POLISH JOURNAL OF FOOD AND NUTRITION SCIENCES
Pol. J. Food Nutr. Sci. 2005, Vol. 14/55, No 3, pp. 281–286

EFFECTS OF WHEAT FLOUR SUPPLEMENTATION WITH OAT PRODUCTS ON DOUGH AND BREAD QUALITY

Anna Czubaszek, Zofia Karolini-Skaradzińska

Department of Cereal Technology, Agricultural University of Wrocław, Wrocław

Key words: breadmaking, oat flour, bran and flakes, wheat flour

The aim of this research was to determine the effects of adding oat flour, bran and flake on the properties of wheat flour, wheat-oat dough and baked products. Two wheat flours of different quality were used in this study as test samples. Blends were made by replacing wheat flour with 5, 10, 15 and 20% of oat products. The blends were analysed for wet gluten content, sedimentation value, farinographic and extensigraphic parameters, and subjected to baking tests.

Increases in the percentage of oat products in the blends were observed to be markedly responsible for decreases in the sedimentation value and quantity of wet gluten washed from the blends. Water absorption estimated using a farinograph increased as substitution with the oat product increased. The addition of oat products to weak-quality wheat flour (commercial wheat flour – CWF) extended the peak time. After adding oat products to strong flour (lab-milled flour – LMF), the time to breakdown was shortened. Unlike oat flour, the presence of oat bran and flakes in the dough was responsible for extending the peak time and had a better effect on dough extensibility measured by an extensigraph. Based on the evaluation of dough energy, it was shown that wheat-oat mixes containing 5 and 10% of oat products recorded average baking values. The same percentage of oat products brought about the improvement in loaf volumes baked with CWF, whereas baked products from strong flour (LMF) enriched with oats demonstrated a smaller volume and worse crumb structure than the wheat breads.

Wheat-oat dough and bread containing 5 and 10% of oat products were characterised by fairly good quality, whereas oat flakes and bran exerted a more beneficial effect on their quality, compared to oat flour.

INTRODUCTION

Baked products are the third most important components of staple diets [Cichoń & Miśniakiewicz, 2001]. Their nutritional value varies and depends on the recipes used in their production. In Poland white wheat and rye flours are used most frequently for breadmaking, even though they are deficient in valuable nutrients present in the coat and aleurone layer of grain. Consequently, baked products should be modified with various additives to balance their nutritional quality and make up for the loss of nutrients during processing [Szajewska *et al.*, 2001].

The cereal which attracts much interest in this context on account of its nutritional value is oats. Its grain is rich in protein and dietary fiber and its content of fatty acids is favourable [Liukkonen *et al.*, 1992]. Wieser *et al.* [1980] demonstrated that oat flour is much richer in protein than wheat, rye, barley, rice, maize and sorghum flours. The average lipid content of oat grain reaches *ca.* 5–9%, triaglycerols with a high percentage of unsaturated fatty acids constituting the main fraction [Kawka, 1996]. Anderson and Bridges [1993] emphasised the profound importance of water-soluble dietary fibers in oat flour and bran. According to their results, the incorporation of oat products into a human diet lowers blood cholesterol levels.

Thus, oat products may be regarded as valuable additives to wheat flour. However, they may also diversely affect the quality of the baked product owing to various factors such as wheat flour quality, the type and quantity of oat products. Lapveteläinen *et al.* [1994] reported that a 3% higher protein oat flour additive incorporated into wheat flour caused baked products to have darker crumb structure and worse porosity, as well as affected their aroma. Gambuś *et al.* [2001] demonstrated that loaves enriched with 5% of bran were well-risen and their taste remained unchanged. According to those investigators, bran additives are more beneficial than the oat flour added. Oomah [1983], and Zhang *et al.* [1998] concluded that the volume of a wheat-oat loaf is smaller than that of a wheat loaf. Other researchers reported increases in this parameter [Lapveteläinen *et al.*, 1994, Subda *et al.*, 1998]. Few papers on the effect of oat products on wheat flour baking value are preoccupied with one type of product only. Results obtained so far remain inconclusive. For this reason, the research reported in this paper was carried out to determine changes in the properties of wheat dough and bread enriched with oat flour, bran and flakes. Attempts were also made to identify how much of oat product could be used to replace wheat flour to obtain good-quality dough and baked products, and which of the products used in our research would produce the best results.

