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BUCKWEAT IN THE WHOLEGRAIN CRACKER PRODUCTION

HELJDA U PROIZVODNJI INEGRALNOG KEKSA

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REZIME

Keks, kao brašneno-konditorski proizvod, se ubraja u koncentrovanu hranu zbog značajne energetske i hranljive vrednosti. Korišćenjem novih sirovina u proizvodnji keksa može se ostvariti novi senzorni kvalitet (miris i ukus) i dobiti nutritivno vredan proizvod. Jedna takva sirovina, značajna po hemijskom sastavu odnosno biološkoj vrednosti je integralno heljdino brašno. Sastav heljdinog zrna je takav da se u njemu nalazi biološko vredni proteini i vitamini, a pri tome ne sadrži gluten, što proizvode od heljde svrstava u funkcionalne. Heljda je dobar izvor bioflavonoida rutina, kvercetina, kemferol-3-rutinozida, a u tragovima sadrži flavonol triglikozid. Cilj ovog rada je bio da se sagleda uticaj integralnog heljdinog brašna na termička i mehanička svojstva testa i senzorni kvalitet slanog keksa u odnosu na integralno pšenično brašno. Reološka svojstva heljdinog brašna su ispitana na Miksolab-u kako bi se procenila pecivna svojstva ispitanog proizvoda. Heljdino integralno brašno značajno utiče na čvrstoću i elastičnost testa tokom zagrevanja. U toku razvoja novog brašneno-konditorskog proizvoda radilo se na iznalaženju povoljnog odnosa integralnog heljdinog brašna, instant kukuruzne krupice i masnoće bez trans masnih kiselina u cilju ostvarivanja optimalnih nutritivnih i senzorskih svojstava proizvoda pri njegovom konzumiranju. Na osnovu kvaliteta integralnog heljdinog brašna kao osnovne sirovine i postavljenog cilja u odnosu na kvalitet gotovog proizvoda razrađen je sirovinski sastav testa, tehnološki proces pripreme i vođenje testa kao i režim pečenja u cilju postizanja optimalnog senzornog kvaliteta.

***Ključne reči**: heljda, integralni heljdin keks, termo-mehaničke osobine testa, senzorska svojstva.*

SUMMARY

Crackers represent concetrated food because of significant energy content and nutritional value. The application of new ingredients in the production of crackers can expand the products range giving cracker products new sensory quality and higher nutritional values. Such an ingredient, containing many important nutrients, is wholegrain buckwheat flour. Buckwheat grain contains a large amount of proteins, starch, vitamins and does not contain gluten, which classify buckwheat products as functional ones. Also, buckwheat grains have been well known as a plant source of rutin, quercetin, kaempferol-3-rutinoside, and a trace quantity of flavonol triglycoside. The aim of the present study was to investigate the effect of wholegrain buckwheat flour on thermo-mechanic properties of dough and sensory quality of salty cracker as compared to wholegrain wheat flour. Rheological properties of buckwheat flour dough were tested on Mixolab in order to predict baking characteristics of investigated buckwheat products. The wholegrain buckwheat flour significantly affected the dough hardness and elasticity during heating. The scope of a novel bakery product development was the optimization of wholegrain buckwheat flour share in a combination with instant corn grits and trans-fatty free margarine, in order to achieve the most acceptable nutritive and sensory quality. Based on the quality of wholegrain buckwheat flour and the desired final product quality, the technology development procedure, dough preparation and baking conditions were developed in order to make a functional product with optimum sensory quality.

***Key words:** Buckweat, Wholegrain buckwheat cracker, thermo-mechanical dough properties, sensory properties.*

INTRODUCTION

Confectionery products such as crackers and related products have an important position in the market and consumption of confectionery products in our country 1. Using ingredients which are nutritively important, biologically valuable products with the enhanced content of nutrients can be developed and, in addition, sensory properties can be improved 2. One such ingredient, nutritionally and biologically valuable, is wholemeal buckwheat.

Buckwheat, unlike most cereals, is an alternative crop belonging to the *Polygonaceae* family. The increasing attention for buckwheat cultivation and utilization of buckwheat products is due to the increasing information focused on its functional properties, which can provide many health benefits based on buckwheat products consummation, first of all during prevention and healing chronic diseases [3].

Functional properties of buckwheat based foods are due to proteins and many rare components with healing effects. Among them, the most attractive ones are flavones, flavonoids, phytosterols, fagophyrins, and thiamin-binding proteins found in buckwheat seed.

