Food Technology 2014

- **DEVELOPMENT OF GLUTEN-FREE MILK-FREE FRENCH BREAD**

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INTRODUCTION

Gluten-Free/Milk-Free Bread

- A search for palatable and tasty gluten-free/milk free breads was performed in both local food stores and on the internet.
- Gluten-free bread found in local groceries were only available in the freezer. Only items were milk free. These included bagels and a roll.
- On line one company provided slice bread along with hamburger and hot dog buns.
- However, the bread products found in store often were freezer burned, often not tasty and had limited selection.

Celiac Disease

- A gluten-free diet for life is recommended for Celiacs
- 1 milligram of gluten a day causes damage of the intestinal mucosa.
- European labeling gluten-free allows <200 ppm. A total of 300 mg. of gliadin/kg. found in products labeled gluten free (Biagi, 2004).
- Despite lack of symptoms, continued inflammatory damage occurs because of unknown consumption of gluten (Catassi, 2007).

Gluten

- Gluten grains identified in the gliadin protein found in when, triticale, rye, barley, & oats (Charbonnier,1980 and Ylimarki,1989).

- FDA Ruling: label a product may be labeled gluten free if final product does not contain wheat, barley rye or cross-bred of these grains, e.g. triticale. Note: Oats are not covered

- FDA Ruling states: the final product contains < 200 ppm

Assays for Gluten-Free

- Several assay analysis tests are available but they differ widely in their results.

- This provides serious concerns on the validity of gluten-testing procedures for labeling.

Baking Gluten-Free

- Low specific volume and hard crumb are associated with gluten-free baking (Miñarro, 2010).
- Hydrocolloids: Guar gum, hydroxypropyl methyl cellulose, and xanthium gum and buckwheat flour, egg powder and whey protein are suggested to formulate gluten-free bread (Mezaize, 2009) .
- Gluten-free flours do not have elasticity of gluten. Denser, need flours starches & emulsifiers for texture & taste (Hazen,2011)

GLUTEN-CONTAINING GRAINS

1. BARLEY
2. KAMUT
3. OATS
4. RYE
5. SPELT
6. WHEAT
7. AND CULTIVATED PRODUCTS FROM THESE GRAINS

GLUTEN-FREE

- The products that are gluten-free **DO NOT** contain the prolamins of wheat, namely α-, β-,γ-, and ω gliadin subgroups causing the damage to the intestinal villi to individual with Celiac Disease.

Identified Gluten-Free Sources

- Acorns
- Almond
- Amaranth
- Arrowroot
- Bean flour
- Buckwheat
- Coconut
- Corn
- Guar Gum
- Quinoa
- Palm
- Poi
- Potato
- Rice
- Sorgum
- Soy
- Sweet Rice
- Sweet Potato
- Tapioca
- Teff
- Xanthum Gum

Milk Substitutes

- Coconut Milk
- Rice Milk
- Soy Milk
- Almond
- Corn

OBJECTIVES

1. Determine the availability of breads that are both gluten-free products and milk-free.

2. Determine what key sensory problems exist with available gluten-free breads.

3. Develop a gluten-free milk-free French Bread.

HYPOTHESIS

- Currently, there is an inadequate supply and variety of quality tasting gluten-free bread that are also milk-free.
- There was no French or Italian bread
- It is possible to create such a product that would be totally acceptable to meet this need.

ASSUMPTIONS

- Using alternative gluten-free grain(s) it is possible to develop a gluten-free French bread and/or Italian bread.

- This could be used to create a Po-Boy or muffalatta sandwich

LIMITATIONS

- Gluten-free grains do not have the elasticity and texture of the gluten grains.
- This means to create similar products requires using several ingredients.
- This is necessary to create the same texture and taste of the gluten product.

