ISSN 1392 – 1231. CHEMINĖ TECHNOLOGIJA. 2013. Nr. 1 (63)

Attitude of Latvian consumers towards new products made from triticale flour blend

M. Sabovics, E. Straumite, R. Galoburda
Faculty of Food Technology, Latvia University of Agriculture,
Liela iela 2, Jelgava, LV-3001, Latvia
E-mail: martins.sabovics@inbox.lv

I. Kantike
Faculty of Economics, Latvia University of Agriculture,
Svetes Str. 18, Jelgava, LV-3001, Latvia

crossref http://dx.doi.org/10.5755/j01.ct.63.1.4515

Received 23 January 2013; Accepted 6 March 2013

Triticale (*Triticosecale wittmack*) is grown mostly for forage or animal feeding; nevertheless, some triticale-based food can be purchased at health food stores. Triticale has a potential in the production of bread and other food products such as pasta and breakfast cereals. The aim of the research was to evaluate a consumer's attitude towards new by developed products made from whole-grain triticale, rye and hull-less barley flour, rice and maize flour. Other cereals besides triticale were used in the flour blend in order to obtain better baking properties. There were 113 respondents who participated in the questionnaire, of them 32 (28.3 %) men and 81 (71.7 %) women. Four samples were given to each respondent – 2 control samples (made from whole-grain wheat flour) and 2 developed products. In sensory evaluation, the experimental muffins and crackers were characterised using a 9-point hedonic scale (determination of overall acceptablity). The overall acceptability of the new products varied between 6.92 and 7.61 on the hedonic scale, which correspond to the acceptability from "like it a little" to "like it much". One hundred and three respondents liked the new by developed products better than the traditional ones. The respondents wrote in the questionnaire that the new products were healthy and tasty, and they would like to buy them in retail shops.

Keywords: triticale, whole grain, consumers.

Introduction

In the production of bread and pastry, various grinds of wheat and rye flour traditionally are used, although new possibilities for expanding the assortment are sought. Researchers worldwide have been studying the use of triticale, hull-less barley, maize, and rice in bread and pastry production [1, 2].

Triticale (*Triticosecale wittmack*) is the first man-made cereal produced by crossing wheat (*Triticum* spp.) and rye (*Secale ceral* L.) [3, 4].

Triticale is mainly used as an ingredient in animal feeding, but also, on a smaller scale, as a food ingredient, for example, in bread making or as a replacement for soft wheat in biscuits, cakes, and cookies [9, 10].

The nutritional value of triticale is close to that of wheat and rye. Triticale has a higher content of protein (13.5 g 100 g^{-1}) and fiber (14.6 g 100 g^{-1}). Protein content in wheat, barley, and rye is 11.3 g 100 g^{-1}, 11.1 g 100 g^{-1}, and 9.4 g 100 g^{-1}, respectively. The content of minerals (1.7 g 100 g^{-1}) in triticale is lower than in barley (2.3 g 100 g^{-1}) and rye (1.9 g 100 g^{-1}), but it is similar to that in wheat. Lipids are in the same range for triticale, wheat, barley, and rye, varying from 1.3 to 2.1 g 100 g^{-1}. Triticale has a higher content of carbohydrates (61.2 g 100 g^{-1}) as compared with wheat and rye, but lower than barley. The content of carbohydrates in wheat and rye is 59.4 g 100 g^{-1} and 60.3 g 100 g^{-1}, respectively, but in barley 62.7 g 100 g^{-1} [5, 6, 7, 8].

Bread contains a wide range of important nutritional components such as dietary fibre, minerals, and vitamins, which provide a positive effect on human health [11]. Considering the development of a fibre-enriched product, it is essential that the cereal market is studied. This is because many consumers have become more aware of the role cereals can play in a healthy diet [12].

Many consumers are unaware of the health benefits of whole-grain products or of the recommendations regarding their increased intake. Also, there is much confusion about which products are truly whole-grain [13]. To view triticale from the nutrition point, it has valuable dietary characteristics such as a higher content of soluble dietary fiber and a better total amino acid composition as compared to wheat [14].