Cody et al. [4] reviewed the biological and pharmaceutical effects of plant flavonoids, including buckwheat flavonoids, on human and test animals. Many of the biological functions, such as antimutagenity, anticarcinogenity and antiaging, originate from antioxidant activity of antioxidative enzymes and nonenzymic antioxidants [5]. They can show strong antioxidative effects and so that they can prevent human lymphocyte DNA from oxidative damage [6].

Oomah and Mazza [7] reported that flavonoids in buckwheat could perform a high antioxidative activity that might have the potential to show pharmaceutical effects due to this property.

Six flavonoids (rutin, orientin, vitexin, quercetin, isovitexin and isoorientin) were isolated and identified in buckwheat, but

only rutin and isovotexin were found in buckwheat seed, and rutin wos mostly attributed to the flavonoid content in buckwheat seed [8]. Rutin and its hemisynthetic derivatives exert different medical effects like normalization of increased vascular permeability and fragility, oedema protection [9], antioxidant [10], hypotensive [11], and antiinflammatory effects.

The aim of this study was to investigate the way of implementing wholegrain buckwheat flour in the cracker production, the mechanical properties of dough during heating and physical and sensory properties of the product.

MATERIAL AND METHOD

The wholegrain buckwheat cracker is a salty cracker prepared from non-fermented dough. The cracker formulation is: 70% wholegrain buckwheat, 30% instantized corn grits, 30% trans-free margarine, 3% salt, 3% powdered sugar, 1% baking powder, 1% soy lecithin, flaxseed and sesame seed.

Wholegrain wheat salty cracker was the standard control sample. The identical formula was applied, only instead of buckwheat flour, wholegrain wheat flour was used.

Wholegrain buckwheat flour was provided from local market. The chemical composition of wholegrain buckwheat flour was analyzed using the methods of AOAC [12].

Table 1. Chemical composition of wholegrain buckwheat flour
Tabela 1. Hemijski sastav integralnog heljdinog brašna

Chemical characteristics Hemijske karakteristike	Moisture (%) Vlaga (%)	Proteins (% in DM) Proteini (% na s.m.)	Fat (% in DM) Mast (% na s.m.)	Fiber (% in DM) Vlakna (% na s.m.)	Mineral matters (% in DM) Mineralne materije (% na s.m.)	Starch (% in DM) Skron (% na s.m.)
Wholegrain buckwheat flour Integralno heljdino brašno	9.8	12.4	2.8	2.7	2.0	67.4

DM – dry matter
DM-suva materija

Mixolab measurements

Mixing and pasting dough of the wholegrain buckwheat flour and kukuruzna krupica (70:30) werw studied using the Mixolab (Chopin, Tripette et Renaud, Paris, France), which measures in the actual time the torque (expressed in Nm) produced by passage of dough between the two kneading arms, thus allowing the study of its physical and chemical behavior. The settings used in the test were as follows: 8 min for initial mixing, temperature increase at 2.3°C/min until 90°C, holding at 90°C for 7 min, temperature increase at the rate of 2.3°C/min until 90°C, holding at 90°C for 7 min, temperature decrease at the rate of 4°C/min until 50°C, and holding at 50°C for 5 min; and the mixing speed during the entire assay was 80 rpm. Parameters obtained from the recorded curve give the information about the protein stability subjected to mechanical and thermal constraints and both the gelatinization and gelling of starch. The following were the parameters obtained from the reorded curve: initial consistency (C1), stability (min) or elapsed time at which the torque produced is kept constant, minimum torque (Nm) or the minimum value of torque produced by the dough passage subjected to mechanical and thermal constraints (C2), peak torque (Nm) or the maximum torque produced during the heating stage (C3), the minimum torque during the heating period (Nm) (C4) and the torque obtained after cooling at 50°C (C5).

Backing process

Baking trials were conducted under laboratory conditions. The dough was mixed in a Diosna mixer using all-in method according to which all ingredients are mixed together in one phase for 15 min. The homogenized dough was wrapped in poliethylene bag and left to rest at 4C for an hour. After resting, the dough was sheeted to 5 mm thickness and cut by pressing molds onto dough sheet. Baking was done in a deck-type oven (Termotehnika, Zagreb) at 170±2°C during 15 minutes; after cooling for 30 min to room temperature, the crackers were wrapped in aluminium foil and kept at room temperature overnight [13].

Sensory evaluation of the product performed by untrained panel [14].

Specific sensory attributes of two samples (WBC– wholegrain buckwheat cracker and WWC- wholegrain wheat cracker: shape, upper and lower surface, fracture, structure of fracture, chewinees, odour and taste were evaluated by the untrained panel. All assessors were familiar with the specific way of processing and specific sensory properties of these products (or with the background in products processing). Four members of the panel gave scores for each sample with respect to their perceptions attributes as 1 (worst) to 5 (best), by using visual, olfactory and gustatory techniques to evaluate the aforementioned properties.