JUSTIFICATION

- Serious need to provide a quality & larger supply of bread both gluten-free and milk-free to meet dietary needs.
- Celiac disease affects 1% of individuals in the United States (Fasano, 2003).
- Autism estimate to affect over 673,000 in the United States (Johnson, 2009).
- Milk is the most common of food allergies (Gonipeta, 2009).
- Additionally, many individuals suffer from wheat allergies.

MATERIALS AND METHODS

STORE SURVEY

- At total of 14 grocery and specialty stores were surveyed to identify available gluten-free bread
- The stores surveyed were located in Louisiana.
- Some products were available in stores.
- In many cases the some products contained milk and all products were found in the freezer with ice particles in them.

Moisture Analysis of Flours

Flour	%Moisture	Stand. Dev.
Tapioca	10.67	0.22
Rice	11.06	0.07
Potato	6.51	1.19
White Bean	11.12	1.54
Tapioca 75%/Potato 25%	9.99	0.02
Tapioca 75%/White Bean25%	11.92	1.53
Rice 75%/Potato 25%	9.52	0.05
Rice 75%/White Bean	10.11	1.19
Tapioca 50%/Rice 50%	10.50	0.02
Tapioca 50%/Potato 50%	7.63	0.19
Tapioca 50%/White Bean 50%	9.96	0.40
Rice 50%/Potato 50%	8.37	0.36
Rice 50%/White Bean 50%	9.81	0.34
Potato 50%/White Bean 50%	9.62	2.05
Wheat	10.75	0.55

RVA Comparison of Flours

Flour	Peak 1	Through 1	Break down	Final Visc	Setback	Total Setback	Peak Time	Pasting Time
Potato 50% Bean 50%	253	249	4	480	227	231	7	80
Rice 50% Potato 50%	934	810	124	1537	603	727	5.73	85.6
Tapioca 50% Rice 50 %	2247	1518	729	2413	166	895	5.4	74.5
Tapioca 50 % Bean 50%	1567	1118	449	1655	88	537	5.27	76.1
Rice 50% Bean 50%	568	570	-2	1892	1324	1322	7	94.3
Rice 75% Bean 50%	87.68	86.92	0.67	249.2	161.7	162.3	6.67	94.3
Rice 75% Potato 25%	113.5	99.92	13.6	203.5	90	103.5	6	94.3
Tapioca 75% Bean 25%	209.7	116	93.7	180.8	-28.92	64.8	4.73	76.1

