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AND FOOD TECHNOLOGIES
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RHEOLOGICAL PROPERTIES OF ANCIENT WHEAT VARIETIES AND SOURDOUGH PROCESSING USED AS A TOOL FOR IMPROVING ANTIOXIDATIVE PROPERTIES OF BREAD

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Wheat (*Triticum aestivum*) is one of the most grown cereal crop in the world, beside rice and corn. Modern wheat varieties have been created to fulfill various requirements such as high yield and different quality parameters. During recent years consumers are getting more interested in consumption of bakery product based on ancient wheat varieties. The reason for such growing interest is related to the fact that ancient cereals such as spelt, emmer, khorasan, etc. are considered as “healthier” among general population. According to some findings ancient wheats are characterized by higher protein, soluble fiber, vitamins, minerals, lipids and different bioactive compound content. Among bioactive substances, polyphenols are mostly in the focus of nutritionists since these compounds have numerous health beneficial effects such as anti-inflammatory, antioxidant, anticarcinogenic and antimutagenic, as well as preserving properties against food deterioration, etc. Although considered nutritionally improved, ancient cereals are generally characterized by low yield, the necessity of dehulling technology application and lower technological quality compared to modern wheat varieties. Recently, sourdough fermentation was proposed as a tool for increasing phenolic compound content as well as for overcoming the shortcomings related to ancient wheat flours dough processing.

In order to determine technological quality of three different ancient wheat varieties (emmer, spelt, khorasan) various rheological test were performed. Common wheat served as a control sample. Mixolab measurements (Chopin France) using Chopin+ protocol were conducted to reveal mechanical changes in tested dough samples upon mixing and heating. Moreover, wet gluten content and gluten index parameter which is also related to dough mechanical properties were determined. Spontaneous sourdough fermentation was performed in order to evaluate the impact of the sourdough fermentation on total phenolic content (TPC) bioaccessibility as well as DPPH antioxidant capacity during breadmaking. Bread samples prepared with common wheat flour using yeast as well as spontaneous sourdough fermentation served as control samples.

The obtained results revealed that spelt flour exhibited high wet gluten content and consequently formed strong gluten network which was characterized by the highest water absorption among all tested samples. However, khorasan flour showed the lowest wet gluten content but the highest dough stability during mixing which could be related to high gluten index values. Moreover, although all samples were characterized by similar starch content, khorasan flour showed the highest starch gelatinization and retrogradation rate during thermal treatment. The results of sourdough fermentation revealed that, after fermentation, antioxidant activity and TPC increased which was followed by minor decrease or it stayed unchanged upon baking. The obtained results also showed that emmer and spelt sourdough were characterized by higher bound phenolics release rate due to the higher acidity of these sourdoughs.

According to obtained results, it can be concluded that rheological properties were dependent on wet gluten content and gluten index values, i.e. gluten quantity and quality. Moreover, it was also determined that sourdough fermentation favored the release of bound phenolics which can be potentially utilized to increase the bread shelf life while avoiding antioxidant addition as food additives in different bakery products.

Key words: *rheology, sourdough, antioxidative properties*

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REOLOŠKE OSOBINE DREVNIH ŽITARICA I UTICAJ FERMENTACIJE KISELIH TESTA NA POBOLJŠANJE ANTIOKSIDATIVNIH OSOBINA HLEBA

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Pšenica (*Triticum aestivum*), pored pirinča i kukuruza, predstavlja jednu od najčešće gajenih žitarica na svetu. Savremene sorte pšenice su kreirane da ispune različite zahteve kao što su visok prinost i različiti parametri kvaliteta. Poslednjih godina potrošači su sve više zainteresovani za konzumiranje pekarskih proizvoda na bazi starih sorti pšenice. Razlog za ovaj porast interesovanja je vezan za činjenicu da se drevne žitarice kao što su spelta, dikokum, kamut, itd. smatraju „zdravijim“ među opštom populacijom. Prema nekim istraživanjima, drevne sorte pšenice karakteriše veći sadržaj proteina, rastvorljivih vlakana, vitamina, minerala, lipida i različitih bioaktivnih jedinjenja. Polifenoli, kao bioaktivne supstance, su generalno sve više u fokusu nutricionista jer je utvrđeno da ova jedinjenja imaju brojne blagotvorne efekte po zdravlje kao što su antiinflamatorni, antioksidativni, antikancerogeni i antimutageni efekti, kao i da imaju svojstva sprečavanja kvarenja hrane, itd. Međutim, za ove žitarice je generalno karakteristično i da imaju nizak prinost, neophodan je proces ljuštenja i niži je tehnološki kvalitet u odnosu na savremene sorte pšenice. Fermentacija kiselih testa je nedavno predložena kao sredstvo za povećanje sadržaja fenolnih jedinjenja, kao i za prevazilaženje nedostataka vezanih za preradu testa na bazi brašna od drevnih pšenica.

Kako bi se utvrdio tehnološki kvalitet tri različite drevne sorte pšenice (dikokum, spelta, kamut) izvršena su različita reološka ispitivanja. Obična pšenica je služila kao kontrolni uzorak. Miksolab merenja (Chopin, Francuska) su sprovedena korišćenjem Chopin+ protokola da bi se utvrdile mehaničke promene ispitivanog uzorka testa pri mešanju i zagrevanju. Pored toga, ispitivan je sadržaj vlažnog glutena i vrednost gluten indeksa koji takođe utiču na mehanička svojstva testa. Takođe je izvršena i spontana fermentacija kiselih testa kako bi se procenio uticaj fermentacije kiselih testa na bioraspoloživost sadržaja ukupnih fenola (TPC) kao i antioksidativni kapacitet (DPPH) tokom pečenja hleba. Kao kontrolni uzorci poslužili su uzorci hleba pripremljeni od običnog pšeničnog brašna koristeći pekarski kvasac, kao i spontanu fermentaciju kiselog testa na bazi pšeničnog brašna.

Dobijeni rezultati su pokazali da brašno od spelte ima visok sadržaj vlažnog glutena i samim tim formira jaku glutensku mrežu koju karakteriše najveća moć upijanja vode među svim ispitivanim uzorcima. Međutim, brašno od kamuta je imalo najmanji sadržaj vlažnog glutena, ali najveću stabilnost testa tokom mešanja, što se može dovesti u vezu sa visokim vrednostima gluten indeksa. Pored toga, iako su svi uzorci bili okarakterisani sličnim sadržajem skroba, brašno od kamuta je pokazalo najveću brzinu želatinizacije i retrogradacije skroba tokom termičke obrade. Rezultati fermentacije kiselih testa su otkrili da se nakon fermentacije povećava antioksidativna aktivnost i TPC, koji se neznatno smanjuju ili ostaju nepromenjeni nakon pečenja hleba. Takođe se pokazalo da se kiselo testo od dikokuma i spelte odlikuje većom brzinom oslobađanja vezanih fenola usled većeg stepena kiselosti ovih testa.

Na osnovu dobijenih rezultata može se zaključiti da su reološka svojstva zavisila od sadržaja vlažnog glutena i vrednosti gluten indeksa, odnosno količine i kvaliteta glutena. Pored navedenog, utvrđeno je da fermentacija kiselih testa favorizuje oslobađanje vezanih fenola koji se potencijalno mogu iskoristiti za produženje roka trajanja i za izbegavanje dodavanja antioksidanasa kao prehrambenih aditiva u hrani u različitim pekarskim proizvodima.

Ključne reči: reologija, kisela testa, antioksidativne osobine

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