Author's address for correspondence: Anna Czubaszek, Department of Cereal Technology, Agricultural University of Wrocław, ul. Norwida 25, 50-375 Wrocław, Poland; e-mail: aczub@ozi.ar.wroc.pl

MATERIALS AND METHODS

Two types of flour were used in this study: commercial wheat flour type 850 (CWF) and wheat flour (LMF) obtained from winter wheat grain by using a laboratory mill Quadrumat Senior (Brabender OHG) (64% yield) and oat products: flakes and hulled grain (KOMPLEKS MŁYN, Wągrowiec). Before the experiment, the oat flakes were finely ground using a laboratory mill WŻ-1 (ZBPP, Bydgoszcz), and the oat grain was ground in a laboratory mill (Quadrumat Junior), which yielded 46% and 54% of oat flour and oat bran, respectively. Twenty four hours before the milling, the oat grain was moistened with water until its moisture content was 11%.

CWF showed worse quality indices (wet gluten content: 29.6%, time to breakdown: 5.6 min, dough energy: 109 cm^2) when compared with LMF (34.8%, 24.8 min and 132 cm^2, respectively). Both flours did not differ in terms of sedimentation value (74 and 75 cm^3) and water absorption (60.8 and 61.1%, respectively).

For both types of flour (CWF, LMF), samples were prepared that contained 0, 5, 10, 15 and 20% of oat product (flour, bran or flakes). The experiment was carried out using materials from crops harvested in 2001 and 2002.

Wheat flour without additives and blends containing oat products were determined for wet gluten content [AACC, 2000] and sedimentation value [Axford *et al.*, 1979]. Physical properties of the dough were identified using a Brabender farinograph and an extensigraph. Farinograms and extensigrams were evaluated using the AACC methods 54–21 and 54–10, respectively [AACC, 2000]. Baking tests were also carried out [Karolini-Skaradzińska *et al.*, 2001]. Bread loaf volume was measured using grain of millet (SAWY apparatus, ZBPP Bydgoszcz), and crumb porosity was scored according to Dallmann's pore table. The identifying procedure was carried out in duplicate.

The results were subjected to one-way ANOVA with four variables: wheat flour type, oat product type, the percentage of oat products in the blend, and the year of the experiment. Variations induced by the above-mentioned factors and the interactions between them were compared with variations occurring in the interactions between all the four factors. The differences between the means were assessed using Duncan's multiple range test. The statistical analyses were conducted using *Statgraphics 5.0 Software*.

RESULTS AND DISCUSSION

The quality of wheat flour is known to depend primarily on the quantity and quality of protein. Perten [1990] reported that the quantity and quality of proteins may be determined by the content and quality of gluten. Ohm and Chung [1999] concluded that gluten parameters determined the quality of wheat flour. Wheat flours used in this study showed a high wet gluten content remaining roughly at the level of 32.2% (Table 1). The addition of oat products to wheat flour caused diffusion of gluten proteins, which resulted in a loss of dough strength and a decrease in loaf volume [Zhang *et al.*, 1998]. Our own experiments have shown that oat flour, bran and flakes had an identical effect on the percentage of washed gluten, whereas their successively increased contents (by 5%) in the blends led to a progressive decrease in the amount of gluten by *ca.* 2% (Table 1). Baking standards require the wheat flour used for bread making to contain at least 25% of wet gluten. In our experiments, an average of 25.1% of gluten was washed from the mixes containing 20% of oats. It may thus be concluded that an appreciable amount of gluten in the flour enriched with as much as 20% of oat product may be sufficient to obtain good-quality baking products.

TABLE 1.Wet gluten content and sedimentation value in wheat-oat blends (averages for samples with the addition of flour, bran and oat flakes and of samples with different percentage of oat-products).

