



# Kreiranje proizvoda na bazi alternativnih žita

dr Aleksandra Torbica

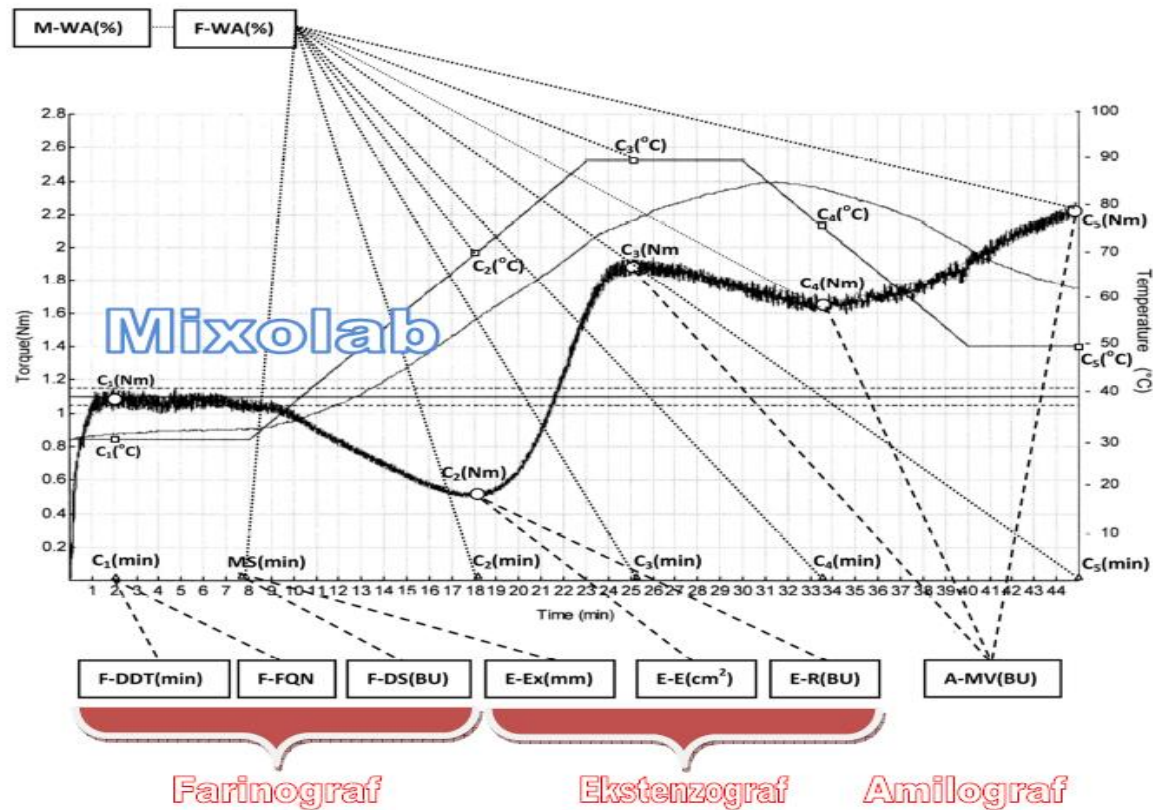


9. Stručni skup „Okoliš i zdravlje“  
 05. Jul 2019, Koprivnica

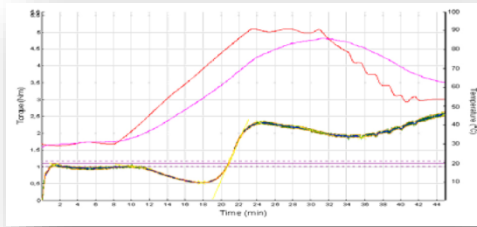
Legend:

----- Linear regression models relations

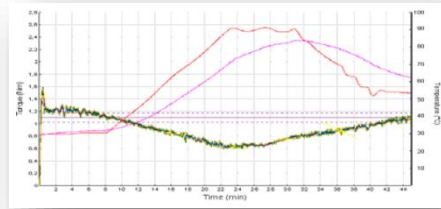
..... Multiple regression model relations in case of F-WA prediction



