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THE EFFECT OF DIFFERENT PULSE ADDTIVES TO BREAD PRODUCTS

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ABSTRACT

The work on improving nutritional value of bread by addition pulses of legume plants was described. To white, wheat bread the whole as well as milled pulses of Lathyrus sativus (grass-pea), Cicer arietinum (chick-pea) and Lens culinaris (lentils) were added at different levels. The milled pulses decreased bread's quality even at lower doses. Addition of 20% whole pulses of described above legume plants increased nutritional value of wheat breads and only slightly decreased its quality. According to opinion of consumers about healthy food, the improvers were not used in this work.

Key words: bread, pulses, nutritional value

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INTRODUCTION

The consumption of bakery products in Poland is about 127 kg/inhabitant in a year. (Year-book Poland 1999, 2000) The mostly consumed product is bread and this has prompted the need to improve its nutritive values by applying additives for adequate feeding of the population. Bread devoid of enriched additives, even the nutritious products such as whole- or meal grain – breads can not fully or completely satisfy the requirements of different consumers. The bread baking processes enable the application of different supplements inquantities of few percentages. The new emerging bread products in the market attract newconsumers and has kept the high demand for bread consumption among other products in the market. Therefore, it is inevitable to increase and apply novel additives to bread products for the enrichment of their tastes, nutritive value as well as reducing the incidence of civilization diseases (Kędzior, 1994).

The newly proposed assortments of bread ought to or should be a combination of good quality organoleptic and nutritive values. The application of additives to dough should maintain its visco-elastic properties. The most commonly or currently used additives for bread baking include milk products, cereals (whole or milled), wheat germ, essential or vital gluten as well as pulses from legume plants or oil seeds *e.g* soya. The pulses from legume plants are characterized by high nutritive values because of their high protein contents, high quality aminoacid compositions, vitamins and trace elements (Nestares, López-Frías, Barrionuevo, & Urbano, 1996; Van der Poel, 1990). The effect and the presence of anti-nutritive agents in different pulses can be eliminated or reduced by heat treatment, f.i. during the baking processes (Ruiz, Price, Arthur, Rose, Rhodes, & Fenwick, 1996; Van der Poel, 1990). The consumption of seeds from legume plants in Poland is low and amounts to about 1 kg/inhabitant in a year. Nevertheless, an increased interest for vegetarian foods has immensely popularized the nutritive values of these raw-materials (Dojczew, Kosziewicz & Lewczuk, 1996; Kawka & Flaczyk, 2000). Studies on the application of new generation additives such as pulses to bakery products are conducted in many experimental stations (Terri, Byung-Kee & Czuchajowska, 1997). The production of these new and attractive bakery products with addition of pulses can promote or increase their consumption.

In this paper, the application of pulses as additives for the enrichment of nutritive values and tastes of bread products were examined.

MATERIALS AND METHODS

In this study, whole and milled pulses of legume plants, grinded to flour meal and sieved with 0.43 mm sieve were used and represented about 80% of the two meshing fractions. The following pulses were used:

- Lathyrus sativus, a variety of KRAB from the Institute of Plant Breeding and Horticultural Seed Production “Spojnia” in Nochow, Poland,
- Cicer arietinum L was obtained from a local market,
- Lens culinaris, also was obtained from a local market as four commercial varieties: shreded, black, green and red.

Wheat flour type 550 and rye flour type 720 mixed at a ratio of 9:1 were used. For the preparation of the dough before baking, whole-pulses were added at 10% or 20%, while whole-milled pulses were added at 5% or 10%. The whole pulses were soaked in water for an appropriate time (0,5–2h) in order to soften them before adding to dough. The dough contained 2% salt and 3% yeast.

Methods

The cereal flours were assayed for dry matter - AOAC 32.063 (AOAC, 1984), gluten content with Glutomatic apparatus, gluten index, falling number and sedimentation values according to the ICC specifications No. 107, 116 and 137 (ICC-standards, 1995).