Wheat flour with additive	Trait	Wet gluten content (%)	Sedimentation value (cm^3)
Oat product type	Flour	28.7^a	67.5^a
	Bran	28.8^a	67.4^a
	Flakes	28.9^a	68.0^a
Percentage of oat products	0%	32.2^a	74.4^a
	5%	30.5^b	71.1^b
	10%	28.9^c	67.5^c
	15%	27.2^d	64.5^d
	20%	25.1^e	60.6^e

a, b, c, d, e – homogenous groups estimated with Duncan's test ($p \geq 0.95$)

A useful parameter which can be used to determine the quality of protein in flour is the sedimentation value. Differences in the sedimentation values for blends containing oat flour, bran and flakes were insignificant (Table 1). Increasing the content of these additives led to a decrease in the sedimentation value. When viewed from the perspective of baking technologies, it indicates the deterioration of hydration properties of protein composition.

Oomah [1983] suggested that it is crucial to know the rheological properties of wheat-oat dough before oat products could be effectivelly utilised in the bread baking industry. These properties are normally determined with a farinograph and using this instrument it is possible to obtain information on the physical properties, such as water absorption of flour and a general profile of dough mixing behaviour [D'Appolonia, 1984]. The oat products used in our research had a varied impact on water absorption of wheat flour. Mixes containing 5, 10, 15 and 20% of oat bran and flakes showed higher water absorption than the same type of mixes containing oat flour (Table 2). It was also concluded that the increased percentage of bran and flakes in the mix led to an increase in water absorption progresssively by *ca.* 1%, whereas the oat flour additive raised this parameter inconsiderably (0.7–1% increase compared to mean values obtained for wheat flours). The high absorption of water by blends containing oat bran and flakes was due to the presence of grain coat particles in those products [Oomah, 1983]. Zhang *et al.* [1998] maintained that the increased water absorption by wheat-oat flour blends was due to a high β-glucan content of oats. Lee *et al.* [1995] reported that adding 1% barley β-glucan into a wheat flour dough system not only increased water absorption estimated with a farinograph, but also extended the time development and stability of dough. The research reported in this

TABLE 2. Farinograph traits of wheat-oat dough (averages for samples with different addition of oat flour, bran and flakes).

Trait	Water absorption (%)			Peak time (min)		
Oat product type / Percentage of oat products in wheat-oat blends	Flour	Bran	Flakes	Flour	Bran	Flakes
0%	61.0^{c}	61.0^{e}	61.0^{e}	3.7^{a}	3.7^{b}	3.7^{b}
5%	61.2^{bc}	62.4^{d}	62.2^{d}	2.7^{b}	4.9^{a}	3.3^{b}
10%	61.7^{ab}	63.3^{c}	63.0^{c}	2.7^{b}	5.0^{a}	4.7^{a}
15%	61.7^{ab}	64.8^{b}	64.2^{b}	2.6^{b}	5.0^{a}	4.7^{a}
20%	62.0^{a}	66.2^{a}	65.3^{a}	2.5^{b}	4.9^{a}	4.5^{a}

a, b, c, d, e – homogenous groups estimated with Duncan's test (p≥0.95)

paper suggests that the addition of oat bran and flakes generally extends the peak time. A 5–20% bran additive brought about an identical increase in this parameter by about 1.2 min (Table 2). With oat flake additives exceeding 10%, the peak time extended to about 1 min when compared with the dough made from wheat flour. By contrast, a 5–20% oat flour additive shortened the peak time by 1 min, compared to wheat dough. Oat bran and flakes appear to have enriched the dough with water absorptive bran particles responsible for the extension of the time of dough formation.

The statistical analyses showed varied mechanical endurance of doughs baked with CWF and LMF (Table 3). The differences noted were due to the type of products used in the research and to their content in the mixes. CWF showed a shorter peak time and time to breakdown (3.0 and 5.6 min, respectively) than LMF (4.3 and 24.8 min). The time to breakdown for LMF doughs and flakes (18.4 min) was longer that that for doughs made from oat flours and bran (14.1 and 15.1, respectively). No significant differences were observed between the times to breakdown for blends containing CWF after the addition of various oat products. Zhang *et al.* [1998] reported that adequate hydrothermal treatments of oat grain may have favourable effects on the rheological properties of wheat-oat dough and this may account for the good properties of the dough with oat flakes. The peak time for weak flour (CWF) was extended by adding 10, 15 and 20% of oat products (CWF – 3 min; 10 and 15% – 3.7 min, 20% – 3.6 min), whereas the time to breakdown was not affected (Table 3). The strong flour (LMF) doughs containing various percentages of oat products had a similar peak time (4.3–4.6 min), though the time to breakdown was shortened significantly at the 5% level of substitution (24.8–15.6 min). The improvements in the properties of the weak wheat flour following the addition of oat products may have been due to their high lipid content [Oomah, 1983]. On the other hand, the weakening of the strong flour dough, which was indicated by a shortening of the time to breakdown, may have been caused by the oat gluten dilution effect resulting from the addition of oat products [Zhang *et al.*, 1998].