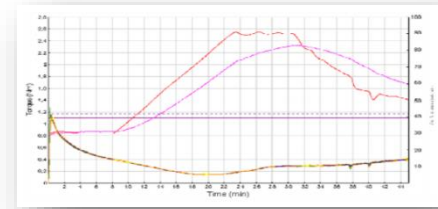
# Mixolabi sirovina



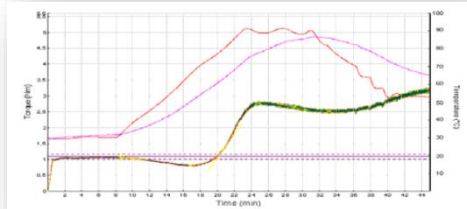
Pšenično brašno



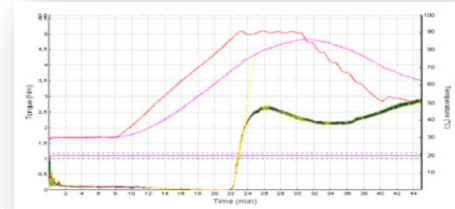
Sojino brašno



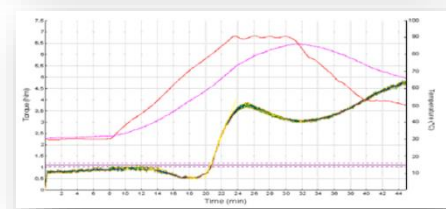
Brašno amarantusa



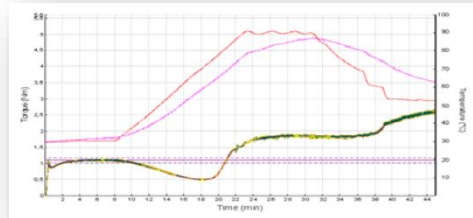
Pirinčano brašno



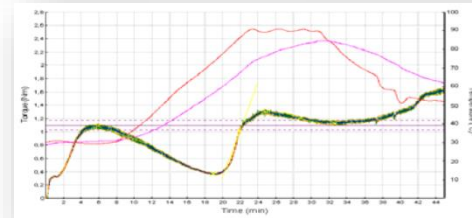
Kukuruzni skrob



Krompirov skrob

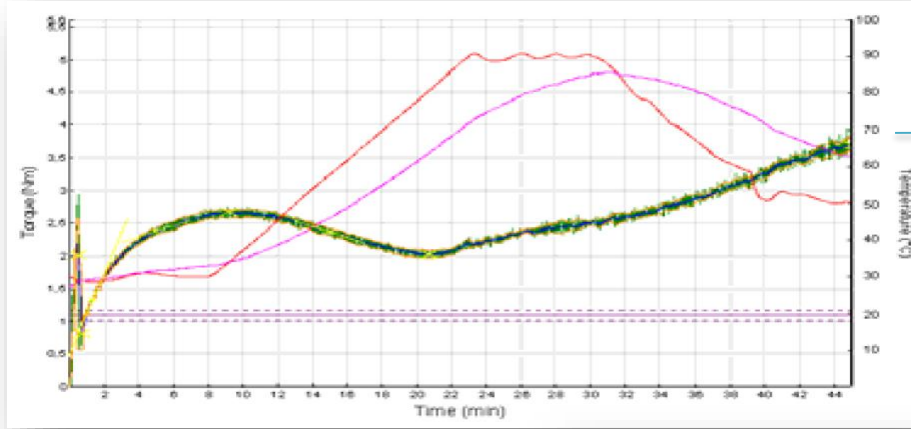


Heljdino brašno



Integralno heljdino  
brašno

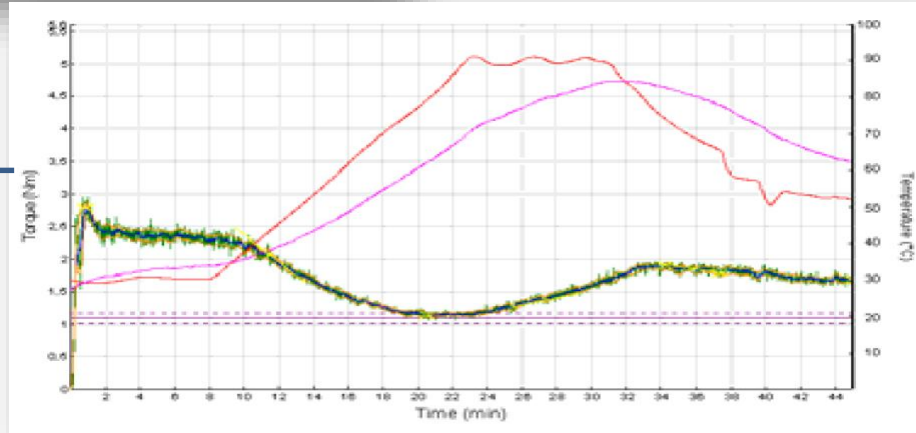
# Mixolabi hidrokoloída

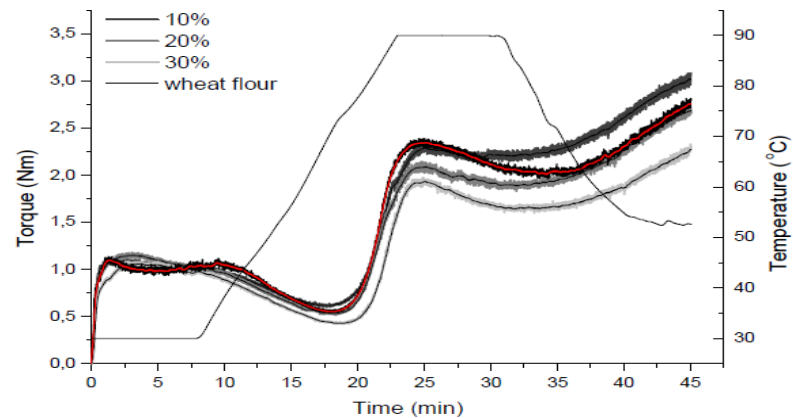
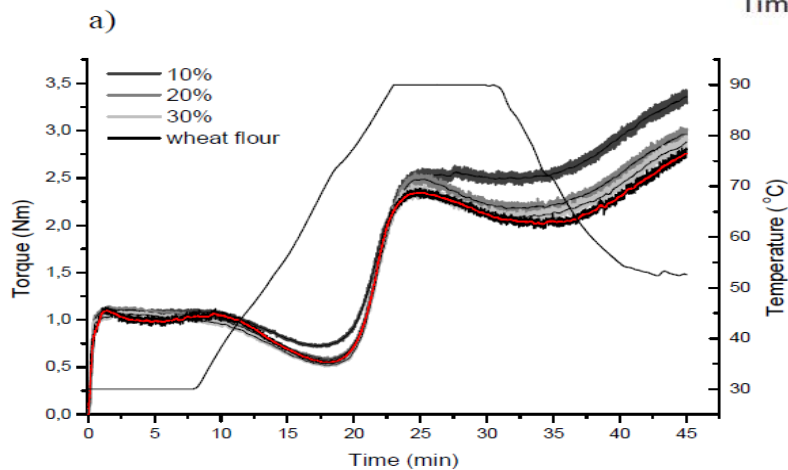
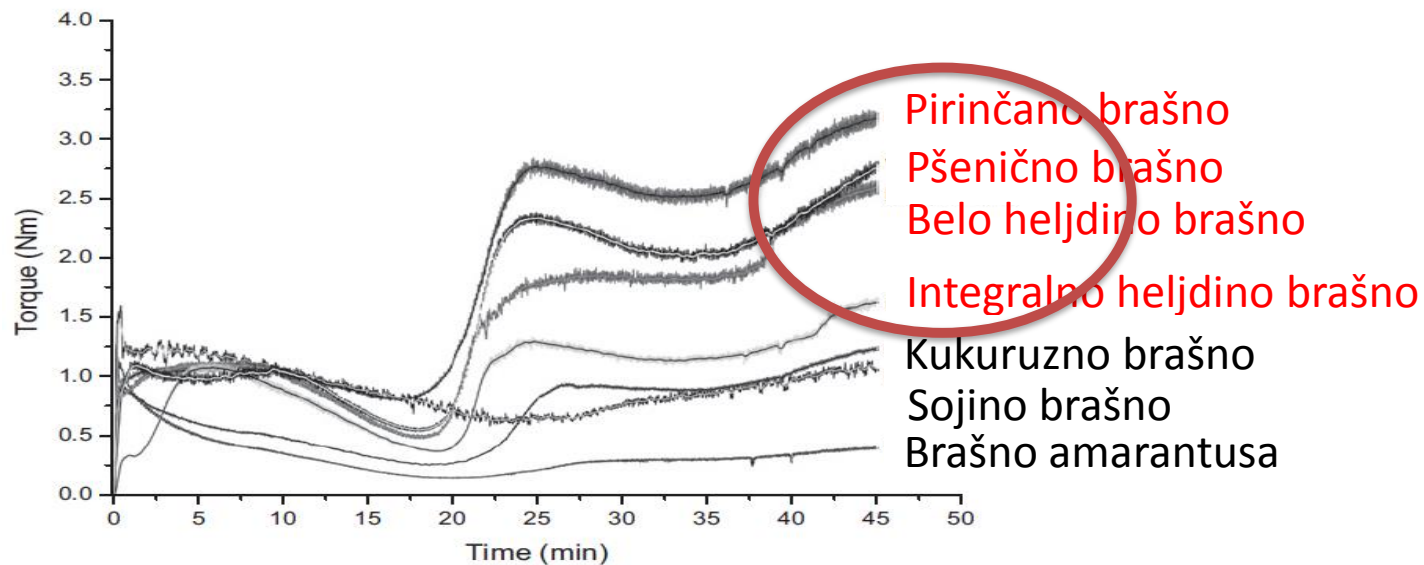


