.58^{d}	36.22^{a}	50.47^{a}	38.03^{d}	4.57^{b}	6.95^{b}

Table 3. Millstream yields (%), estimated ash (d.m. basis), total and soluble magnesium content with the streams sorted in the order of increasing ash content for wheat cultivar Moma

Stream	Yield, %	Ash, % d.m. basis	Total magnesium, mg kg^{-1} d.m. basis	Soluble magnesium, mg kg^{-1} d.m. basis
M3	6.00	0.505	857.07	320.49
B1	7.40	0.533	862.14	353.16
M1	31.60	0.567	856.49	347.72
M2	5.80	0.594	862.10	369.58
B2	8.20	0.703	1034.07	464.96
M4	13.40	1.166	1474.36	829.58
B3	1.60	1.560	1802.90	1258.02
B5	1.60	1.633	1834.72	1194.81
M5	1.70	1.833	1838.52	1334.18
M6	1.50	3.555	3275.82	2660.08
B4	1.10	3.970	3992.72	3413.72
Shorts5	7.30	5.781	5354.49	3326.11
Bran	2.00	6.418	5614.76	2749.54
Shorts4	8.00	6.765	6199.06	4591.15

B2), comprised 57% of total milled products. Also, the calculated ash content of the mixture of these four flour streams according to the equation for cumulative flour ash curves [20] was 0.520% d.m. basis, in the range of the refined white T-500 flour, and calculated total and soluble Mg content 799.8 and 300.8 mg kg^{-1} d.m. basis. Calculated total Mg content of the mixtures with value of ash parameters in the range of refined white T-500 flour represents approximately 45% of the total Mg content in grain of both examined wheat cultivars. This is almost three times higher than the level of 16% which Anonymous (2002) [25] found in refined flour when compared to whole grain flour. Also, the calculated level of soluble Mg content of the mixtures with value of ash parameters in the range of refined white T-500 flour represents approximately 17% and it is available for uptake in the human body. By mixing five flour streams of Moma cultivar (B2, M4, B3, B5 and M5), which makes 26.50% of extraction rate, the gained flour would be with ash content 1.118% d.m. basis, total and soluble Mg content 1403.1 and 797.0 mg kg^{-1} d.m. basis (calculated according to equation for cumulative flour ash curves [20]). This kind of flour belongs to the refined T-1100 flour (brown flour) since the ash content was in the range from 1.05 to 1.15% d.m. basis [24]. By mixing four flour streams of Todorka cultivar (M4, B3, B5 and M5), which makes 19.90% of extraction rate, flour will be gained with ash content 1.158% d.m. basis (upper limit for refined dark T-1100 flour), total and soluble Mg content 1423.0 and 852.0 mg kg^{-1} d.m. basis (calculated according to the equation for cumulative flour ash curves [20]).

In order to assess the nutritional values of white and dark flours and Mg concentrations, Mg content of a standard 100 g slice of commercially prepared white and brown bread was calculated. According to the USDA National Nutrient Database for Standard Reference (NDB 18069), the bread slice contains 36.7% water. In a standard Basic Straight-Dough Bread-Baking Method-Long Fermentation [26] the flour comprises 86% of the dry ingredients. Therefore, a standard 100 g slice of white bread prepared from the Moma cultivar white mixture of four flour streams (M3, B1, M1 and M2) in this study contained 59.7 mg of total Mg and 24.2 mg of soluble Mg, whereas 100 g slice of white bread prepared from a white mixture of five flour streams (B1, M3, M1, M2 and B2) obtained from the Todorka cultivar contained a total of 55.6 mg Mg and 20.9 mg of soluble Mg. A standard slice of brown bread prepared from Moma cultivar brown mixture of five flour streams (B2, M4, B3, B5 and M5) in this study contained 97.5 mg of total Mg and 55.4 mg of soluble Mg, whereas a standard slice of brown bread prepared from the Todorka cultivar dark mixture of four flour streams (M4, B3, B5 and M5) in this study contained 98.9 mg of total Mg and 59.2 mg of soluble Mg. Taking into account that the average daily recommended value for Mg for adults between the ages 19 to 65 is 220 mg for women and 260 mg for men [27], the consumption of only 400 g of brown bread would fulfil total Mg requirements (only soluble Mg is taken into account). Average bread consumption in the EU per year is 59.4 kg, whereas Balkan countries such as Greece, Bulgaria and Turkey eat bread even more (68.0, 95.0 and 104.0 kg per year) [28]. The average bread consumption in Serbia is at the level of the Balkan countries, 83.7 kg per year [29] or 229 g per day. It could be concluded that

Table 4. Millstream yields (%), estimated ash (d.m. basis), total and soluble magnesium content with the streams sorted in the order of increasing ash content for wheat cultivar Todorka