For expanding the range of bakery and pastry production in the world, there have been developed various recipes for product enriched with fibre, especially β-glucan, proteins, vitamins, and other nutrients for a healthier diet. It can be done making a flour blend from whole-grain triticale, rye, hull-less barley, rice and maize flour [8, 9]. Rye, hull-less barley, rice and maize flour were added in order to increase the baking properties of flour blend [15, 16]. The future of triticale is bright because it is environmentally more flexible than other cereals and shows a better tolerance of diseases, drought, and pests than its parental species [17].

The aim of the research was to evaluate a consumer's attitude towards new by developed products made from whole-grain triticale, rye and hull-less barley flour, rice and maize flour.

Materials and methods

Triticale, rye and hull-less barley crops of 2011, cultivated at the Priekuli Plant Breeding Institute (Latvia), were used in the current study. Triticale, rye, and hull-less barley used for the study were grounded in a *Hawos* laboratory mill (Hawos Kornmühlen GmbH, Germany) obtaining whole-grain fine flour. Rice and maize flour were purchased from JSC *Ustukiu Malunas* (Lithuania). All flour samples were mixed together in one flour blend. The flour blend for muffin and cracker production contained 60 % of whole-grain triticale, 15 % of whole-grain hull-less barley, 15 % of whole-grain rye, 5 % of rice, and 5 % of maize flour, but when making control samples (muffins and crackers), whole-grain wheat flour was used [13]. Ingredients, such as sugar, salt, baking powder, eggs, oil, margarine, and water, were used for muffins and crackers in order to improve their sensory properties. Recipes of muffins and crackers are shown in Table 1, and the technological scheme of muffin and cracker production is shown in Fig. 1.