Ksantan guma

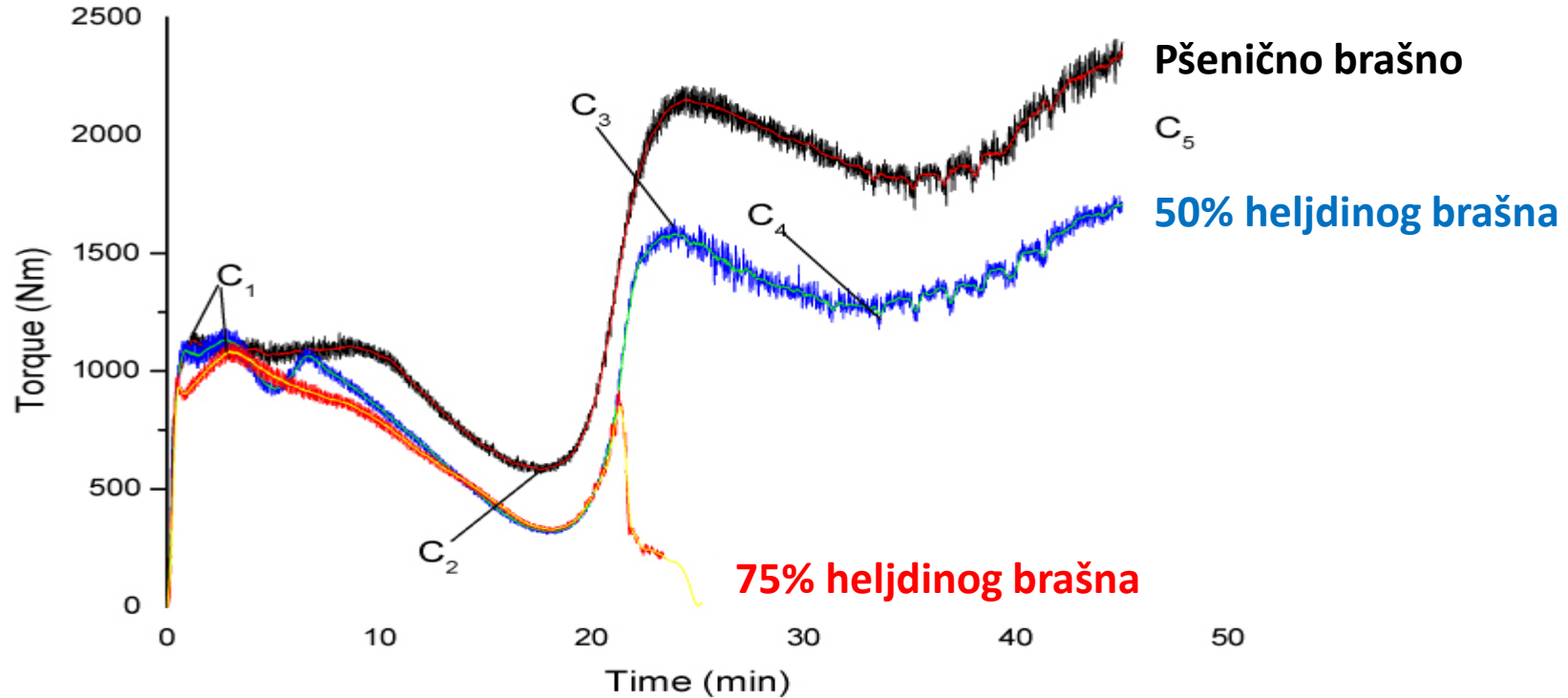
## Ksantan guma

## Guar guma

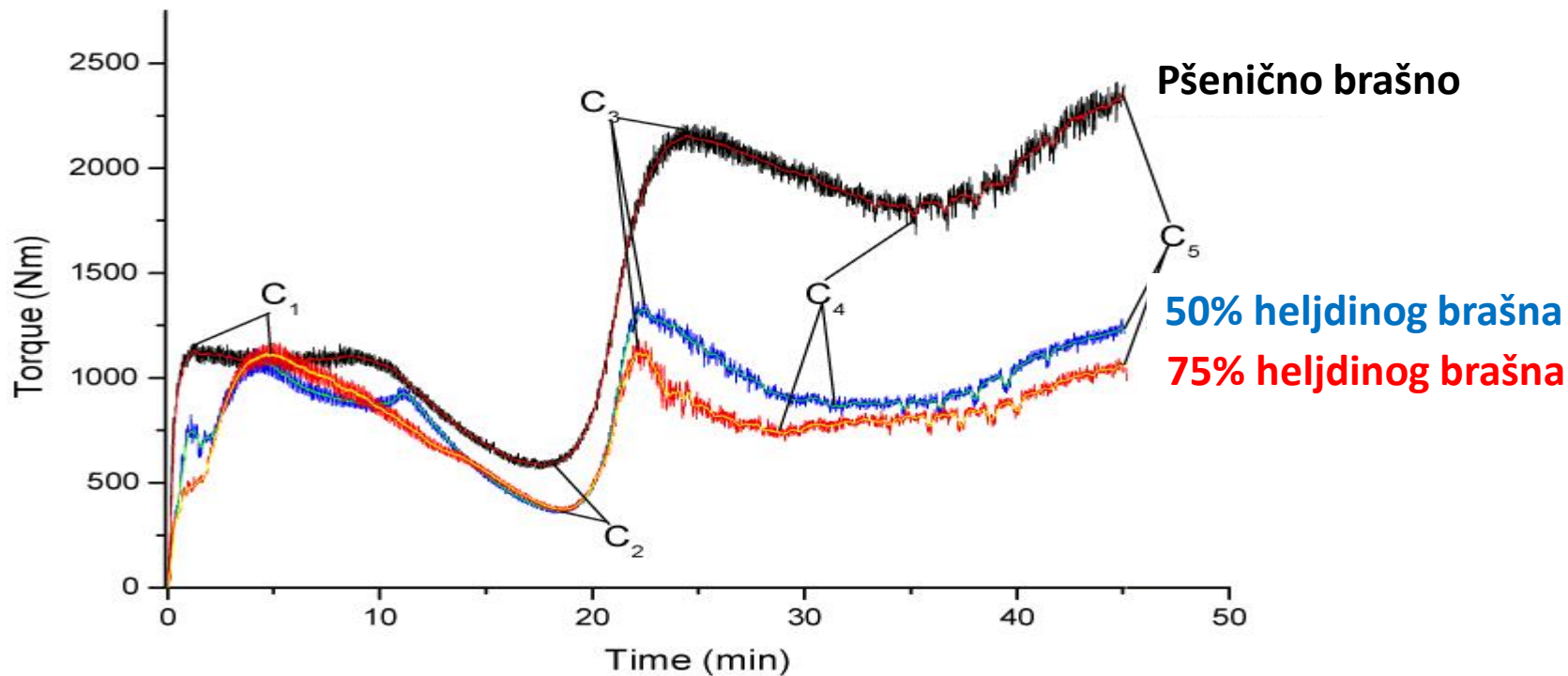




# Dodatak belog heljdinog brašna

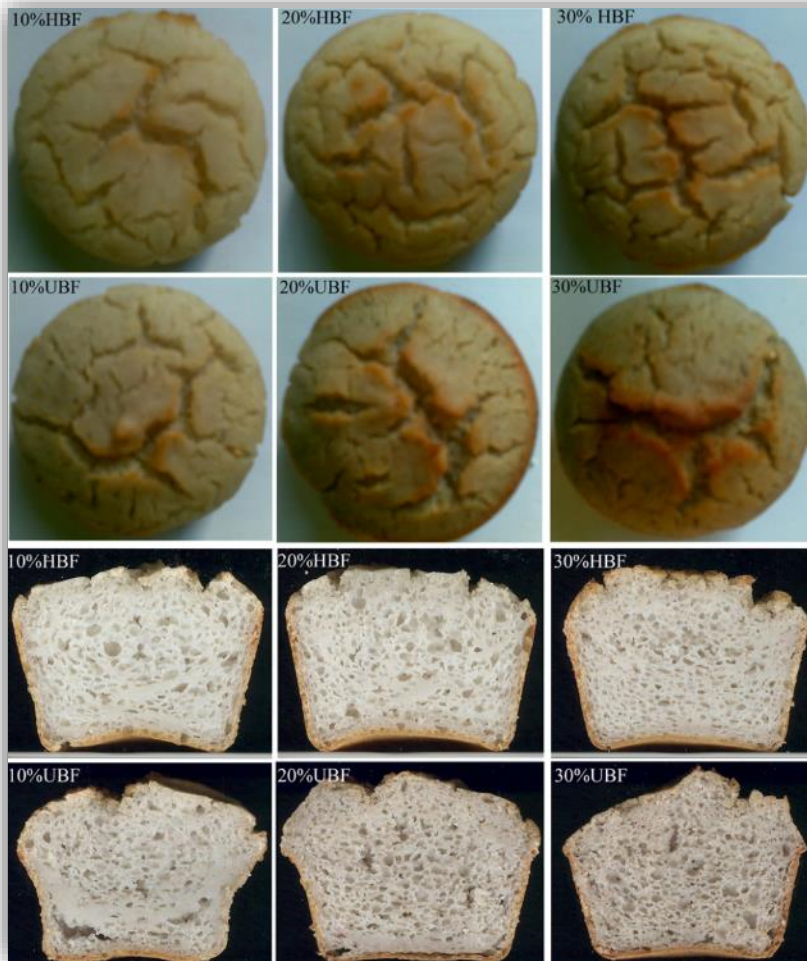


# Dodatak integralnog heljdinog brašna





# BEZGLUTENSKI HLEB NA BAZI PIRINČA I HELUDE, BEZ DODATKA ADITIVA, I SA POVEĆANIM SADRŽAJEM ANTIOKSIDATIVNIH MATERIJA





# BEZ DODATKA ADITIVA

Gluten-free bread formulations containing blends of rice flour with husked or unhusked buckwheat flour in ratios 90:10, 80:20 and 70:30

Ingredient	%
Gluten-free blend	100
Deionised water	180 or 190 <sup>A</sup>
Fresh yeast	4
Sugar	3
Salt (NaCl)	3
Vegetable fat	4



## BEZGLUTENSKI

<sup>A</sup> The amount of added water in formulations with HBF was 180%, while in UBF was 190% due to higher water absorption values observed using Mixolab measurements

RF = Rice flour

LBF = HBF

Light buckwheat flour  
= Husked buckwheat  
flour

WBF = UBF

Wholegrain  
buckwheat flour =  
Unhusked buckwheat  
flour

Contents of rutin and quercetin in rice flour (RF), light (LBF) and wholegrain buckwheat flours (WBF).

Extracts	Rutin (mg/100 g dmb)	Quercetin (mg/100 g dmb)
RF	n.d. <sup>a</sup>	n.d. <sup>a</sup>
LBF	8.71 ± 0.12 <sup>b</sup>	0.54 ± 0.05 <sup>b</sup>
WBF	21.34 ± 0.05 <sup>c</sup>	0.58 ± 0.075 <sup>b</sup>



# BEZGLUTENSKI TVRDI KEKS NA BAZI PIRINČA I HELJDE, SA POVEĆANIM SADRŽAJEM PRIRODNIH ANTIOKSIDATIVNIH MATERIJA, NAMENJEN INDUSTRIJSKOJ PROIZVODNJI

Gluten-free cookie formulations containing blends of rice flour and husked buckwheat flour in ratios 90:10, 80:20 and 70:30

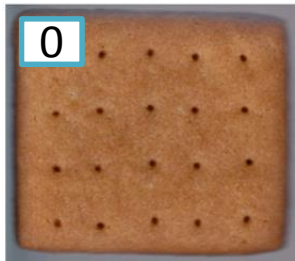
Ingredient	%
Gluten-free blend	100
Deionized water	35
Vegetable fat	33.33
Granulated sugar	25
Honey	15
Sodium bicarbonate ( $\text{NaHCO}_3$ )	3
DATM	3
Carboxymethylcellulose (CMC)	1.5
Salt (NaCl)	0.7



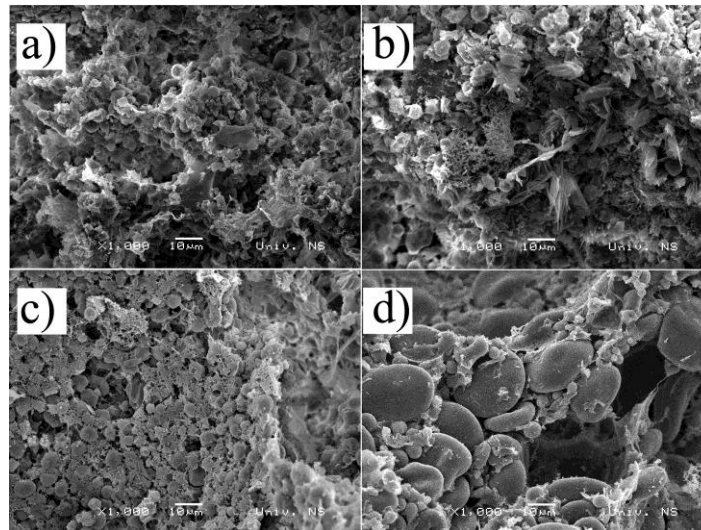
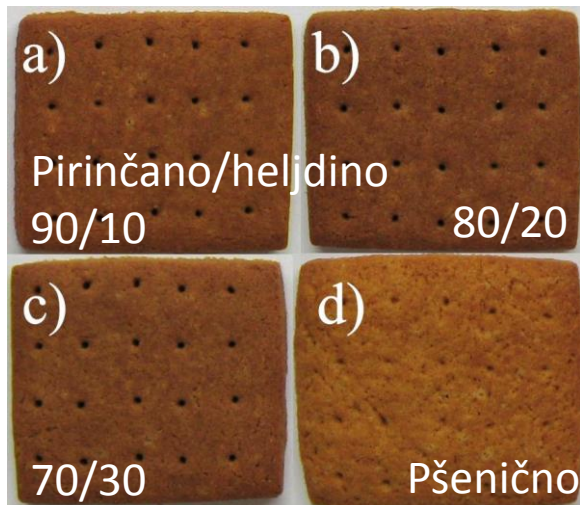
Visok sadržaj vlakana