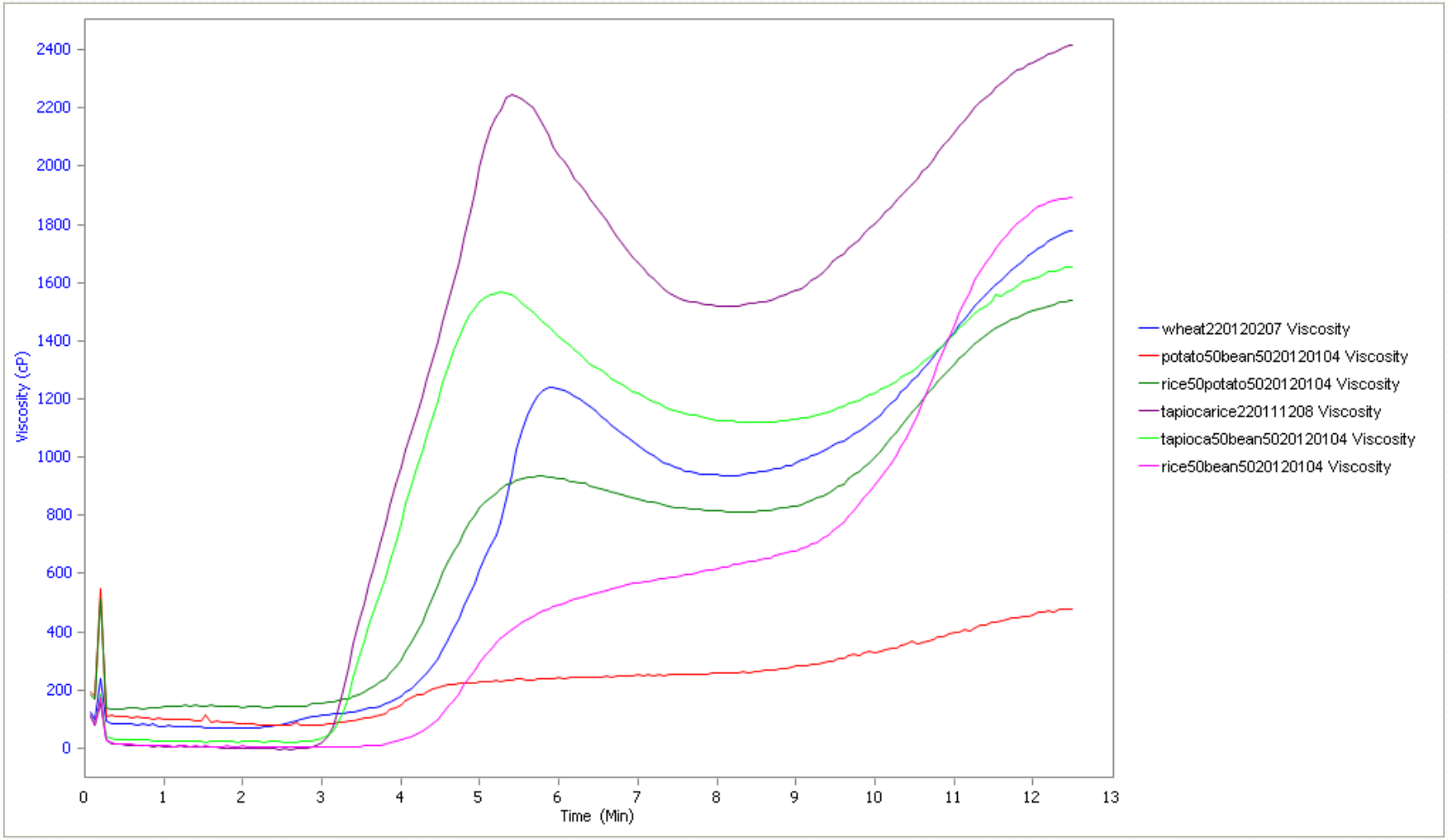
RVA Comparison of Flours

Test	Peak 1	Through 1	Break down	Final Visc	Setback	Total Setback	Peak Time	Pasting Time
Tapioca 75% Potato 25%	273.7	120.9	153.1	188.1	-85.58	68.2	4.33	76
Rice 50% Potato 25% Bean 25%	826	806	20	1805	979	999	6.2	84.9
Wheat 100%	103.3	18	25.3	148.3	45.1	70.3	5.9	90.4
Rice 100%	190.9	145.4	45.5	354.4	163.5	209	5.73	85
Potato 100%	130.1	75.25	54.8	114.3	-15.8	39.1	2.8	84
Tapioca 100%	377.9	159.2	218.8	277.5	-100.4	118.3	4.13	72
Bean 100%	14.83	15	-0.2	47.17	32.33	32.17	6.93	76