The analyses of pulses were also conducted for dry matter - AOAC 32.063 (AOAC, 1984), starch content - ICC standard No. 122 (ICC-standards, 1995), simply and total sugars - AOAC 32.040, 32.041 (AOAC, 1984). The content of dietary fiber in pulses were determined by the method of Hellendoorn (Rutkowska, 1981), raw protein content was determined according to the Kjeldahl method in Büchi distillation unit B 324 (N×6.25), while fat contents - according to the method of Soxhlet, using Büchi Universal Extraction System B 811.

A one–phase dough baking process was conducted at 230 °C for 35 min. From each additive combination, six bread products were baked and the organoleptic properties were evaluated in 40 scale–point. The dough yield, bread yield, oven loss and total baking loss were calculated (Jakubczyk & Haber, 1993).

The bread texture profile measurements were conducted on the day of baking and after 24, 48, and 72 h using a texture analyzer type TX–XTA integrated with a software XTRI. The following parameters were measured: hardness, cohesion, elasticity, adhesion, viscosity, chewiness, firmness and guminess.

The statistical analyses were used to calculate the significant differences in the chemical compositions of the examined pulses using the tests of F–Snedecor and t-Student The least significant difference (LSD) was determined at $p = 0.01$.

RESULTS AND DISCUSSION

The wheat and rye flours used for the preparation of baking processes had a good baking qualities. The results of the analyses are shown in Table 1. The wheat flour had a good falling value, dough stability time as well as high amount of gluten content of good quality parameters. Of course, flour of a good baking quality should have a gluten index value above 90% but flours used for baking processes with added yeast should have gluten index values of 60 – 90% (Ramulu & Udayasekhara Rao, 1997). At higher gluten index value, the gluten is short and strong and the flour of such value is used mainly to correct the baking quality of other flour products of low baking qualities. The marketable flour product of rye Type 720 used in this study can be classified as a product of high baking qualities based on the measured parameters such as falling value, water absorption, gelatinization characteristics and, particularly, its maximum viscosity.

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Table 1. Technologic values of the used wheat and rye flours

Criteria of quality	Wheat flour type 550	Rye flour type 720
Moist or Humidity [%]	13.1	11.4
Wet gluten [%]	29.9	-
Gluten quality value	70.0	-
Gluten index [%]	71.2	-
Sedimentation with SDS	55	-
Falling number [s]	348	244
Water absorption at 50 j.B [%]	58.6	57.7
Flour stability time [min]	5.1	-
Dough development time [min]	3.0	-
Dough relaxation[min]	80	-
Solubility time [min]	-	26.4
Initial temperature of gelatinization [° C]	-	49
Final temperature of gelatinization [° C]	-	70
Maximum viscosity of gelatine [j.B]	-	600

The chemical composition of the examined pulses in this study are shown in Table 2. The values were somewhat consistent with the reports of Dodok, Modhir, Hozova, Halasova & Polacek (1993). But, the existing differences in the contents of certain nutritional compositions of the examined pulses can be attributed to differences in the analytical procedures and the varieties of the examined pulses. Statistical analyses show that the genus of pulses had a significant effect on the measured or analyzed chemical composition of each pulse.

Table 2. Chemical composition of examined pulses in % dry mass

Type of pulse	Starch [%]	Protein [%]	Dietary fiber [%]	Fat [%]	Sugars (glucose, fructose, inverted sugars) [%]
Shreded (Lens culinaris)	52.0	28.8	8.0	1.4	5.2
Red (Lens culinaris)	46.4	26.6	18.6	1.4	5.2
Green (Lens culinaris)	46.9	24.9	15.9	1.6	5.3
Black (Lens culinaris)	47.5	22.5	19.1	1.8	5.9
Cicer arietinum	40.9	22.3	16.3	6.4	6.6
Lathyrus sativus	39.0	30.8	18.1	1.5	6.4
LSD p=0,01	1.88	1.35	1.07	0.06	0.14