Bezglutenski

	GF cookies (rice flour : unhusked buckwheat flour=80:20)
Rice/buckwheat ratio	80/20
Dietary fiber content (%)	10,57
Rutin content (mg/100 g product)	0,25
Quercetin content (mg/100 g product)	0,040



## Pšenično brašno-standardna procedura



## Pirinčano brašno-procedura za smešu brašna





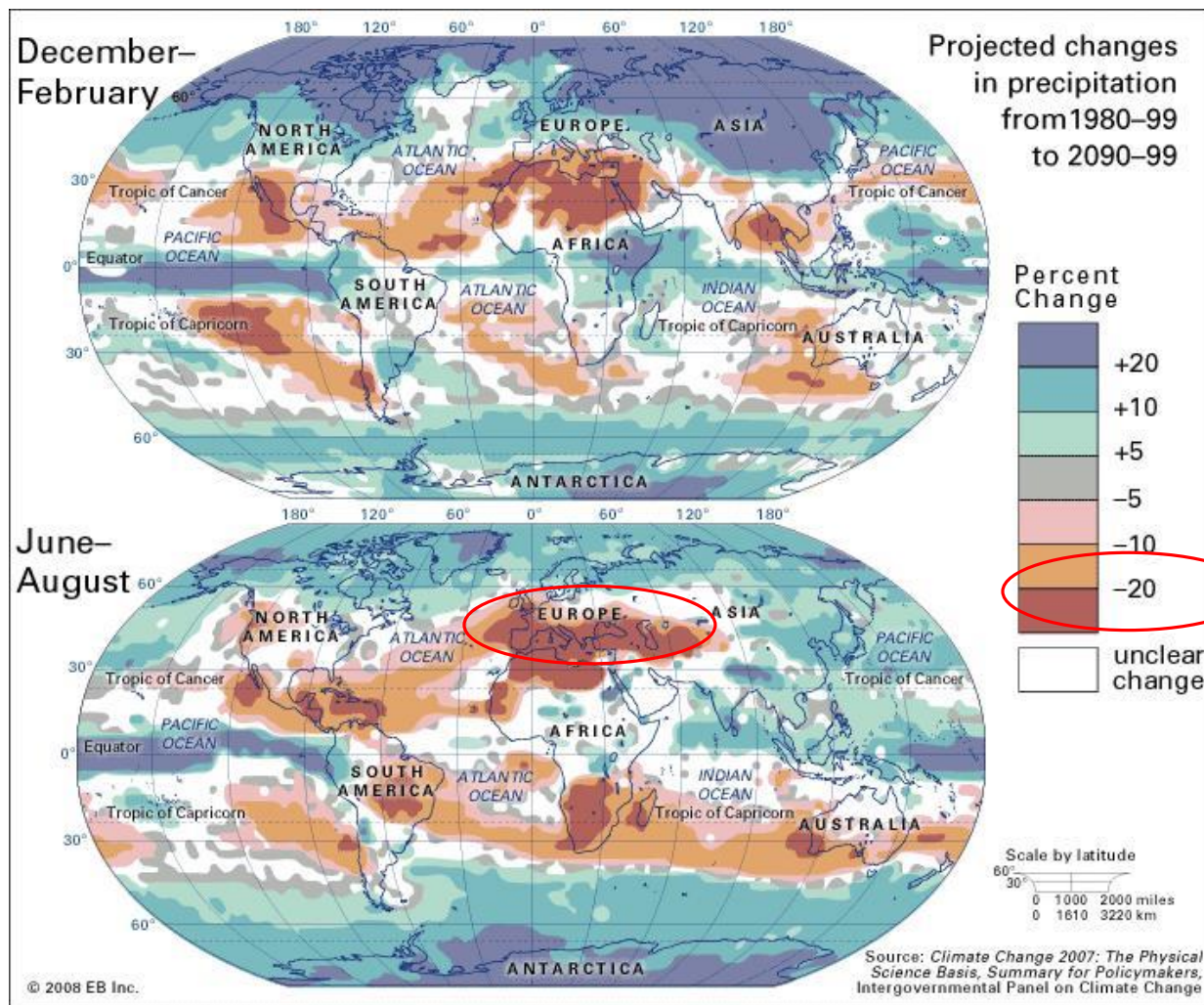
# Klimatske promene

Projekat tehnološkog razvoja TR 31007

## VREDNOVANJE KVALITETA I OPTIMIZACIJA PRERADE PŠENICE U SVETLU KLIMATSKIH PROMENA

Finansirano sredstvima  
Ministarstva prosvete,  
nauke i tehnološkog  
razvoja Republike Srbije

2011-do danas





# Kreiranje ne-pšeničnog hleba



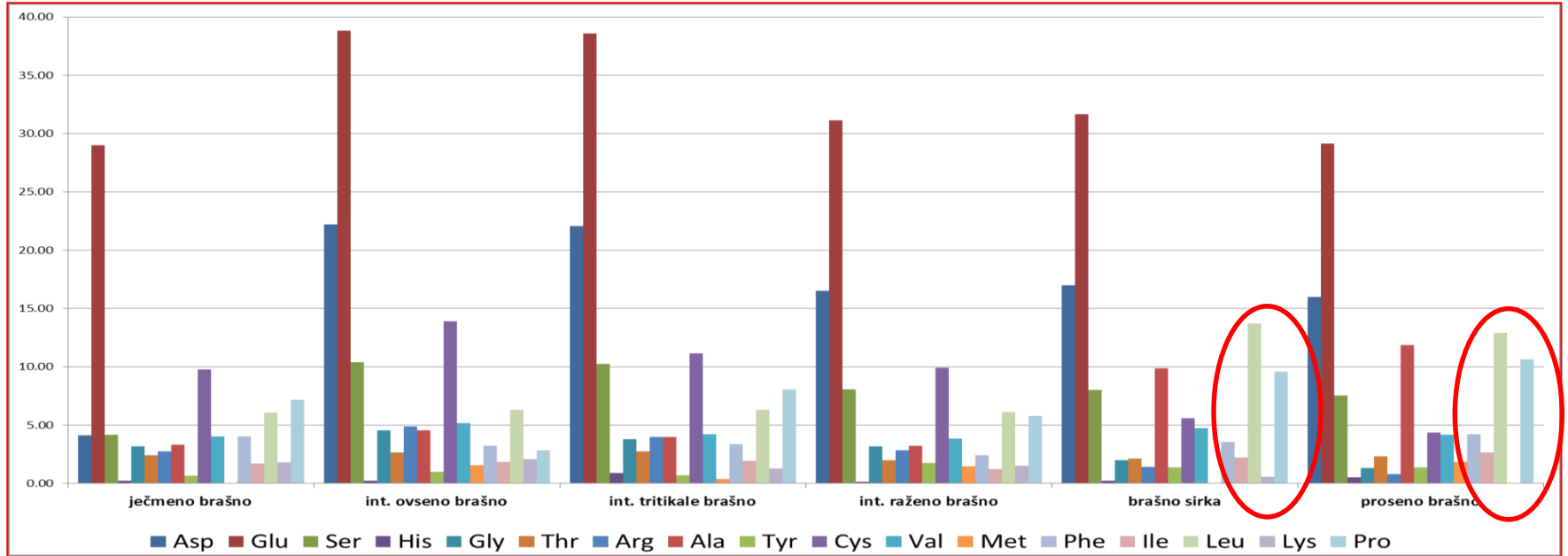
**Cilj**

Od 100% svakog brašna

# Hemijski i nutritivni sastav

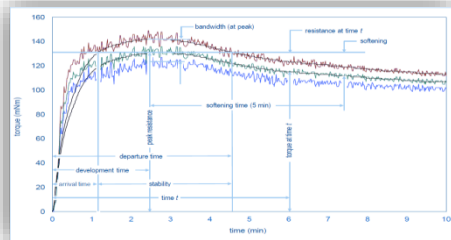
KULTURE	Sadržaj skroba (%)	Sadržaj sirovih Proteina (%)	Sadržaj masti (%)	Sadržaj ukupnih šećera (%)	Svarljivost proteina u kiselom pepsinu (%)	Sadržaj ukupnih vlakana (%)	Sadržaj nerastvorljivih vlakana (%)	Proteolitička aktivnost U/g brašna
PŠENIČNO brašno ODLIČNOG KVALITETA	70.41	10.58	1.665	1.93	73.44	4.45	2.40	1.05
PŠENIČNO brašno LOŠEG KVALITETA	78.32	6.55	0.995	2.65	73.05	4.38	2.25	1.71
DURUM brašno	65.94	11.39	2.285	2.89	81.67	8.42	3.52	5.87
RAŽENO brašno	58.32	12.90	2.52	3.85	78.47	12.94	8.72	4.61
OVSENO brašno	65.00	8.33	1.49	3.61	77.83	11.25	7.52	4.82
JEČMENO brašno	66.95	11.60	1.87	2.89	73.37	15.21	8.68	2.45
TRITIKALE brašno	57.30	11.22	1.735	3.61	74.53	18.13	12.29	9.40
Brašno SIRKA	67.05	13.31	2.18	0.96	80.52	12.13	9.01	3.40
Brašno PROSA	77.77	9.48	1.615	0.48	80.50	4.63	1.77	0.57