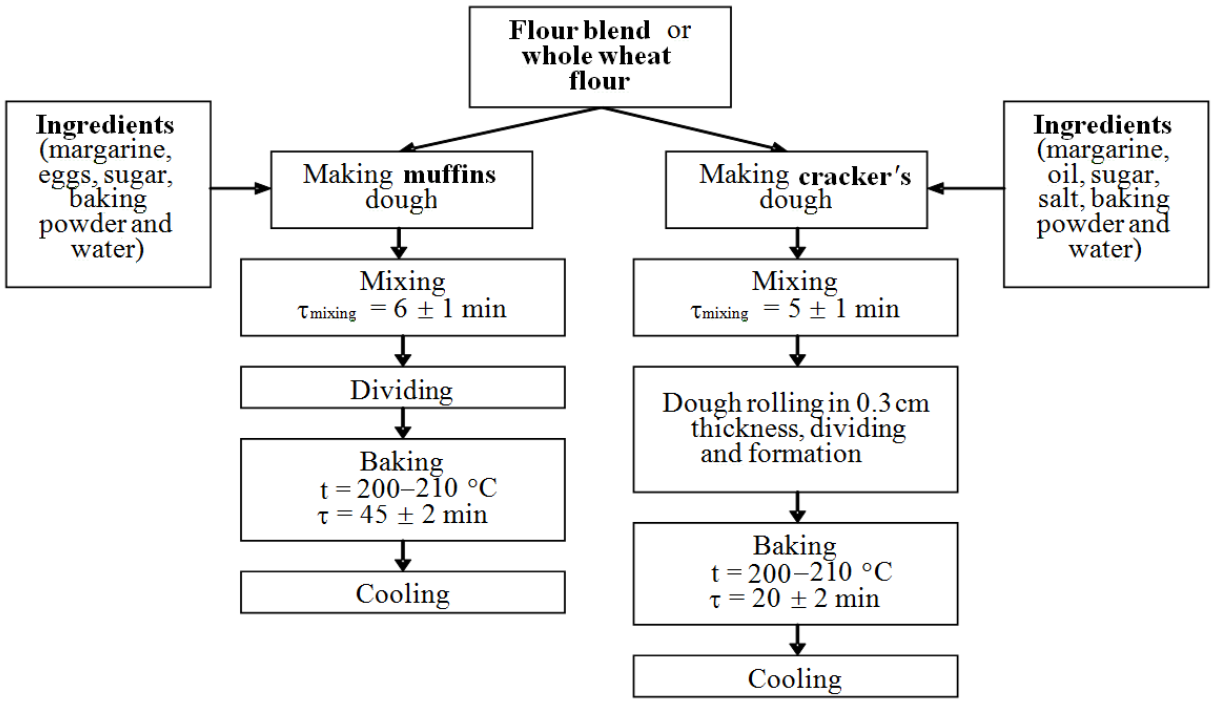

Fig. 1. The technological scheme of muffin and cracker production

Table 1. The muffins' and crackers' recipe per 1 kg of flour blend

Ingredients	Muffins	Crackers
Triticale flour blend, g	1000	1000
Margarine, g	500	200
Oil, ml	-	30
Eggs, g	450	-
Sugar, g	500	50
Salt, g	-	20
Baking powder, g	6	3
Water, ml	500	250

The hardness of muffins and crackers was objectively measured using a TA.XT.*plus* texture analyser (*Stable Micro Systems*). For muffins (sliced approximately 60 × 80 × 10 mm), the analyser was equipped with the following compression test parameters: probe – 25 mm diameter aluminium cylinder, test speed – 1 mm·s^{-1}, distance – 4 mm. But, to measure cracker hardness (30 × 80 × 3 mm) till snap, the analyser was equipped with the following compression test parameters: probe – mini 3 point bend rig (HDP/M3PB) and heavy duty platform (HDP/90), test speed – 1 mm·s^{-1}, distance – 4 mm.

The moisture content of muffins and crackers was determined in an oven by drying at 105 °C according to the procedure described in AACC (2000), Method No. 44-15A. The moisture content of muffins and crackers was determined by weighing 2 g of a sample in a pre-weighed china dish and drying it in an air-forced draft oven at a temperature of 105 ± 5 °C till the constant weight of dry matter. The moisture content in the sample was determined as shown below (1).

$$Moisture\ (\%) = \frac{Wt.of\ original\ sample - Wt.of\ dried\ sample}{Wt.of\ original\ sample} \times 100 \quad (1).$$

The instrumental measurement of the muffin crumbs and cracker surface was performed in the CIE L*a*b*

colour system using a *ColorTec-PCM/PSM* (Accuracy Microsensors Inc., USA). Crumb and surface colour measurements were made by placing the colorimeter directly on the samples. The muffin crumb colour was measured at four different points of 10 slices, but the cracker surface colour was measured at two different points of 10 pieces. Colour values were recorded as L^* (brightness) – the vertical co-ordinate runs from $L^* = 0$ (black) through grey to $L^* = 100$ (white); a^* (-a, greenness, +a, redness) – the horizontal co-ordinate, that runs from $-a^*$ (green) through grey to $+a^*$ (red) and b^* (-b, blueness, +b, yellowness) – on the other the horizontal co-ordinate which runs from $-b^*$ (blue) through grey to $+b^*$ (yellow) [18].

A questionnaire was designed to evaluate the consumer's attitude and establish the acceptability of control (muffins B and crackers D made from whole-grain wheat flour) and the new by developed products (muffins A and crackers C made from whole-grain flour blend which contained whole-grain triticale, rye and hull-less barley flour, rice and maize flour), taking into account the usage frequency of confectionery, age, and gender.

Experimentally, muffins and crackers were characterised using a 9-point hedonic scale (determination of overall acceptability) in sensory evaluation. The 9-point hedonic scale (9 – extremely like, 5 – neither like or dislike, and 1 – extremely dislike) methods were used based on ISO 4121:2003 "Sensory analysis – Guidelines for the use of quantitative response scales".

The questioning was performed on 113 consumers (28.3 % men and 71.7 % women).