Wheat flour can be classified in terms of dough energy measured with an extensigraph. Thus four flours have been classified: weak (energy below 80 cm^2), medium (80–120 cm^2), strong (120–200 cm^2), and very strong (above 200 cm^2) [Preston & Hoseney, 1991]. Comparing the average energy of wheat doughs (120.9 cm^2) (Table 4) with the above-mentioned values, it may be concluded that the wheat flours used in our research showed average baking values. The energy of the dough decreased as oat product percentage increased in the wheat flour blends. At the 5 and 10% levels of substitution, the dough could be classified as medium, and at 15 and 20% – as weak already. It should also be noted that the average energy of doughs containing oat flakes (94.4 cm^2) was higher than in doughs containing oat flour (92.8 cm^2) or bran (90.4 cm^2).

TABLE 3. Farinograph traits of wheat-oat dough (averages for samples of wheat flour CWF and LMF with the addition of oat flour, bran and flakes, and with different contents of oat-products).

Trait		Peak time (min)		Time to breakdown (min)	
Wheat flour type / Wheat flour with additive		CWF	LMF	CWF	LMF
Oat product type	Flour	2.5^{a}	3.2^{a}	5.5^{a}	14.1^{b}
	Bran	4.0^{a}	5.4^{a}	6.8^{a}	15.1^{b}
	Flakes	3.6^{a}	4.7^{a}	6.1^{a}	18.4^{a}
Percentage of oat products	0%	3.0^{b}	4.3^{a}	5.6^{a}	24.8^{a}
	5%	2.8^{b}	4.4^{a}	6.2^{a}	15.6^{b}
	10%	3.7^{a}	4.6^{a}	6.0^{a}	13.6^{bc}
	15%	3.7^{a}	4.5^{a}	6.4^{a}	13.3^{bc}
	20%	3.6^{a}	4.4^{a}	6.6^{a}	12.0^{c}

a, b, c, – homogenous groups estimated with Duncan's test (p≥0.95)

TABLE 4. Extensigraph traits of wheat-oat dough (averages for samples with the addition of oat flour, bran and flakes and for samples with different content of oat-products).

Trait / Wheat flour with additive		Energy of dough (cm^2)	Extensibility of dough (mm)	Maximum dough resistance (UB)
Oat product type	Flour	92.8^{b}	172^{a}	388^{a}
	Bran	90.4^{c}	166^{b}	389^{a}
	Flakes	94.4^{a}	162^{b}	405^{a}
Percentage of oat products	0%	120.9^{a}	166^{ab}	518^{a}
	5%	109.0^{b}	170^{a}	473^{b}
	10%	88.3^{c}	172^{a}	347^{c}
	15%	75.5^{d}	167^{ab}	319^{c}
	20%	69.1^{d}	160^{b}	312^{c}

a, b, c, d – homogenous groups estimated with Duncan's test (p≥0.95)

Lapveteläinen *et al.* [1994] reported that dough extensibility and resistance measured with an extensigraph decreased following the addition of 3 and 6% of high-protein oat flour to wheat flour. According to those investigators, the weakening of wheat-oat dough may have been caused by enzyme activity in oat flour. Our own experiments have demonstrated that dough extensibility was greater in oat flour blends (172 mm) than in blends containing bran and flakes (166 and 162 mm, respectively) (Table 4). As the percentage of oats increased, differences were observed in CWF and LMF dough extensibility. The increased percentage of oat products in CWF led to a gradual decrease in dough extensibility (0% – 186 mm, 20% – 165 mm) (Table 5). By contrast, the extensibility of the dough made from strong flour (LMF) increased. In addition, the maximum resistance of the dough containing oat flour, bran and flakes was found to vary as their percentage increased (Table 6). At the 5% addition of oat products, the bran addition (528 UB) was more beneficial than flour and flake additions (436 and 455 UB, respectively), at 15 and 20% substitution – the dough containing oat flakes had better properties. However, the resistance of the dough markedly declined due to the addition of 5% of oat products (Tables 4 and 6).