# Aminokiselininski sastav

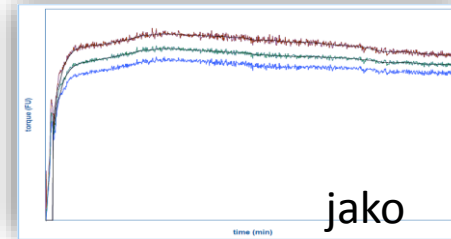
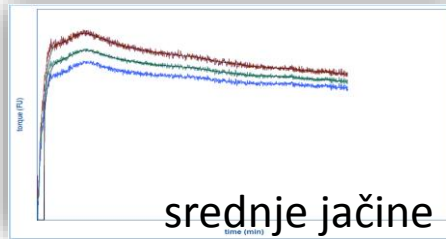
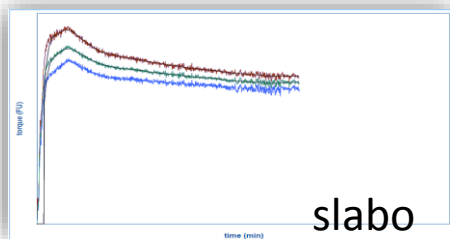




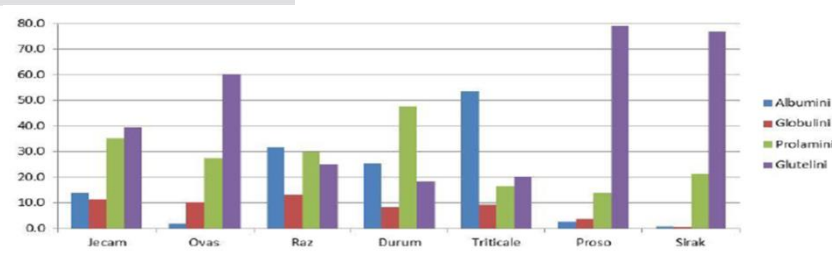
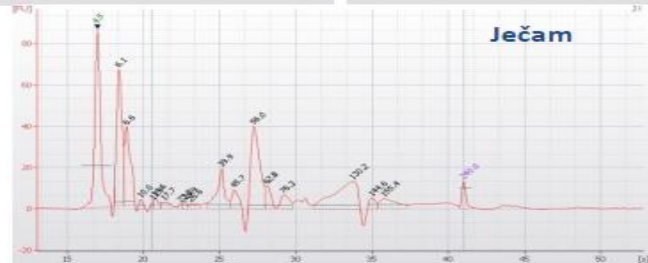
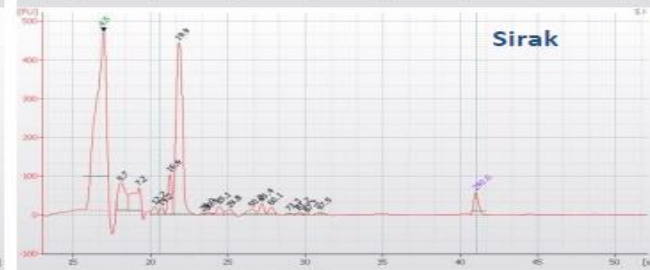
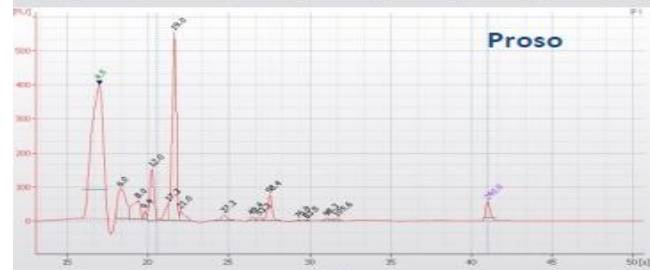
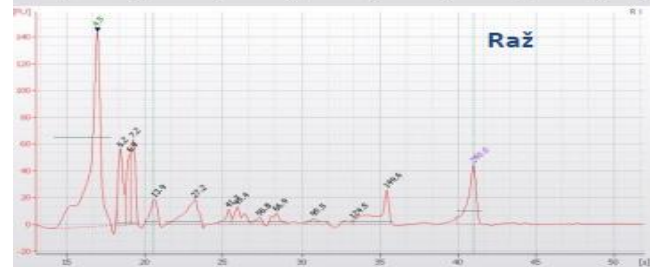
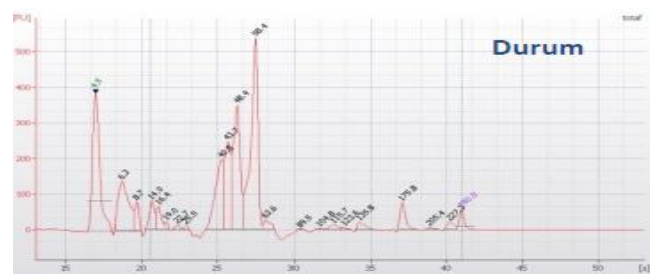
# Micro-doughLAB



	Tip zamesa (rpm)	Moč upijanja vode (%)	Razvoj testa (min)	Stabilitet (min)	Stepen omekšanja (mNm)
PŠENIČNO brašno ODLIČNOG KVALITETA	120	56,3	2,8	3,2	25,3
PŠENIČNO brašno LOŠEG KVALITETA	120	46,8	1,0	2,3	16,0
DURUM brašno	120	58,2	2,4	5,2	10,7
RAŽENO brašno	120	48,7	3,6	3,0	17,0
OVSENO brašno	120	56,3	2,8	3,2	25,3
JEČMENO brašno	120	67,5	1,0	0,6	29,0
TRITIKALE brašno	120	59,9	1,4	0,9	37,3
Brašno SIRKA	120	52,8	9,2	0,7	-
Brašno PROSA	120	44,0	9,6	3,5	-