The effect of added additives on the technologic values of the dough and the bread are shown in Table 3. The added additives increased the dough and bread yield and reduced the loss in yield during and after baking. A maximum addition of whole-pulse increased the bread yield by 12%. The form of pulses (whole or milled) had no effect on the reduction of yield loss. Upon addition of whole-pulse or seed, the yield losses were similar and were 15% and 7%, respectively for 10% and 20% added pulses as well as 7% and 16% at 5% and 10% added milled pulses, respectively. The reduction of total yield losses were around 10% for 10% added milled pulses, and in the other cases, these were about 3%.

Table 3. The effect of applied additives on the technologic values and qualities of dough and bread.

Type of additives	Dough Yield [%]	Bread yield [%]	Oven loss [%]	Total baked loss [%]	Bread volume [cm^3]	Organoleptic values (Quality class)
Standard	169.7	148.1	11.6	12.8	758	I
10 % whole – pulses						
Shreded (Lens culinaris)	179.9	158.2	9.8	12.1	757	I
Red (Lens culinariss)	179.9	159.4	9.5	11.4	742	I
Green (Lens culinaris)	179.9	160.3	8.4	10.9	735	I
Black (Lens culinaris)	179.9	156.6	8.4	12.9	740	I
Cicer arietinum	179.9	155.2	12.4	13.7	745	I
Lathyrus sativus	179.9	155.7	10.7	13.5	715	I
20 % whole – pulses						
Shreded (Lens culinaris)	190.2	167.7	10.8	11.8	742	I
Red (Lens culinariss)	190.2	166.9	10.3	12.2	740	I
Green (Len culinaris)	190.2	163.9	11.9	13.8	745	I
Black (Lens culinaris)	190.2	165.2	11.1	13.1	742	I
Cicer arietinum	190.2	166.6	10.7	12.4	724	I
Lathyrus sativus	190.2	168.5	9.5	11.4	757	I
5 % milled pulses						
Shreded (Lens	174.8	153.7	10.0	12.1	740	I

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culinaris)						
Red (Lens culinaris)	174.8	152.0	11.3	13.1	745	I
Green (Lens culinaris)	174.8	154.6	9.7	11.5	712	I
Black (Lens culinaris)	174.8	152.6	11.2	12.7	722	I
Cicer arietinum	174.8	151.7	11.6	13.2	735	I
Lathydrus sativus	174.8	153.5	10.8	12.2	722	I
10 % milled pulses						
Shreded (Lens culinaris)	179.9	160.2	8.5	10.9	557	II
Red (Lens culinaris)	179.9	160.5	8.9	10.8	505	II
Green (Lens culinaris)	179.9	160.2	8.8	11.0	560	II
Black (Lens culinaris)	179.9	157.2	10.8	12.6	512	II
Cicer arietinum	179.9	159.6	9.9	11.2	560	II
Lathydrus sativus	179.9	156.7	11.3	12.9	555	II

The bread mass of the examined products with added whole-pulses reduced by 2% irrespective of the amount or quantity added. The most rapid reduction of bread yield loss was observed for bread products with added milled pulses. These reductions were about 4% for 5% added milled-pulses. No changes was observed in the bread values due to the type (genus) and variety of added pulses.

All the examined breads had suitable or adequate tastes, flavours and light brown coloured bread-crumbs caused by the presence of added pulses and were positively evaluated. Breads with added 5% milled pulses as well as 10% and 20% whole-pulses were evaluated as class one category based on their organoleptic values. But, breads with 10% added milled pulses were the only ones qualified to class two category due to low volume of about one-third when compared to the standard (Table 3). Breads with added whole-pulses obtained the highest point. These breads were characterized with such features like good external appearance, while the size and volume are consistent with the parameters of the standard. Bread with added pulse from Len culinaris super-passed the others although it had a lesser volume or size but these pulses were equally distributed on the bread-crumb compared with larger size of pulses such as Cicer arietinum and Lathyrus sativus.