The colour of the crackers was determined on a tristimulus photocolorimeter MOM Color 100. Colour parameters were presented in the CIELab system [15].

The obtained data were processed using the program Statgraphic Plus V7.1. (Statistical Graphic Corporation, UK).

RESULTS AND DISCUSSION

Doughs made from blends of wholegrain buckwheat flour and corne grits or wholegrain wheat flour and corne grits in proportion 70:30 were subjected to a dual mechanical shear stress and temperature constraint using the Mixolab device. Data regarding mechanical and thermal dough properties such as protein weakening, starch gelatinization and starch gelling can be extracted from the recorded curves (Fig.1 and Fig. 2).

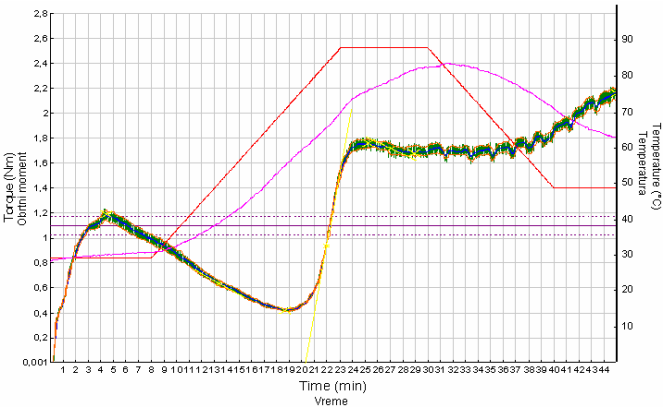


Fig. 1. Dough behaviour during mixing and heating measured on Mixolab (wholemeal buckwheat flour and corn grits 70:30)
Sl. 1. Ponašanje testa tokom mešanja i zagrevanja određeno mixolab-om
(integralno heljdino brašno i kukuruzna krupica 70:30)

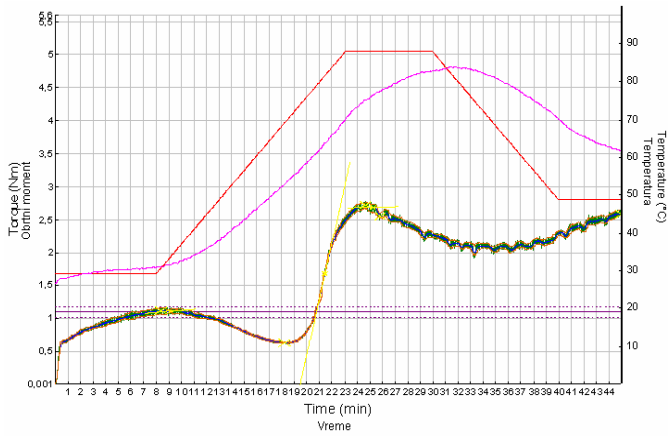


Fig. 2. Dough behaviour during mixing and heating measured on Mixolab (wholemeal wheat flour and corne grits 70:30)
Sl. 2. Ponašanje testa tokom mešanja i zagrevanja određeno mixolab-om (integralno pšenično brašno i kukuruzna krupica 70:30)

Table 2. Thermo-mechanical properties of tested dough samples – Mixolab parameters
Tabela 2.Termo-mehaničke osobine ispitivanog uzorka testa-određene miksolab-om

Samples **Uzorci**	WBF:CG 70:30	WWF:CG 70:30
Water absorption, (%) Apsorpcija vode, (%)	67.7	61.4
Development time, (min) Vreme razvoja, (min)	4.47	8.40
Stability, (min) Stabilitet, (min)	4.72	8.65
Amplitude, (Nm) Amplituda, (Nm)	0.08	0.10
Maximum torgue, (C1) (Nm) Maksimalni torzioni moment, (C1) (Nm)	1.19	1.12
Minimum torgue, (C2)(Nm) Maksimalni torzioni moment, (C2) (Nm)	0.42	0.63
Peak torque, (C3) (Nm) Vršni torzioni moment, (C3) (Nm)	1.76	2.72
C4, (Nm)	1.68	2.55
C5, (Nm)	2.16	2.58

WBF-wholegrain buckwheat flour
WBF-integralno heljdino brašno
CG-corn grits
CG-kukuruzni kriz
WWF-wholegrain wheat flour.
WWF-integralno pšenično brašno

Wholegrain buckwheat flour increased water absorption and decreased dough development i.e. time needed to hydrate all components. Stability and dough elasticity decreased in comparison to the wholegrain wheat dough. Dough made from wholegrain buckwheat had lower mixing stability (C2). Wholegrain buckwheat flour has higher activity of amylases and a low starch gelatinization degree which caused higher C4 values. C4 is an indicator of amylase activity during heating. A lower C5 value measured for the dough made with buckwheat flour implies to a lower starch retrogradation which positively affect the product shelf-life. Wholegrain buckwheat flour impairs the rheological properties of dough, and therefore it is necessary to adjust the dough formula and processing parameters in order to improve the product quality.