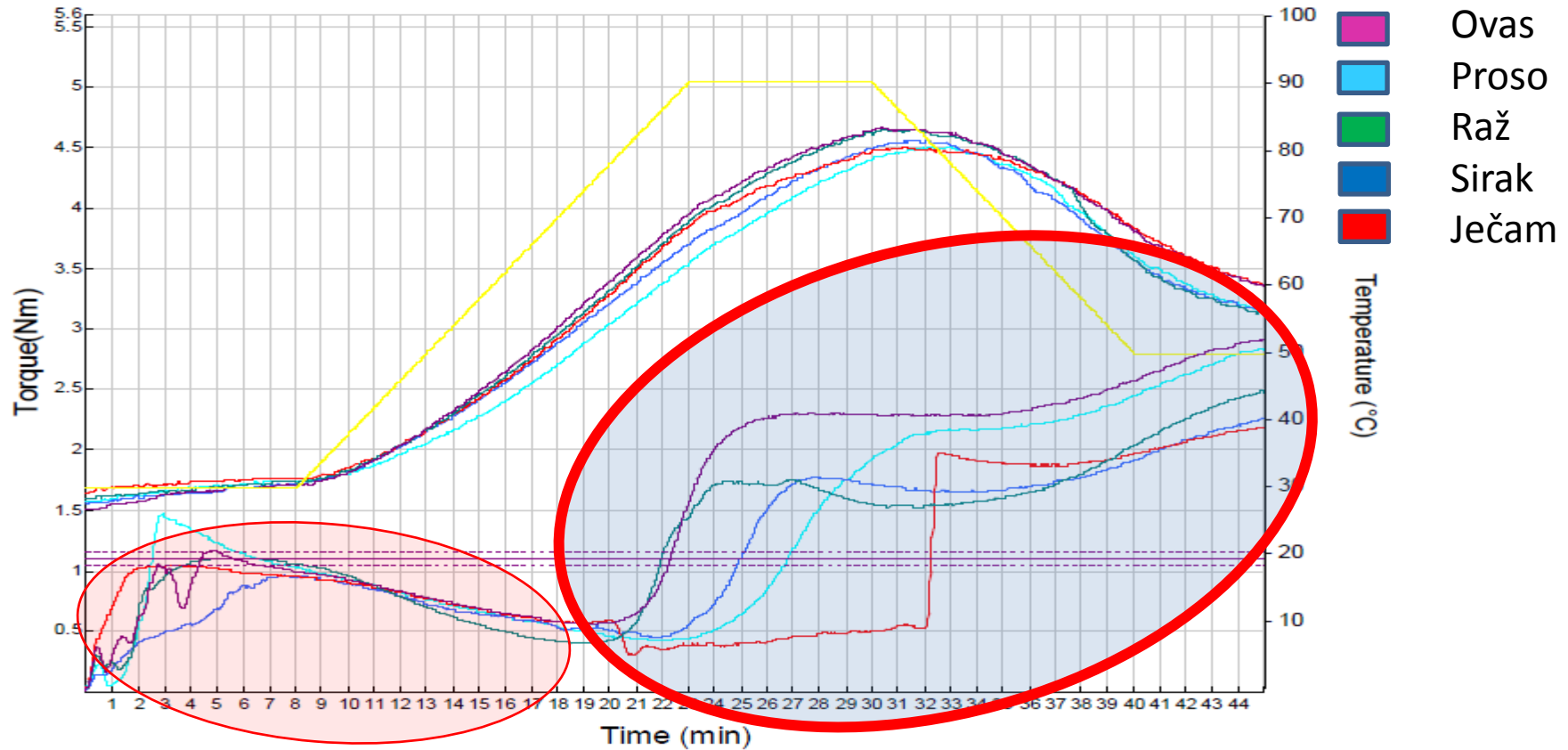


# Struktura

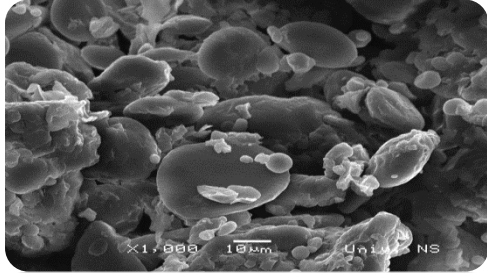




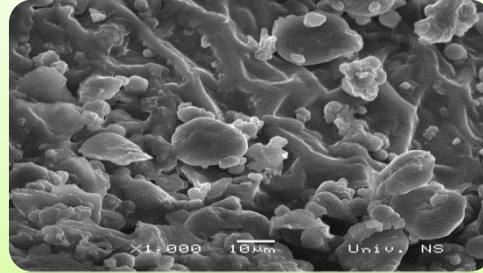
# Termo-mehaničke osobine



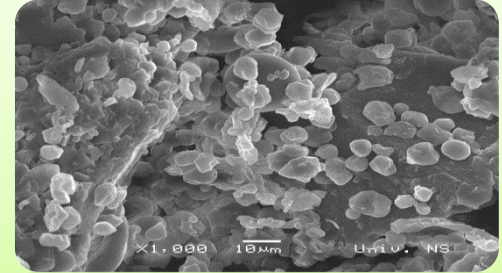
# Mikrostruktura



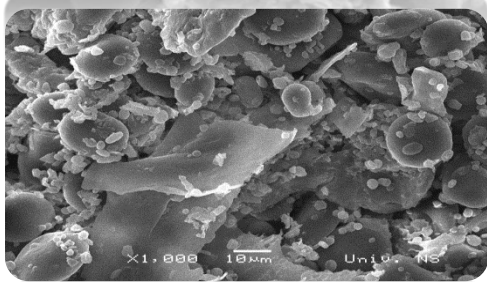
Durum



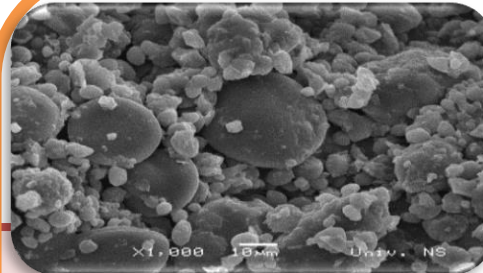
Sirak



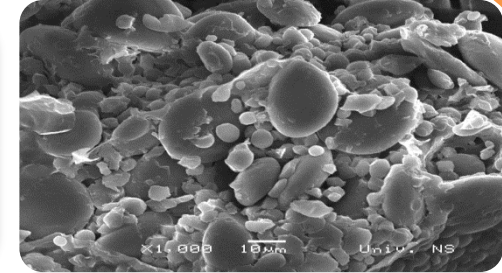
Proso



Ječam

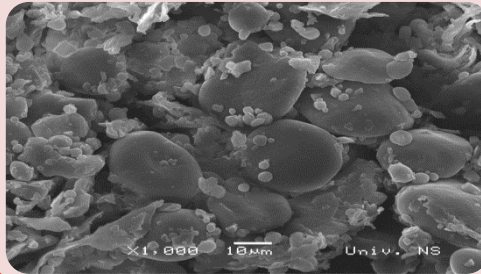


Raž

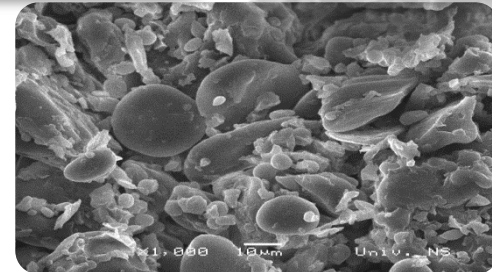


Pšenica

Ovas



Ovsene  
pahuljice



Triticale



# Tržište hleba od prosa



gluten free  
Millet Sandwich  
Bread

## INGREDIENTS

Recipe Success G

Choose your measure: ☐ Volume ☐ Ounces ☒ Grams

468g King Arthur Gluten-Free Flour

35g sugar

2 teaspoons instant yeast

1 1/4 teaspoons salt

1 1/4 teaspoons xanthan gum

227g warm milk

57g soft butter

3 large eggs

## Ingredients

- 1 cup (250 ml) warm milk, about 100°F
- 2 teaspoons (8 grams) dry active or rapid rise yeast
- 1 Tablespoon (15 ml) honey
- 1 cup (150 grams) millet flour
- 1/2 cup (80 grams) brown rice flour
- 1/2 cup (35 grams) potato starch (not flour)
- 1/4 cup (30 grams) almond meal
- 1/4 cup (35 grams) tapioca starch/flour
- 1/4 cup (18 grams) skim milk powder
- 1 Tablespoon (10 grams) xanthan gum
- 1 - 1 1/2 teaspoons (4-6 grams) salt
- 1 teaspoon (5 ml) apple cider vinegar
- 1/4 cup (60 ml) canola oil
- 3 large eggs, room temperature
- 2-3 teaspoons (10-15 ml) sesame seeds (optional)





# Proizvodnja hleba od prosa i sirka

- Brašno 100%
- Voda 65 %
- Kvasac 2%
- So 2%

Zames

Fermentacija

Oblikovanje

Završna  
fermentacija

Pečenje



Proso



Sirak

## Hleb od prosa bez aditiva





**100%**



Termički tretman



Hidrotermički  
tretman

**100%**





## Nutritivni sastav i izgled hleba

	Rye bread		Oat bread		Sorghum bread		Millet bread	
	per 100 g	%RDA	per 100 g	%RDA	per 100 g	%RDA	per 100 g	%RDA
Carbohydrates (%)	49.4	19	52.7	20	52.1	20	58.3	22
Protein (%)	9.9	20	7.1	14	10.6	21	7.6	15
Fat (%)	1.6	2	1.0	1	1.5	2	1.0	1
Dietary fibre (%)	10.0		9.9		10.5		4.3	
Energy value (kcal)	271.2	14	267.4	13	286.0	14	280.9	14
% of proteins in energy value	14.6		10.6		14.9		10.8	