A thoroughout evaluation of flour strength is made possible after the breadbaking test. Gambuś *et al.* [2001] concluded that, owing to the quality and nutritional value of the dough, oat bran is a more valuable technological additive for breadmaking than oat flour. These authors recommended the 5% addition of oat bran to wheat breads. The analytical data cited in the literature regarding the volume of bread loaves containing oat products vary. Some investigators [Oomah, 1983; Krishnan *et al.*, 1987; Zhang *et al.*, 1998; Gambuś *et al.*, 2001] reported a decrease, whereas others [Lapveteläinen *et al.*, 1994; Subda *et al.*, 1998] noted an increase in bread loaf volume after the addition of oat products to wheat flour. In the experiments reported in this paper, the volume of bread loaves baked with CWF and LMF was observed to be differently affected by oat products and their percentage in the blend (Table 7). The average loaf volumes of bread baked with LMF and all oat products investigated in our experiments were similar (493–507 cm^3). The loaves baked with CWF enriched with oat flour and flakes had higher volumes (551 and 545 cm^3, respectively) than those containing bran (519 cm^3). The incorporation of 5 and 10% of oat products into CWF blends increased loaf volume when compared with the mixes containing wheat flour. At the 15 and 20% levels of substitution, changes in volume were insignificant. For loaves baked with LMF, however, the volume of loaves containing 5% of oat products was comparable to that of wheat bread loaves, whereas at a higher level of substitution the loaf volume decreased (Table 7).

TABLE 5. Extensibility of wheat-oat dough (averages for wheat flour CWF and LMF with different contents of oat products).

Trait	Extensibility of dough (mm)	
Percentage of oat products in wheat-oat blends \ Wheat flour type	CWF	LMF
0%	186^a	146^b
5%	181^{ab}	158^a
10%	182^{ab}	163^a
15%	173^{bc}	162^a
20%	165^c	154^a

a, b, c – homogenous groups estimated with Duncan's test (p≥0.95)

TABLE 7. Features of wheat-oat bread (averages for CWF and LMF samples with the addition of oat flour, bran and flakes and with different content of oat products).

Trait		Bread loaf volume from 100 g flour (cm^3)		Crumb porosity by Dallman's scale (points)	
Wheat flour with additive \ Wheat flour type		CWF	LMF	CWF	LMF
Oat product type	Flour	551^a	493^a	4.5^a	7.0^a
	Bran	519^b	507^a	4.5^a	5.5^b
	Flakes	545^a	498^a	4.6^a	5.5^b
Percentage of oat products	0%	534^{bc}	520^a	4.0^a	7.5^a
	5%	563^a	512^{ab}	4.8^a	6.3^b
	10%	548^{ab}	494^c	5.0^a	6.0^{bc}
	15%	522^c	501^{bc}	4.5^a	5.2^{bc}
	20%	524^c	474^d	4.3^a	5.0^c

a, b, c, d – homogenous groups estimated with Duncan's test (p≥0.95)

The crumb structure of loaves was measured according to the 8-grade Dallman's score. Neither the type of oat product, nor its content in the blends (Table 7) affected the crumb porosity of loaves baked with CWF. On the other hand, the crumb of loaves baked with LMF enriched with oat flour had a better score (7 points) than that with added bran and flakes (5.5 points). An increase in the percentage of oat products in breads baked with that type of flour significantly deteriorated crumb structure (wheat bread – 7.5 points; breads with oat additions 5–6.3 points).

CONCLUSIONS

1. Oat products – flour, bran and flakes – had identical effects on the yield of washed wet gluten and hydration properties of proteins (sedimentation value) causing it to decrease significantly with their increased substitution.

TABLE 6. Maximum dough resistance of wheat-oat dough (averages for samples with different addition of oat flour, bran and flakes).