The sensory properties of crackers are displayed in Table 3. The wholegrain wheat cracker was used as the standard control.

Table 3. Sensory properties of wholegrain buckwheat cracker and wholegrain wheat cracker
Tabela 3. Senzorske osobine integralnog heljdinog keksa i integralnog pšeničnog keksa

Scoring method Metoda bodovanja						
Properties Osobine	Asses-sor Ocen-jivač	Assigned evaluation Dodeljene ocena		Relevance coefficient Faktor značaja	Adjusted evalua-tion Ponderisana cena	
		*WBC	**WWB		*WBC	**WWB
Shape Oblik	1 2 3 4	3 4 4 4	4 5 4 4	0.3	0.9 1.2 1.2 1.2	1.2 1.5 1.2 1.2
Upper surface Gornja površina	1 2 3 4	5 5 5 5	4 4 3 4	0.5	2.5 2.5 2.5 2.5	2.0 2.0 1.5 2.0
Lower surface Donja površina	1 2 3 4	3 5 5 5	4 3 3 4	0.4	1.2 2.0 2.0 2.0	1.6 1.2 1.2 1.6
Fracture Prelom	1 2 3 4	3 4 3 3	3 3 3 3	0.4	1.2 1.6 1.2 1.2	1.2 1.2 1.2 1.2
Structure of fracture Struktura na prelomu	1 2 3 4	5 3 4 5	4 3 4 4	0.6	3.0 1.8 2.4 3.0	2.4 1.8 2.4 2.4
Chewiness Masti-kacija	1 2 3 4	4 4 4 4	4 4 4 4	0.8	3.2 3.2 3.2 3.2	3.2 3.2 3.2 3.2
Odour Miris	1 2 3 4	4 4 4 4	3 3 3 3	1.0	4 4 4 4	3 3 3 3
Taste Ukus	1 2 3 4	5 5 5 5	3 3 3 3	1.0	5 5 5 5	3 3 3 3
GEN-ERAL SCORE OPŠTI REZUL-TAT	Total evaluation (scores) Ukupna ocean (rezultati):				21.3	17.2
	Ponderd value: Ponderisana vrednost				4.3	3.4

*WBC – Wholegrain buckwheat cracker
**WWC – Wholegrain wheat cracker
*WBC – Integralni heljdin keks
**WWC – Integralni pšenični keks

Upper and lower surfaces of the wholegrain buckwheat cracker were more uniform as compared to the control. The wholegrain buckwheat cracker was scored the best regarding taste, but the best score for odour was given to the control. Total sensory score for the wholegrain buckwheat was 21.3 and for the control wheat cracker was 17.2. It is obvious that the buckwheat crackers were scored higher for sensory properties.

According to the instumental colour parameters, the wholegrain buckwheat cracker was darker (as indicated by lower L* values) than the control. The values obtained for a* and b* pa-

rameters were positive which implies to the presence of red and yellow hues in the product colour.

Table 4. Objective colour values for wholegrain buckwheat cracker and wholegrain wheat cracker

Tabela 4. Objektivne vrednosti za boju integralnog heljdinog keksa i integralnog pšeničnog keksa

Samples Uzorci	Colour parameters / *Parametri boje* *CIELAB*		
	*L**	*a**	*b**
Wholegrain buckwheat cracker Integralni heljdin keks	44.31	27.94	10.88
Wholegrain wheat cracker Integralni pšenični keks	51.96	19.81	21.8

CONCLUSION

Wholegrain buckwheat flour is an interesting ingredient for the production of crackers and related products particularly due to its chemical composition and nutritive value.

Wholegrain buckwheat flour modifies the thermo-mechanical properties of dough as compared to wheat dough. Therefore, the dough formula and processing parameters should be adjusted to ensure the optimum sensory quality of the end-product.

The results demonstrated that wholegrain buckwheat cracker had acceptable sensory quality, the taste score was even improved as compared to the wheat cracker.

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