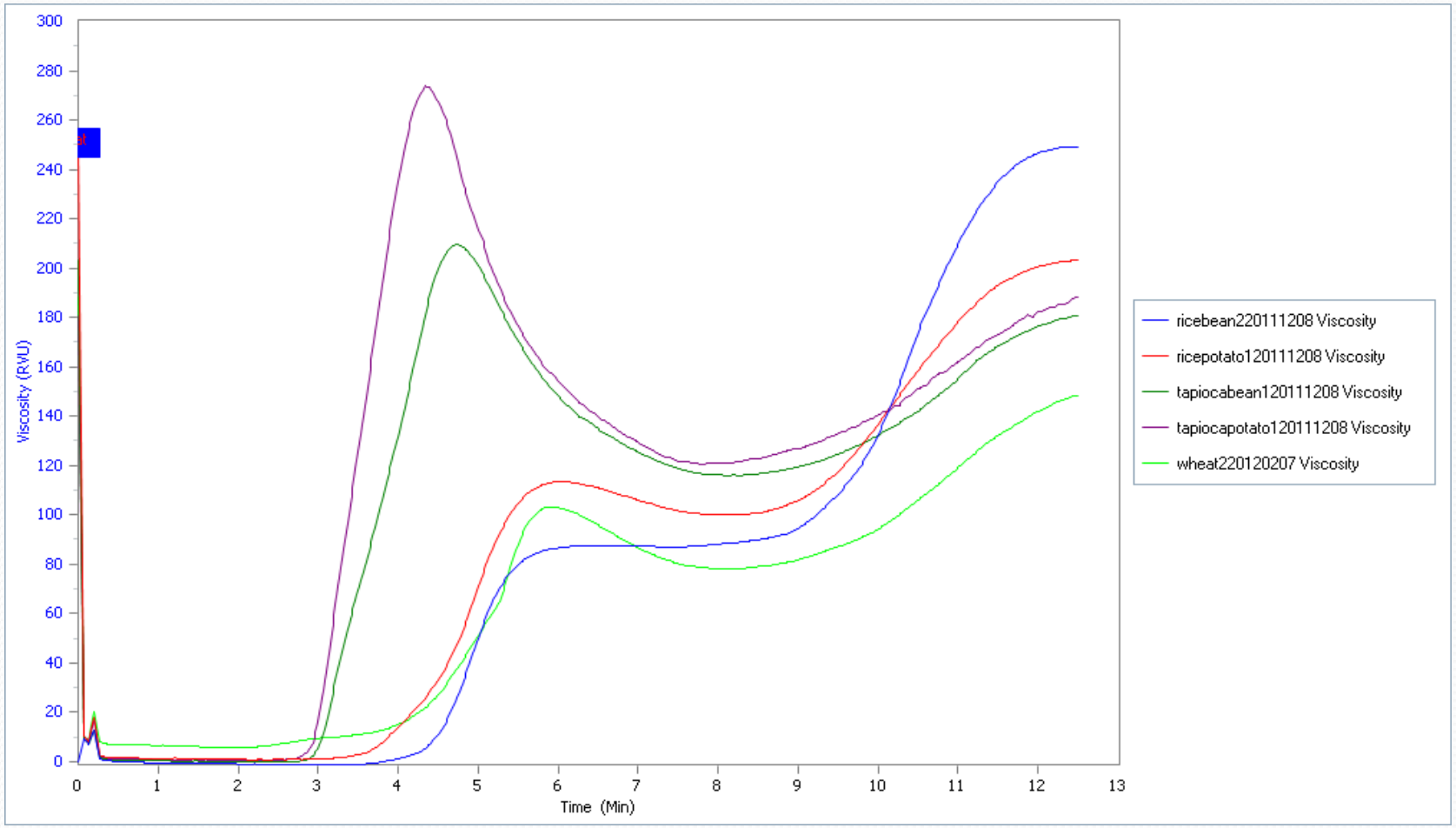
RVA Analyses of Flours

- Triplicate analyses of rice, tapioca, potato, bean and what flours were performed.
- Analyses of 50/50 combinations rice, tapioca, bean and potato flours.
- Analyses of 75/25 combinations of rice, tapioca, bean and potato flours.
- Analyses of the combination of 50% rice/25% potato/25% bean flour.
- This was done to determine the viscoelastic behavior of the gluten-free flours and compare to wheat flour.
- Comparison revealed the 50/50 combination of rice/bean and the rice 50/bean 25/potato 25 were the closest creep recovery and viscoelastic behaviors compared to wheat