Questions were formulated in the way that a respondent could answer by selecting one of the multiple choices or giving his own view. The survey included questions about the consumer's age and gender, usage frequency of confectionery, whether they would buy a new by developed product in the market.

The mean values and the standard deviation of the means were calculated using the Microsoft Office Excel 2007 (Microsoft Corporation, Redmond, WA), but the questionnaire data were subjected to the one-way analysis of variance (ANOVA), Pearson Chi-square test, using SPSS 17 (SPSS, Inc., USA).

Results and discussion

An important parameter of muffins and crackers is moisture, as it possesses the ability to bind and return water during the technological process (dough mixing, baking, and cooling). The muffin crumb and cracker hardness is closely related to their moisture content. Table 2 presents the moisture content and hardness of whole-grain wheat, triticale flour blend muffins, and crackers.

The moisture content of triticale flour blend muffins and crackers in comparison with whole-grain wheat flour muffins and crackers was higher by about 1.56 % and 0.23 %, respectively. However, the hardness of the triticale flour blend muffins and crackers was lower by about 11.69 N and 1.73 N, respectively, as compared with whole-grain wheat flour muffins and crackers. The obtained results show that the triticale flour blend muffins (32.77 %) and crackers (9.10 %) are softer than the whole-grain wheat muffins and crackers. The moisture content of the muffins and crackers has a significant ($p < 0.05$) effect on their hardness. It can be conclude that if the moisture content in a sample is higher, the hardness of the sample is lower.

Table 2. Moisture content and hardness of the muffins and crackers

Samples	Moisture, %	Hardness, N
Whole-grain wheat flour muffins	36.43 ± 0.16	35.67 ± 2.43
Triticale flour blend muffins	37.99 ± 0.19	23.98 ± 1.47
Whole-grain wheat flour crackers	0.78 ± 0.04	19.01 ± 0.90
Triticale flour blend crackers	1.01 ± 0.03	17.28 ± 0.87

Muffins are characterised by a typical porous structure and a high volume, which confer a spongy texture. To obtain such a final structure, a stable batter lodging many tiny air bubbles is required [19]. The whole-grain wheat and triticale flour blend muffins have a typical and regular specific volume (Fig. 2.).

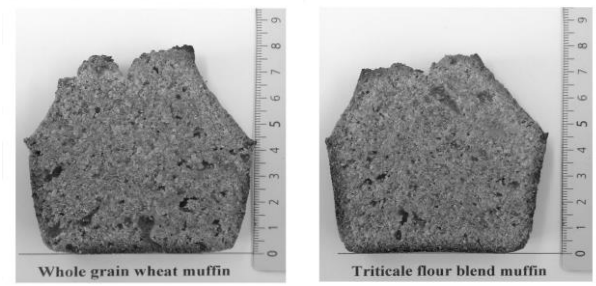

Fig. 2. Digital images of whole-grain wheat and triticale flour blend muffins

During muffin baking, a second step takes place: the air cells are expanded by CO_2 and the vapour pressure generated, resulting in the formation of the final gas cells, which influence the texture of the finished product [19].

Comparing the triticale flour blend with whole-wheat flour usage in muffin making, it has been noted that the muffins made from triticale flour blend have a smaller volume and porosity. The triticale flour blend muffin crumb is denser, but it is softer as compared with whole-grain wheat flour muffins.

Colour values of whole-grain wheat flour and triticale flour blend muffins and crackers are shown in Table 3.

The colour of crust and crumb can be influenced by the Maillard reaction in the baking process. Muffins with more reduced sugars had a stronger orange colour. Sugar did not change significantly the values of L^* and a^*, but gave significantly higher b^* values of the muffin crumb [19].