The applied additives did not affect significantly the bread-crumb moist. A somewhat higher moist content was observed only for bread with 10% added milled pulses. On the other hand, the addition of 20% whole-pulses caused an increased fall of moist in the bread-crumb within three days and on the last day, the moist returned to its normal value as on the first day of baking, This is caused by reversible migration of water between the bread-crumb and the added pulses. After baking process, the pulses absorbed water from the bread-crumb of the loaf, which had the highest water content but after storage for 2 or more days, the water migrated back to the loaf from the pulses. We assumed that this process can be controlled by extending the soaking duration of the pulses before baking.

The hardness of the bread-crumb is one of the most significant factors that determines the texture profile of bread that allows the consumers to qualify bread as fresh or stale. The hardness of the bread-crumb with added whole-pulses were generally low when compared to the standard. But, at 20% added pulses, these values were almost similar to the standard on the third day (Figure 1).

For added milled pulses, these evaluated values were at high levels irrespective of the amount or concentration of added additives (Figure 2). Furthermore, the texture indexes of the analyzed bread *e.g* elasticity, were lower than the standard.

Figure 1. The effect of 20% whole grain additive on the harndess of breads crumb (hardness of standard bread crumb = 100%)

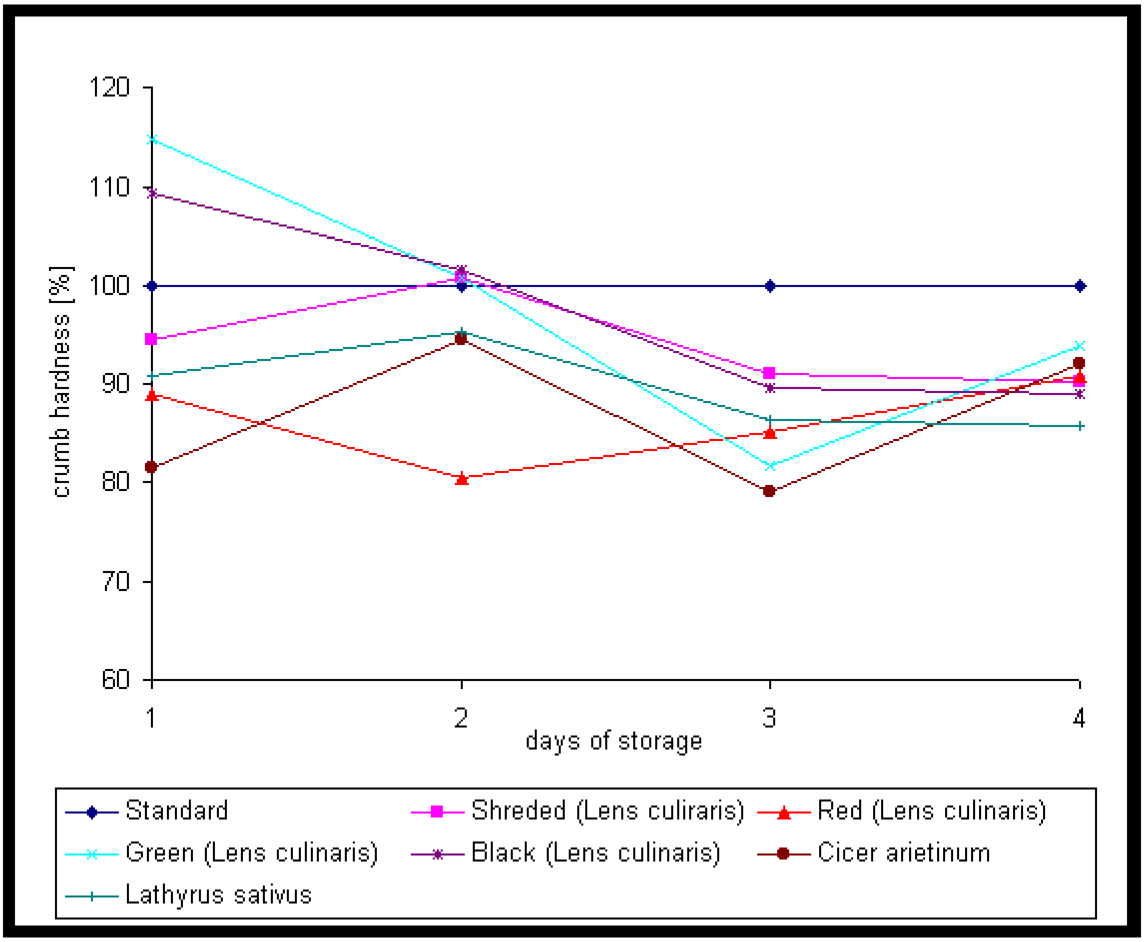

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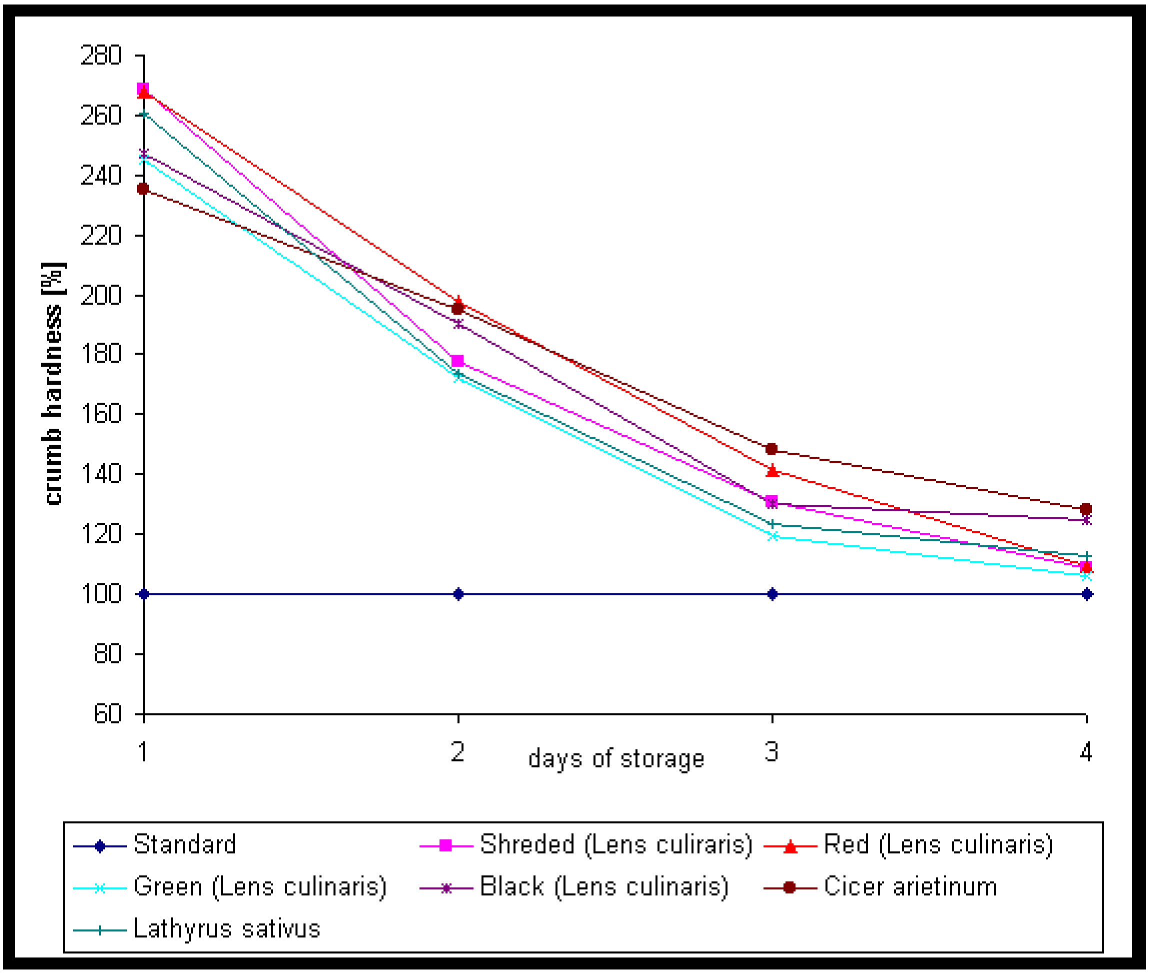
Figure 2. The effect of 10% milled pulses additive on the harndess of breads crumb (hardness of standard bread crumb = 100%)