Trait	Maximum dough resistance (UB)				
Oat products type \ Percentage of oat products in wheat-oat blends	0%	5%	10%	15%	20%
Flour	518^a	436^b	371^a	318^b	298^{ab}
Bran	518^a	528^a	335^a	281^b	281^b
Flakes	518^a	455^b	334^a	359^a	358^a

a, b – homogenous groups estimated with Duncan's test (p≥0.95)

2. The water absorption of flour was found to increase with a higher percentage of oat products, especially in the wheat flour mixes containing bran and flakes. An increase in oat products resulted in the extension of the time required for the farinograph curve to reach maximum consistency for the dough made from CWF flour and in the shortening of the time to breakdown of the dough made from LMF flour. In contrast to oat flour, the addition of oat bran and flakes caused the peak time to extend.

3. On the basis of evaluation of dough energy it was demonstrated average quality of dough at the 5 and 10% addition of oat- products; and weak at higher levels of addition. Bran and flakes increased the extensibility of the doughs.

4. The loaf volume of bread with weak-quality flour (CWF) was beneficially affected by the addition of 5 and 10% oat products. The crumb structure of bread from flour LMF deteriorated as the additive of oats products increased.

5. The properties of wheat-oat doughs and breads were more favourably affected by oat flakes and bran than by oat flour. The results obtained showed that wheat flour may be replaced with up to 10% of oat products without deteriorating its quality.

REFERENCES

1. AACC, American Association of Cereal Chemists: Approved Methods of the AACC, 10th ed. Methods 38–10, 54–10, 54–21. The Association, St. Paul, MN, 2000.
2. Anderson J.W., Bridges S.R., Hypocholesterolemic effects of oat bran in humans. 1993, *in*: Oat Bran (ed. P.J. Wood). Am. Assoc. Cereal Chem. St. Paul, MN, pp. 139–197.
3. Axford D.W.E., McDetmott E.E., Retman D.G., Note on the sodium dodecyl sulfate test of breadmaking quality. Comparison with Pelshenke and Zeleny tests. Cereal Chem., 1979, 56, 582–584.
4. Cichoń Z., Miśniakiewicz M., Research of consumers preference of bread in aspect his qualities. 2001, *in*: Technology of Food and Expectations of Consumers (eds. T. Haber, H. Porzucek). Wydz. Techn. Żywn. SGGW, KTiChŻ PAN (materials on CD) Warszawa, p. 6 (in Polish)
5. D'Appolonia B.L., Types of farinograph curves and factor affecting them. 1984, *in*: Farinograph Handbook (eds. B.L. D'Appolonia, W.H. Kunerth). Am. Assoc. Cereal Chem. St. Paul MN, pp. 13–23.
6. Gambuś H., Gambuś F., Pisulewska E., Advisability of use of naked oat milling products to baking of bread. 2001, *in*: Technology of Food and Expectations of Consumers (eds. T. Haber, H. Porzucek). Wydz. Techn. Żywn. SGGW, KTiChŻ PAN (materials on CD) Warszawa, p. 5 (in Polish).
7. Karolini-Skaradzińska Z., Subda H., Korczak B., Kowalska B., Żmijewski M., Czubaszek A., Technological assessment of grain and flour of selected winter cultivars. Żywność. Nauka. Technologia. Jakość, 2001, 27, 2, 68–77 (in Polish; English abstract).
8. Kawka A., Lipids of oat groats – content, distribution and fraction composition. Post. Nauk Rol., 1996, 1, 65–73 (in Polish; English abstract).
9. Krishnan P.G., Chang K.C., Bron G., Effect of commercial oat bran on the characteristics and composition of bread. Cereal Chem., 1987, 64, 55–58.
10. Lapveteläinen A., Puolanne E. Salovaara H., High-protein oat flour functionality assessment in bread and sausage. J. Food Sci., 1994, 59, 1081–1085.
11. Lee Y.T., Schwartz P.B., D'Appolonia B.L., Effects of (1,3),(1-4) β-glucans from hull-less barley on the properties of wheat starch, flour and bread. Barley Newsl., 1995, 39, 83–88.
12. Liukkonen K.H., Montfoort A., Laakso S.V., Water--induced lipid changes in oat processing. J. Agric. Food Chem., 1992, 40, 126–130.
13. Ohm J.B., Chung O.K., Gluten, pasting and mixograph parameters of hard winter wheat flours in relation to breadmaking. Cereal Chem., 1999, 76, 606–613.
14. Oomah B.D., Baking and related properties of wheat–oat composite flours. Cereal Chem., 1983, 60, 220–225.
15. Perten H., Rapid measurement of wheat gluten quality by the gluten index. Cereal Chem., 1990, 35, 401–402.
16. Preston K.R., Hoseney R.C., Applications of the extensigraph. 1991, *in*: Extensigraph Handbook (eds. V.F. Rasper, K.R. Preston). Am. Assoc. Cereal Chem. St Paul, MN, p. 13.
17. Subda H., Karolini-Skaradzińska Z., Czubaszek A., Chemical composition and technological value of several oat cultivars. Biul. Inst. Hod. Rośl., 1998, 208, 111–122 (in Polish; English abstract).
18. Szajewska A., Ceglińska A., Haber T., Tests to use of protein-fiber preparations as additions to wheat bread. 2001, *in*: Technology of Food and Expectations of Consumers (eds. T. Haber, H. Porzucek). Wydz. Techn. Żywn. SGGW, KTiChŻ PAN (materials on CD) Warszawa, p. 6 (in Polish).
19. Wieser H., Seilmeier W., Belitz H.D., Vergleichende Untersuchungen über partielle Aminosäuresequenzen von Prolaminen und Glutelinen verscheidener Getreidearten. Lebensm. Unters. Forsch., 1980, 170, 17–26.
20. Zhang D., Moore W.R., Doehlert D.C., Effects of oat grain hydrothermal treatments on wheat-oat flour dough properties and breadmaking quality. Cereal Chem., 1998, 75, 602–605.