**Nutritivne  
izjave**



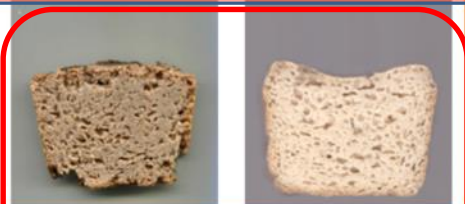
**Sadrže gluten**

Visok  
sadržaj  
vlakana

Izvor  
proteina



Visok  
sadržaj  
vlakana



**Bezglutenski**

Visok  
sadržaj  
vlakana

Izvor  
proteina

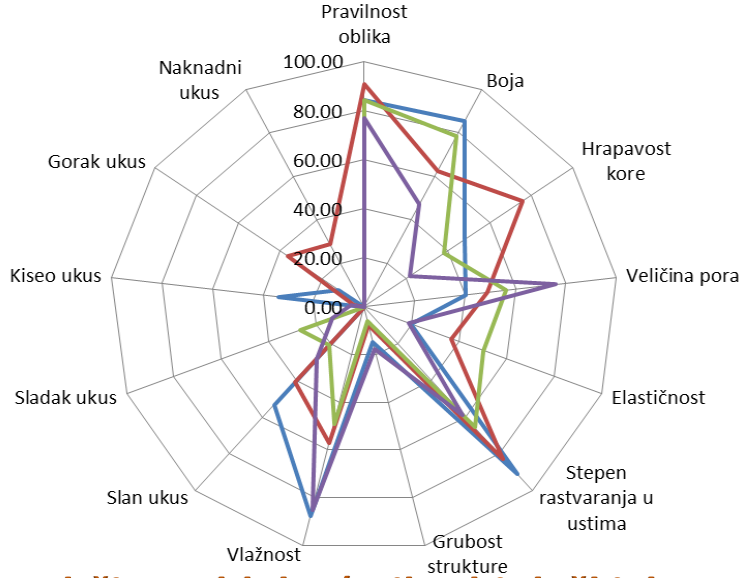
Izvor  
vlakana



## Senzorska svojstva

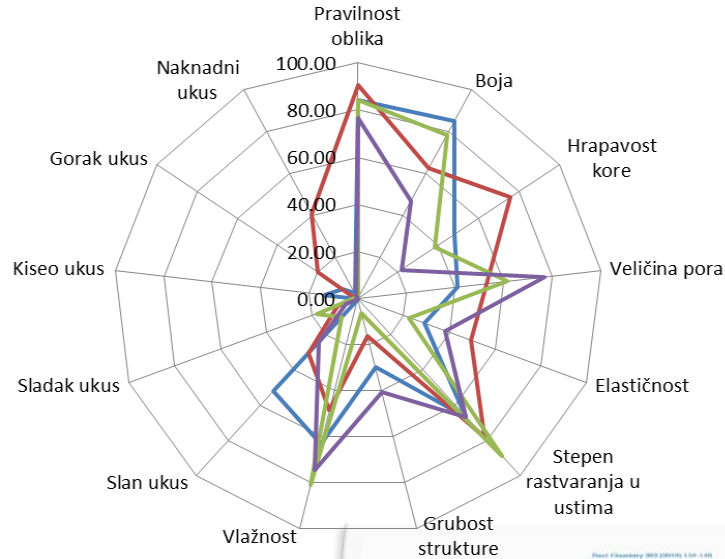
1 h

— SIRAK 1h — OVAS 1h — RAŽ 1h — PROSO 1h



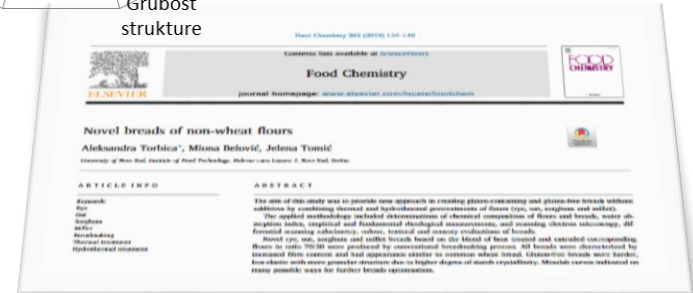
24 h

— SIRA K 24h — OVA S 24h — RAŽ 24h — PROSO 24h

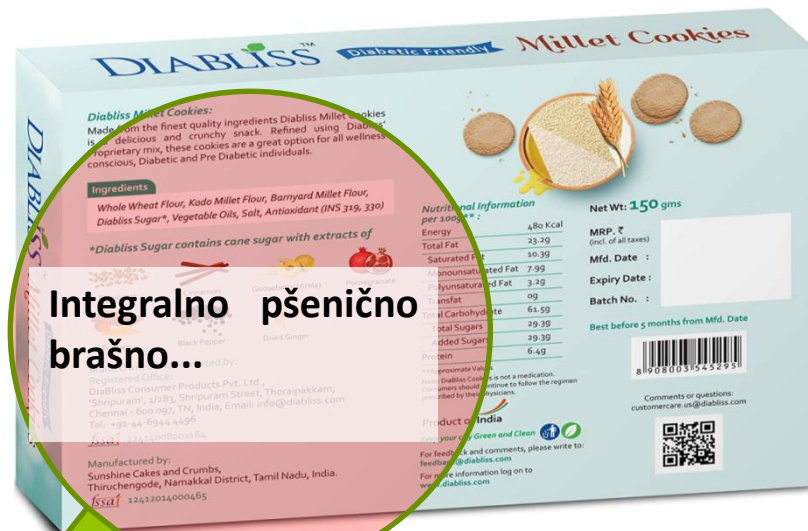


## Održivost hleba (mikrobiološki, bez konzervansa):

- Neupakovan – svež;
- Upakovan - do 3-4 dana



# Tržište keksa na bazi brašna od prosa



## Primer 1



# Primer 2

## Primer 3



### Ragi Millet Cookies

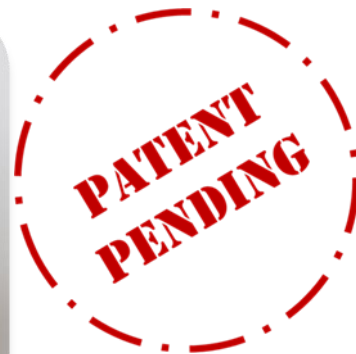
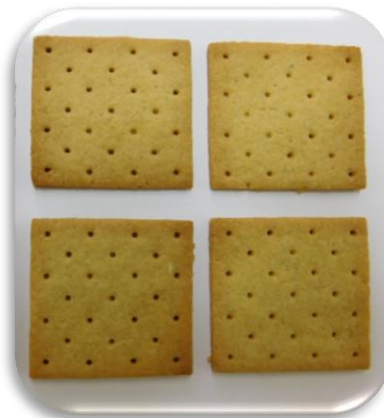
Integralno pšenično  
brašno...

Description :

- Made from farm fresh and organic ragi millets and other organic ingredients like whole wheat flour, edible vegetable oil and jaggery.
- Ragi millet cookies are rich in Calcium, Iron, protein and other minerals. They also have some essential amino acids for our body.
- Ragi millet foods can be considered as the best replacement for rice and wheat for all age group people.
- No added preservatives, artificial colours or flavours.

# Tvrdi keks na bazi 100% brašna prosa

Raw material	Gluten free cookies
<b>Millet flour - native</b>	
<b>Millet flour - Hydrothermally treated flour</b>	
Deionized water	
Powdered sugar	
Vegetable fat	
Ammonium hydrogen carbonate ( $\text{NH}_4\text{HCO}_3$ )	
Sodium hydrogen carbonate ( $\text{NaHCO}_3$ )	
Salt ( $\text{NaCl}$ )	
Lecithin	
Tartaric acid	

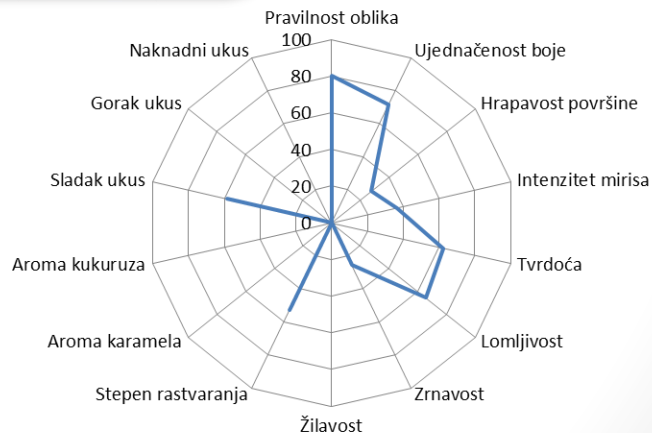


Sadržaj ukupnih vlakana = 4 - 5%



IZVOR VLAKANA

BEZGLUTENSKI

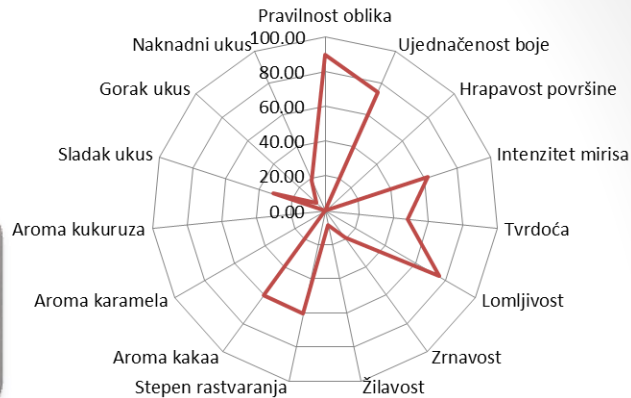




# Tvrdi keks

na bazi 100% brašna prosa  
sa dodatkom kakao praha

Raw material	Gluten free cookies
<b>Millet flour - native</b>	
Deionized water	
Powdered sugar	
Vegetable fat	
Ammonium hydrogen carbonate ( $\text{NH}_4\text{HCO}_3$ )	
Sodium hydrogen carbonate ( $\text{NaHCO}_3$ )	
Salt ( $\text{NaCl}$ )	
Lecithin	
Tartaric acid	
Cocoa powder	

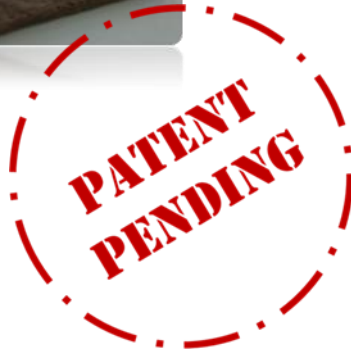


Sadržaj ukupnih vlakana = 8 - 9%



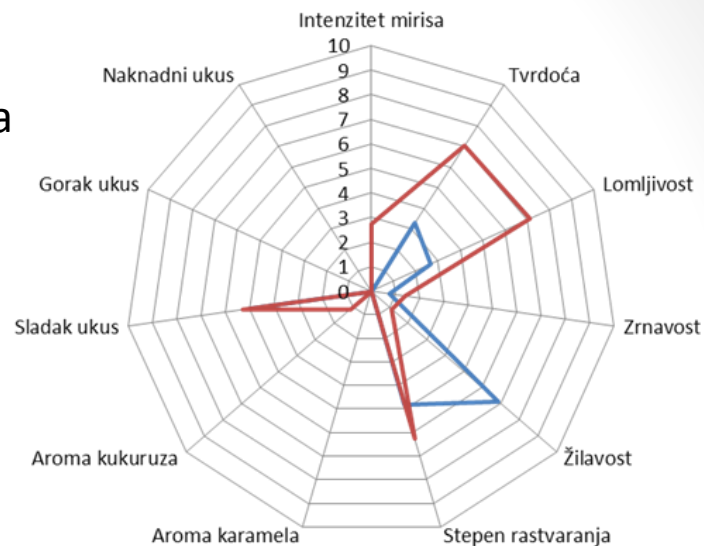
VISOK SADRŽAJ VLAKANA

BEZGLUTENSKI



# Čajno pecivo na bazi 100% brašna prosa

Raw material	Gluten-free cookies
<b>Millet flour - native</b>	
<b>Millet flour - Hydrothermally treated flour</b>	
Deionized water	
Powdered sugar	
Vegetable fat	
Ammonium hydrogen carbonate ( $\text{NH}_4\text{HCO}_3$ )	
Sodium hydrogen carbonate ( $\text{NaHCO}_3$ )	
Salt ( $\text{NaCl}$ )	
Lecithin	
Tartaric acid	