Stream	Yield, %	Ash, % d.m. basis	Total magnesium, mg kg^{-1} d.m. basis	Soluble magnesium, mg kg^{-1} d.m. basis
B1	7.40	0.431	765.50	269.24
M3	6.00	0.462	777.01	241.44
M1	30.20	0.536	800.06	306.53
M2	5.80	0.541	758.73	301.51
B2	7.60	0.578	881.62	354.94
M4	14.90	0.984	1287.91	719.04
B3	1.80	1.354	1607.67	1012.71
B5	2.00	1.533	1733.45	1157.13
M5	1.20	2.396	2306.03	1753.65
M6	1.30	3.974	3668.16	2992.59
B4	1.20	4.105	3936.68	3337.30
Shorts5	7.30	6.198	6466.45	3247.53
Shorts4	7.70	6.725	5965.07	3771.38
Bran	1.30	7.233	5843.93	2815.47

by the average daily consumption of bread about 60% of magnesium requirements would be met.

The calculated cumulative curves for ash total and soluble Mg of wheat cultivars Moma (A) and Todorka (B), identical to the cumulative ash curve, are shown in Figure 2. This figure is the most usual presentation of data in the milling industry since it is one of the best ways to evaluate performance of the used mill and allow precise selection of gained flour streams for making the final products (flour) for different purposes [30]. The curve of both cultivars showed that concentration of total and soluble Mg in the lowest ash flour streams was relatively low, whereas it was high in the shorts and bran. Hence, it confirmed that most of the soluble Mg is stored in the external parts of the kernel.

CONCLUSIONS

According to the results of refined white flour, it could be concluded that the level of soluble magnesium in refined white flours (T-500 with ash content between 0.46-0.60 d.m.%) represents approximately 17% and it is available for uptake in human body. Also, by milling the Moma cultivar it was possible to obtain 26.50% of the extraction rate of brown flour, whereas the Todorka cultivar gained about 7% lower extraction rate of the brown flour. This means that the industrial mill with the capacity of 100 t per day will produce approximately 6.6 t more of this valuable nutritive product by using the Moma cultivar as a raw material than by using the Todorka cultivar. Furthermore, consuming brown bread on the average level in Serbia would satisfy about 60% of magnesium requirements.

Acknowledgments

This work was funded by the Serbian Ministry of Education, Science and Technological Development (project TR31066 and project TR31007).

REFERENCES

[1] R. Jiang, J.E. Manson, M.J. Stampfer, S. Liu, W.C. Willett, F.B., Hu, JAMA 288 (2002) 2554-2560

[2] E.J. Feskens, C.H. Bowles, D. Kromhout, Am. J. Clin. Nutr. 54 (1991) 136-140

[3] S. Liu, J. Am. Coll. Nutr. 21 (2002) 298-306

[4] T.T. Fung, F.B. Hu, M.A. Pereira, S. Liu, M.J. Stampfer, G.A. Colditz, W.C. Willett, Am. J. Clin. Nutr. 76 (2002) 535-540

[5] P.G. Weston, Am. J. Psychiatry 78 (1921) 637-638

[6] W.E. Wacker, A.F. Parisi, N. Engl. J. Med. 278 (1968) 712-719

[7] I. Cernak, V. Savic, J. Kotur, V. Prokic, B. Kuljic, D. Grbovic, M. Veljovic, Magnes. Res. 13 (2000) 29-36

[8] A.R. Walker, F.W. Fox, J.T. Irving, Biochem. J. 42 (1948) 452-62

[9] C.J. Simpson, A. Wise, Br. J. Nutr. 64 (1990) 225-232

[10] A.S. Sandberg, H. Andersson, J. Nutr. 118 (1988) 469-473

[11] R.A. McCance, E.M. Widdowson, Biochem. J. 29 (1935) 2694-2699

[12] J.J.C. Hinton, Cereal Chem. 36 (1959) 19-31

[13] Y. Pomeranz, in Wheat Chemistry and Technology. Chemical composition of kernel structures, Vol. I, Y. Pomeranz (Ed.), American Association of Cereal Chemists, St. Paul, MN, 1988, p. 97

[14] SRPS EN ISO 712:2012. Cereals and cereal products – Determination of moisture content Reference method. Institute for standardization of Serbia, Belgrade, Serbia

[15] SRPS EN ISO 2171:2012. Cereals, pulses and by-products - Determination of ash yield by incineration. Institute for Standardization of Serbia, Belgrade, Serbia

[16] G. Kaluđerski, N. Filipović, In Methods of testing the quality of wheat, flour and finished products, M. Žeželj, R. Vukobratović (Eds.), University of Novi Sad, Faculty of Technology, 1998, p. 25