Received January 2004. Revision received May 2004 and accepted January 2005.

WPŁYW DODATKU PRODUKTÓW OWSIANYCH NA JAKOŚĆ CIASTA I PIECZYWA PSZENNO-OWSIANEGO

Anna Czubaszek, Zofia Karolini-Skaradzińska

Zakład Technologii Zbóż, Akademia Rolnicza we Wrocławiu, Wrocław

Celem pracy było określenie wpływu dodatku mąki, otrąb i płatków owsianych na właściwości mąki pszennej, ciasta i pieczywa pszenno-owsianego. Do badań użyto dwie mąki pszenne różniące się jakością. Stanowiły one próby kontrolne. Mieszanki sporządzono zastępując mąkę pszenną produktami owsianymi w ilości 5, 10, 15 i 20%. Dla tak przygotowanych próbek określono zawartość glutenu mokrego, liczbę sedymentacji, cechy farinograficzne i ekstensograficzne ciasta oraz wykonano wypieki laboratoryjne.

Stwierdzono, że przy wzroście dodatku produktów owsianych istotnie zmniejszała się ilość wymytego z mieszanek glutenu mokrego i wartość liczby sedymentacji (tab. 1). Wodochłonność mąki oznaczana farinograficznie zwiększała się pod wpływem udziału produktów owsianych (tab. 2). Produkty owsiane dodawane do słabszej jakościowo mąki pszennej (handlowej) (CWF) wydłużały czas do maksimum, a w cieście z mąki mocniejszej (uzyskanej z przemiału laboratoryjnego) (LMF) skracały czas do załamania (tab. 3). Udział otrąb i płatków w cieście, w przeciwieństwie do mąki owsianej, powodował wydłużenie czasu do maksimum i korzystniej działał na rozciągliwość ciasta ocenianą ekstensograficznie (tab. 2 i 4). Na podstawie energii ciasta stwierdzono, że przy 5 i 10% udziale produktów owsianych mieszanki pszenno-owsiane miały średnią wartość wypiekową (tab. 4). Przy takiej ilości produktów owsianych poprawiała się objętość chleba z mąki handlowej (CWF), a pieczywo z mocnej mąki (LMF), po dodaniu produktów owsianych, miało mniejszą objętość i gorszą strukturę miękiszu niż chleby pszenne (tab. 7).

Ciasto i pieczywo pszenno-owsiane z 5 i 10% udziałem produktów owsianych charakteryzowało się odpowiednią jakością, a płatki i otręby owsiane korzystniej oddziaływały na cechy jakościowe niż mąka owsiana.