CONCLUSIONS

1. Addition of legume pulses enriched the nutritive values of bread products, especially the protein contents.
2. In order to maximize enrichment of bread with nutritive compounds, it is better to use whole-pulses because of the possibility of increasing the level of additives without deteriorating the bread quality.
3. The pulses of Cicer arietinium, Lens culinaris and Lathyrus sativus can be used as additives for the enrichment of nutritive values of bread products at a maximum concentration of 20%. A higher concentration deteriorates the technologic and organoleptic properties of breads.

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REFERENCES

1. AOAC. (1984): Official methods of analysis. Arlington: Association of Official Analytical Chemists.
2. Dodok, L., Modhir, A., Hozova, B., Halasova, G., & Polacek I. (1993): Importance and utilization of chickpea in cereal technology. Acta Alimentaria 2, 110-129.
3. Dojczew, D., Kosziewicz, D., & Lewczuk J. (1996): Wpływ dodatków naturalnych na jakość pieczywa pszennego. Przegląd Piekarski i Cukierniczy 7, 35-37.
4. ICC - standards. (1995): Standard methods of the International Assosiation of Cereal Science and Technology (ICC). Vienna: ICC.
5. Jakubczyk, T., & Haber, T. (1993): Analiza zbóż i produktów zbożowych. Warsaw: Wydawnictwo SGGW AR.
6. Kawka, A., & Flaczyk, E. (2000): Dodatki technologiczne wzbogacające pieczywo. Przegląd Piekarski i Cukierniczy 5, 8-10.
7. Kędzior, Z. (1994). Porównanie wpływu dodatków mleka i koncentratu białka grochu na skład aminokwasowy chleba. Przegląd Piekarski i Cukierniczy 6, 28-30.
8. Nestares T., Ló pez-Frías M., Barrionuevo M., & Urbano G. (1996): Nutritional assessment of raw and processed chickpea (*Cicer arietinum* L.) protein in growing rats. Journ. Agric. Food Chem. 44, 2760-2765.
9. Ramulu, P., & Udayasekhara Rao, P. (1997): Effect of processing on dietary fiber content of cereals and pulses. Plant Foods for Human Nutrition 3, 249-257.
10. Ruiz R.G., Price K.R., Arthur A.D., Rose M.E., Rhodes M.J.C., & Fenwick R.G. (1996): Effect of soaking and cooking on the saponin content and composition of chickpeas (*Cicer arietinum*) and lentils (*Lens culibaris*). Journ. Agric. Food Chem. 44, 1526-1530.
11. Rutkowska, U. (1981): Wybrane metody badania składu i wartości odżywczej żywności. Warsaw: PZWL.
12. Terri, O., Byung-Kee, B., & Czuchajowska Z. (1997): Microstructure of seeds, flours and starches of legumes. Cereal Chemistry. 74 (4), 225-451.
13. Van der Poel, A.F.B. (1990): Effect of processing on antinutritional factors and protein nutritional value of dry beans (*Phaseolus vulgaris* L.). A review. Animal Feed Science and Technology 29, 179-208.
14. Year-book Poland 1999. (2000): Warsaw: GUS.

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