Table 3. Colour values of muffins and crackers

Samples	Colour		
	L^*	a^*	b^*
Muffin crumb			
Whole-grain wheat flour muffins	50.52 ± 0.93	0.82 ± 0.36	19.76 ± 0.67
Triticale flour blend muffins	53.04 ± 0.96	0.43 ± 0.24	21.42 ± 0.78
Cracker surface			
Whole-grain wheat flour crackers	45.30 ± 1.29	5.11 ± 0.66	20.38 ± 0.90
Triticale flour blend crackers	51.29 ± 2.60	4.82 ± 0.53	24.76 ± 4.12

The lightest colour of muffin crumb (L^* = 53.04 ± 0.96) was determined for triticale flour blend muffins; also, the triticale flour blend muffins had the highest value of b^* (yellow component 21.42 ± 0.78), i. e. the muffin crumb acquired a more saturated yellowish colour. The same situation was obtained for triticale flour blend crackers. The lightest colour of cracker surface (L^* = 51.24 ± 2.60) and the highest value of b^* (yellow component 24.76 ± 4.12) were determined for triticale flour blend crackers. The whole-grain wheat crackers showed a darker surface (L^* = 45.30 ± 1.29) using the same thickness of the sample and the same baking temperature and time. The whole-grain wheat and triticale flour blend crackers showed a higher value of the redness component a^* (5.11 ± 0.66 and 4.82 ± 0.53, respectively) in comparison with whole-grain wheat flour and triticale flour blend muffins (0.82 ± 0.36 and 0.43 ± 0.24, respectively). The type of the used flour had a significant effect ($p < 0.05$) on the colour of the cracker samples.

It can be concluded that the technological parameters, water amount, type of products have an effect on the physico-chemical properties of muffins and crackers.

The respondents were from Latvia, and the questioning was done at the international exhibition "Made in Latvia".

The division of the respondents according to age is presented in Fig. 3.

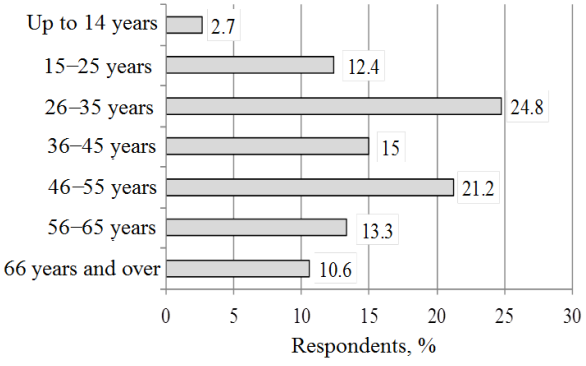

Fig. 3. Distribution of respondents according to age, %

Most of the respondents were aged from 26 to 35 (24.8 %) and from 46 to 55 (21.2 %). The least number of respondents were aged up to 14 years (2.7 %), because the exhibition "Made in Latvia" is focused more on manufacturers and employers. To reveal the attitude of 14-year-old respondents about the new by developed products, the questioning should be carried out in schools.

To ascertain the different tastes of muffins and crackers, the respondents were asked a control question about how frequently they consumed confectionery goods. The results showed that 30 % of the respondents frequently consumed confectionery goods (almost every day), 52 % of them – sometimes (2–5 times a month), but 18 % did it rarely (about once a month). The majority of the respondents consumed confectionery goods only sometimes.

Table 4 shows the overall acceptability average ratings of the respondents' satisfaction for two control samples B and D (made from whole-grain wheat flour) and two developed products A and C (made from triticale flour blend).

Table 4. Evaluation of the overall acceptability of new products

Type of product	Acceptability
A – muffins made from triticale flour blend	7.21
B – muffins made from whole-grain wheat flour (control)	6.92
C – crackers made from triticale flour blend	7.61
D – crackers made from whole-grain wheat flour (control)	7.23

The overall acceptability of muffins and crackers was within a range of 6.92 to 7.61, which corresponds to the evaluation from "like it a little" to "like it much" on the 9-point hedonic scale. There was no significant difference ($p > 0.05$) among the acceptability of muffin and cracker samples.

Analysis of the data by the Pearson Chi-square test (Table 5) revealed that the respondents frequently consuming confectionery goods preferred muffins (sample B) and crackers (Sample D) made from whole-grain wheat flour as compared with the other respondents who did not frequently consume confectionery goods.