[17] SRPS EN ISO 520:2012. Cereals and pulses - Determination of the mass of 1000 grains, Institute for Standardization of Serbia, Belgrade, Serbia

[18] M.J. Guttieri, B.W. Seabourn, C. Liu, P.S. Baenziger, B.M. Waters, J. Agric. Food Chem. 63 (2015) 10681-–10688

[19] InfoStat (Info Stat Student, 2016, Version 2016e, UNC, Argentina (www.infostat.com.ar)

[20] A. Fišteš, G. Tanović, In Practice book in milling technology, Z. Zavargo, (Ed.), University of Novi Sad, Faculty of Technology, 2014, p. 75

[21] S. Jensen, L. Munck, H. Martens, Cereal Chem. 59 (1982) 477-484

[22] M.P. Cochrane, C.M. Duffus, Ann. Appl. Biol. 102 (1983) 177-181

[23] Y. Zhang, Q. Song, J. Yan, J. Tang, R. Zhao, Y. Zhang, Z. He, C. Zou, I. Ortiz-Monasterio, Euphytica 174 (2010) 303-313

[24] Regulation on the quality of grains, milling and bakery products and pasta, Official Gazette of the Republic of Serbia, 68, 2018

[25] Anonymous, Harv. Heart Lett. 13 (2002) 2-4

[26] American Association of Cereal Chemists (AACC), Approved Methods of Analysis, 10th ed., Methods (AACC Method 10-09), AACC, St. Paul, MN, 2000

[27] Report of a joint FAO/WHO expert consultation Bangkok, Thailand (2001) Human Vitamin and Mineral Requirements (http://www.fao.org/3/a-y2809e.pdf)

[28] A. Eglite, D. Kunkulberga, Foodbalt, in Proceedings of 11th Baltic conference on food science and technology "Foodbalt 2017", Jelgava, Latvia, 2017, p. 178

[29] B. Gulan, Macroeconomy, Bread and its consumption in Serbia, 2016 (in Serbian) https://www.makroekonomija.org/poljoprivreda/hleb-i-potrosnja-u-srbiji2016/

[30] S.D. Sakhare, A.A. Inamdar, J. Food Sci. Technol. 51 (2014) 795-799.

DRAGAN ŽIVANČEV[1]
BOJAN JOCKOVIĆ[1]
NOVICA MLADENOV[1]
ALEKSANDRA TORBICA[2]
MIONA BELOVIĆ[2]
BRANKA MIJIĆ[1]
JORDANA NINKOV[1]

[1]Institut za ratarstvo i povrtarstvo, Maksima Gorkog 30, 21101 Novi Sad, Srbija
[2]Univerzitet u Novom Sadu, Institut za prehrambene tehnologije, Bulevar Cara Lazara 1, 21000 Novi Sad, Srbija

NAUČNI RAD

UTICAJ MLINSKE SIROVINE NA PROIZVODNJU TIPSKOG BRAŠNA TAČNO DEFINISANOG SADRŽAJA MAGNEZIJUMA

Zrna žita su najznačajniji izvor magnezijuma. Ovaj mineral ima nekoliko pozitivnih efekata na zdravlje ljudi. Međutim, ljudski organizam nema mogućnost da prilikom procesa varenja iz hrane biljnog porekla apsorbuje celokupnu količinu magnezijuma. Mlevenjem pšenice uobičajeno se proizvode bela brašna, koja se i najčešće konzumiraju, što dodatno smanjuje količinu magnezijuma u ishrani. Cilj ovog istraživanja je bio da se ispita kako izbor mlinske sirovine može uticati na proizvodnju brašna i hleba od istog brašna sa tačno definisanim sadržajem magnezijuma. Da bi se odabrala odgovarajuća sorta pšenice prvo je na pet sorti analiziran sadržaj pepela, masa hiljadu zrna i veličina zrna. Dve sorte (Moma i Todorka) koje su se statistički najviše razlikovale po ovim osobinama su samlevene na laboratorijskom mlinu tako da se dobije maksimalan broj pasažnih brašna (jedanaest). Iz ovih pasaža ekstrahovan je magnezijum, a njegov sadržaj je određen tehnikom induktivne spregnute plazme. Rezultati su pokazali da je nivo rastvorljivog magnezijuma u belom brašnu 17% tako da bi se prilikom procesa varenja ova količina mogla u celosti abpsorbovati. Takođe, mlevenjem sorte Moma u industrij mlinu kapaciteta 100 t dnevno bi se proizvelo 6,6 t više crnog brašna nego što je to slučaj sa sortom Todorka. Na ovaj način bi se u Srbiji konzumiranjem crnog hleba zadovoljilo 60% dnevnih potreba za magnezijumom.

Ključne reči: magnezijum, pšenica, brašno, mlevenje.