 Nakon 1 h  
 Nakon 24 h

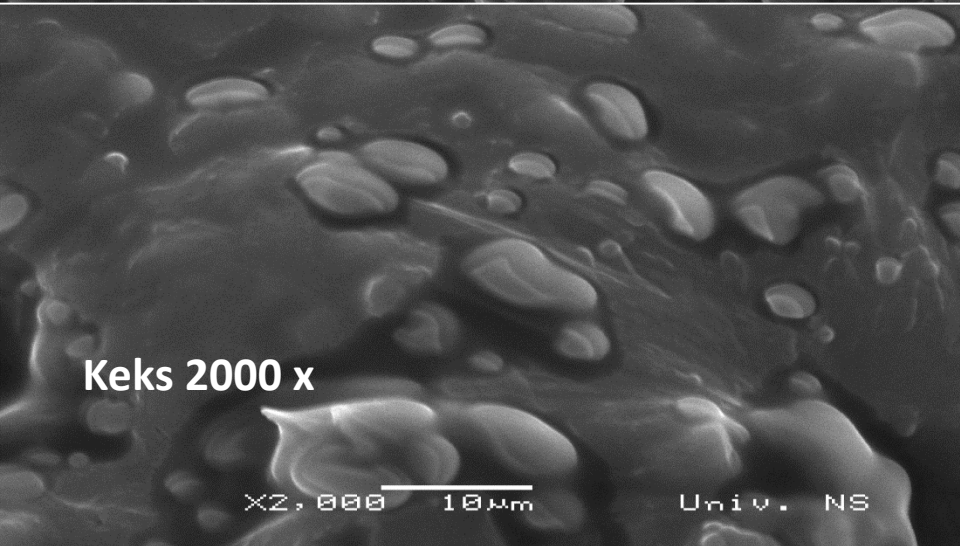
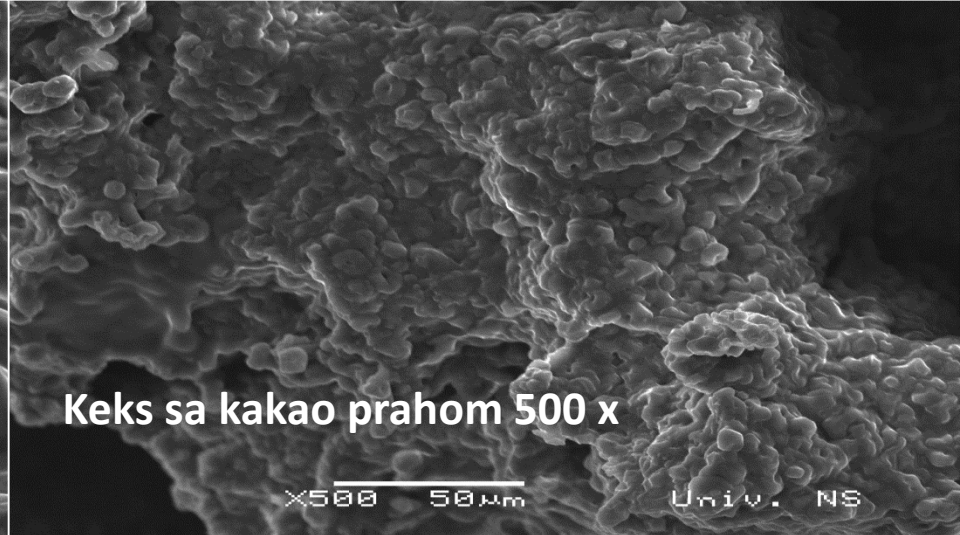
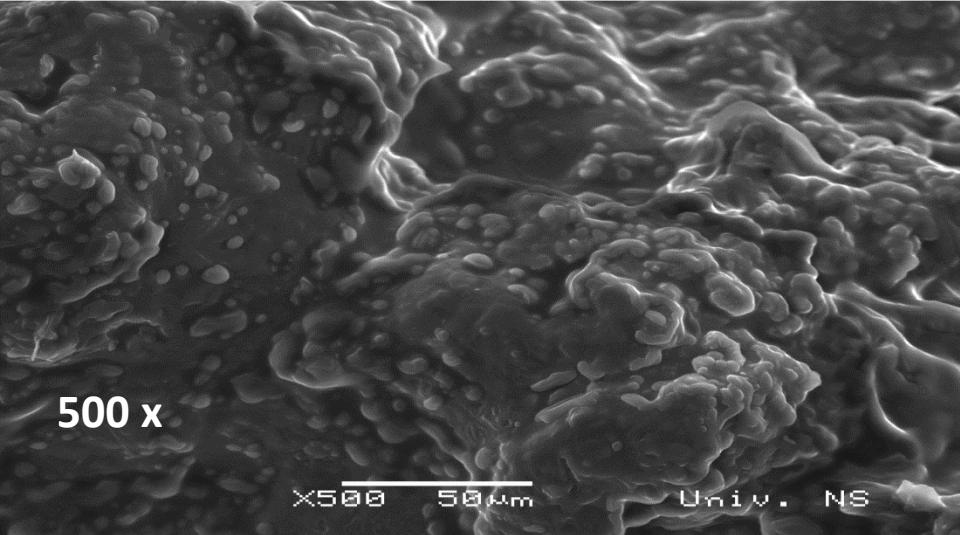
Sadržaj ukupnih vlakana = 4 - 5%



IZVOR VLAKANA



BEZGLUTENSKI



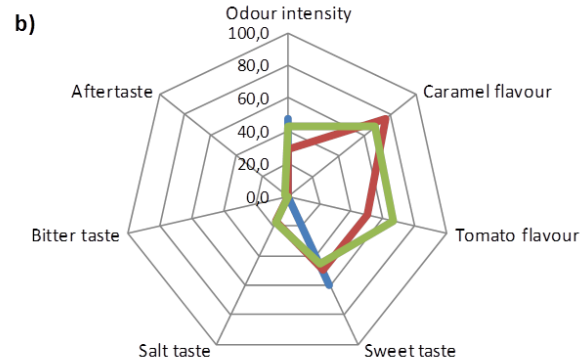
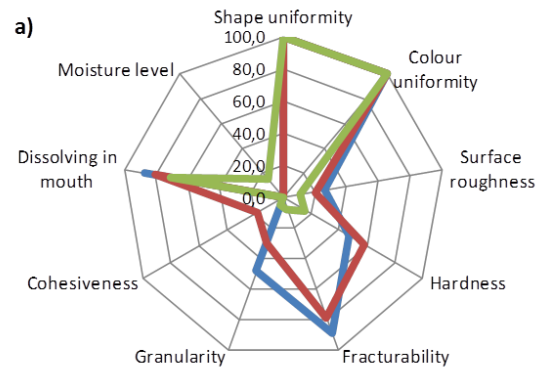
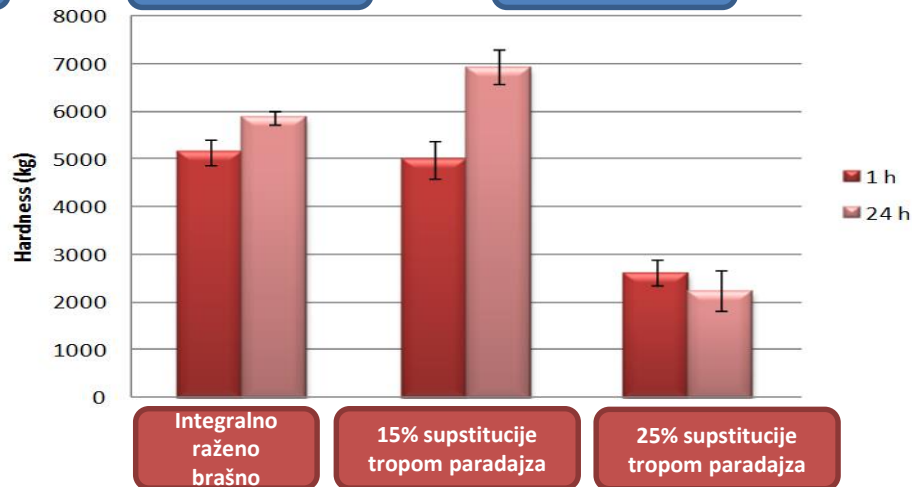
# Čajno pecivo od raženog brašna



Integralno  
raženo  
brašno

15% supstitucije  
tropom paradajza

25% supstitucije  
tropom paradajza



RB

85%RB:15%TP

75%RB:25%TP

# Zaključci

- Šira primena alternativnih žita u ishrani
- Potreba tržišta
- Novi proizvodi na bazi alternativnih žita moraju biti kreirani novim tehnološkim postupcima
- Senzorska prihvatljivost