Table 5. Relationship between the acceptability of a product and the frequency of consuming confectionery goods by the respondents

Type of product	Pearson Chi-square
A – muffins made from triticale flour blend	0.163
B – muffins made from whole-grain wheat flour (control)	0.784
C – crackers made from triticale flour blend	0.832
D – crackers made from whole-grain wheat flour (control)	0.640

The women that frequently consumed confectionery goods preferred crackers made from triticale flour blend. Respondents who sometimes consumed confectionery goods (2–5 times a month) preferred muffin (B) made from whole-grain wheat flour, but the acceptability of muffin did not depend on the respondents' age and gender. The same situation was established for crackers from whole-grain triticale flour blend (C). Upon analysing the data regarding the reasons for preferring the new products A and C, it was ascertained that these products would be purchased for two reasons: they are tasty and are considered healthy. One hundred and three respondents (91.15 %) liked the new by developed products better than the traditional ones, and they would like to buy them in retail shops.

Only 10 respondents noted that they would not buy the new by developed products in retail shops.

Conclusions

1. The moisture content of muffins and crackers has a significant ($p < 0.05$) effect on their hardness.
2. The whole-grain wheat and triticale flour blend muffins have a typical and regular specific volume.
3. The type of the used flour has a significant effect ($p < 0.05$) on the colour of triticale flour blend and whole-wheat flour crackers.
4. Of all 113 respondents, 30 % use confectionery goods almost every day, 52 % use confectionery goods 2–5 times a month, and 18 % – about once a month.
5. The overall acceptability of muffins and crackers was ranged within 6.92 to 7.61, what means "like it a little" and "like it much".
6. The respondents who use confectionery goods almost every day preferred whole-grain wheat flour muffins and crackers as compared with other respondents who did not use confectionery goods almost every day. The women that frequently consumed confectionery goods preferred triticale flour blend crackers.
7. The triticale, rye and barley whole-grain flours could be incorporated into the formula of muffins and crackers for nutritious and healthy foods.

Acknowledgment

This research was supported by the ESF Project "Formation of the Research Group in Food Science", Contract Nr. 2009/0232/1DP/1.1.1.2.0/09/APIA/VIAA/122.

References

1. **Taketa S., Kikuchi S., Awayama T., Yamamoto S., Ichii M., Kawasaki S.** // Theoretical and Applied Genetics. 2004. Vol. 108. P. 1236–1242. http://dx.doi.org/10.1007/s00122-003-1560-1
2. **Ozola L., Straumite E., Klava D.** // Proceedings of the 6th Baltic Conference on Food Science and Technology "Innovations for Foods and Production" FOODBALT-2011. Jelgava, 2011. P. 131–136.
3. **Salmon D., Temelli F., Spence S.** // Proceedings of the 5th International Triticale Symposium. Poland, 2002. P. 445–450.
4. **Hosseinian F. S., Mazza G.** // Journal of Functional Foods. 2009. Vol. 1. P. 57–64. http://dx.doi.org/10.1016/j.jff.2008.09.009
5. **Leon A. E., Rubiolo A., Anon M. C. //** Miscellaneous. 1996. Vol. 73, N 6. P. 779–784.
6. **Belitz H. D., Grosch W., Schieberle P.** Cereals and cereal products. In: Food Chemistry (4th ed.). Belitz H. D., Grosch W., Schieberle P. (eds.), Springer, Berlin, 2009.
7. **Peña R. J.** Food uses of Triticale. In: Triticale improvement and production. FAO Plant production and protection paper 179. Mergoum M., Gómez-Macpherson H. (eds.), Rome: Food and Agriculture Organization of the United Nations, 2004.
8. **Straumite E., Sabovics M., Gramatina I., Galoburda R., Kronberga A.** // Abstract book: Enchancing Health Benefits of Cereal Foods. Results, Perspectives and Challenges. Lund, 2010. P. 103.
9. **Sabovics M., Straumite E., Galoburda R., Kronberga A.** // Proceedings of International conference on food innovation "FoodInnova 2010". Valencia, 2010. available on: http://www.foodinnova.com/foodInnova/docu2/36.pdf.
10. **Rakha A., Aman P., Andersson R.** // Journal of Cereal Science. 2011. Vol. 54. P. 324–331. http://dx.doi.org/10.1016/j.jcs.2011.06.010
11. **Gellynck X., Kühne B., Van Bockstaele F., Van de Walle D., Dewettinck K.** // Appetite. 2009. Vol. 53, N 1. P. 16-23. http://dx.doi.org/10.1016/j.appet.2009.04.002
12. **Arvola A., Lahteenmaki L., Dean M., Vassallo M., Winkelmann M., Claupein E., Saba A., Shepherd R.** // Journal of Cereal Science. 2007. Vol. 46, N 3. P. 197–206. http://dx.doi.org/10.1016/j.jcs.2007.06.001
13. **Slavin J.** // Nutrition Research Reviews. 2004. Vol. 17. P. 99–110. http://dx.doi.org/10.1079/NRR200374
14. **Varughese G., Pfeiffer W. H., Pena R. J.** // Cereal Food World. 1996. Vol. 41. P. 474–482.
15. **Sabovics M., Straumite E.** // Proceedings of the Research for rural development 2012, Jelgava. 2012. P. 143–148.
16. **Sabovics M., Straumite E., Galoburda R.** // Proceedings of the 6th Baltic Conference on Food Science and Technology "Innovations for Food Science and Production", Foodbalt 2011. Jelgava. 2011. P. 33–38.
17. **Darvey N. L., Naeem H., Gustafson J. P.** Triticale: production and utilization. Chapter 9 in: Handbook of Cereals Science and Technology, 2nd ed. Kulp K., Ponte J. (eds.), Marcel Dekker, New York, 2000.
18. **Coultate T. P.** Food: the Chemistry of its Components. Cambridge, UK: RSC Paperbacks, pp. 213–217, 2002.
19. **Martínez-Cervera S., Sanz T., Salvador A., Fiszman S. M.** // LWT - Food Science and Technology. 2012. Vol. 45. P. 213–220.

M. Sabovics, E. Straumite, R. Galoburda, I. Kantike

LATVIJOS VARTOTOJŲ POŽIŪRIS Į NAUJUS PRODUKTUS, PAGAMINTUS IŠ KVIETRUGIŲ IR KITŲ MILTŲ MIŠINIŲ

S a n t r a u k a

Dažniausiai kvietrugiai (*Triticosecale Wittmack*) auginami gyvūnų pašarams, tačiau kai kuriuos maisto produktus, kurių pagrindą sudaro kvietrugiai, galima įsigyti ir sveiko maisto parduotuvėse. Darbo tikslas – įvertinti vartotojų požiūrį į kuriamums naujus maisto produktus, kurie yra pagaminti iš neskaldytų rugių ir kvietrugių grudų bei miežių, ryžių ir kukurūzų miltų. Kitų grūdų miltų buvo pridėta siekiant pagerinti kvietrugių miltų kokybę.

Buvo vertintos bandelės ir krekeriai. Kiekvienam respondentui buvo pateikti keturi bandiniai – 2 kontroliniai (pagaminti naudojant tradicines receptūras) ir 2 naujai sukurti produktai (naudojant kvietrugių miltus).

Apklausoje dalyvavo 113 respondentų, iš kurių – 32 (28,3 %) vyrai ir 81 (71,7 %) moterys.

Remiantis hedonine skale, rezultatai yra intervale nuo 6,92 iki 7,61. 103 respondentams naujai sukurti produktai patiko labiau nei tradiciniai. Respondentai nurodė, kad nauji produktai yra skanesni ir naudingesni sveikatai ir kad jie norėtų jų įsigyti mažmeninės prekybos parduotuvėse.

Kvietrugių naudojimas duonos ir kitų maisto produktų, pvz., makaronų ir sausų pusryčių, gamybai yra perspektyvus.