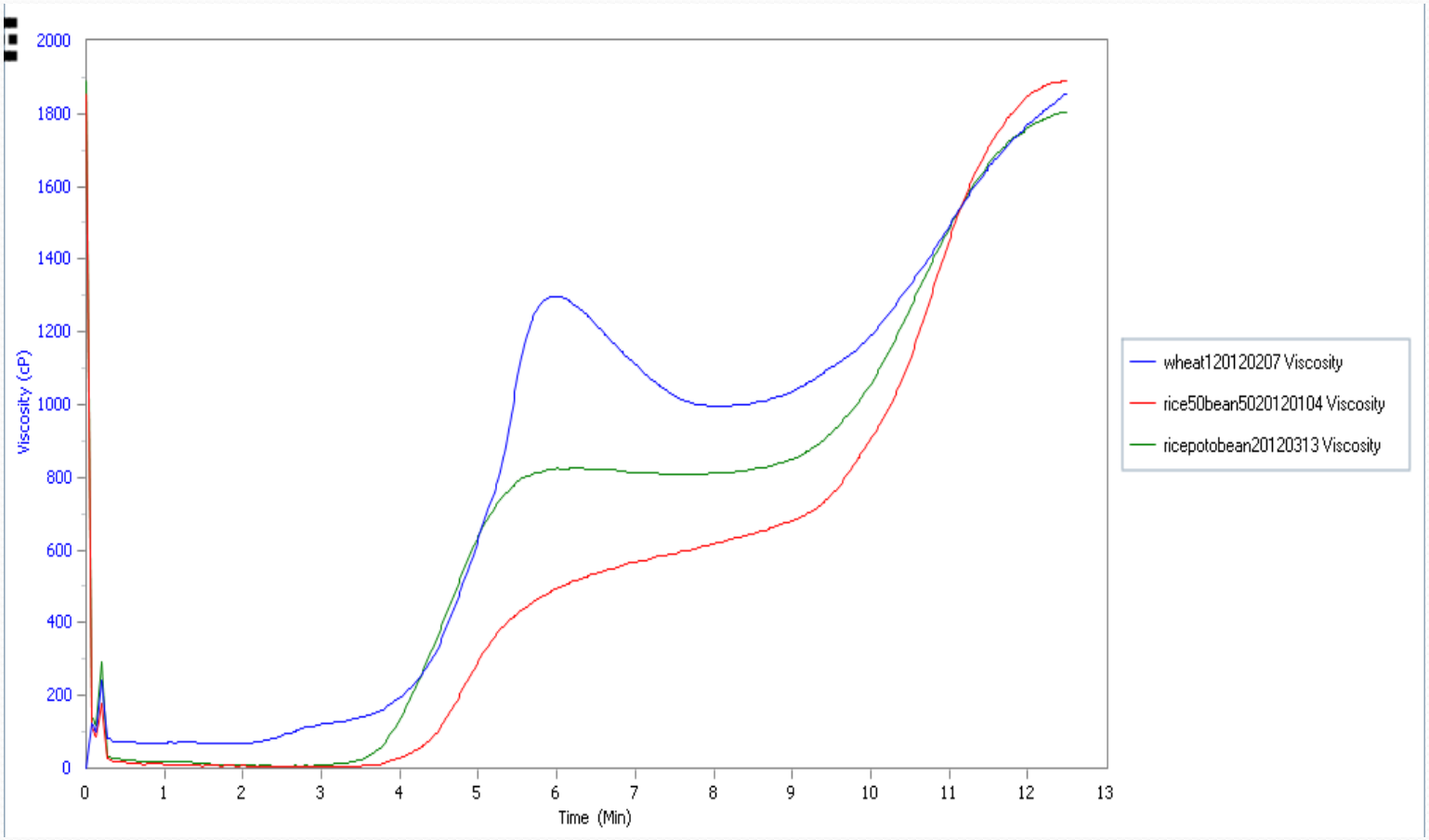
Graph 50/50 Flour Combinations & Wheat



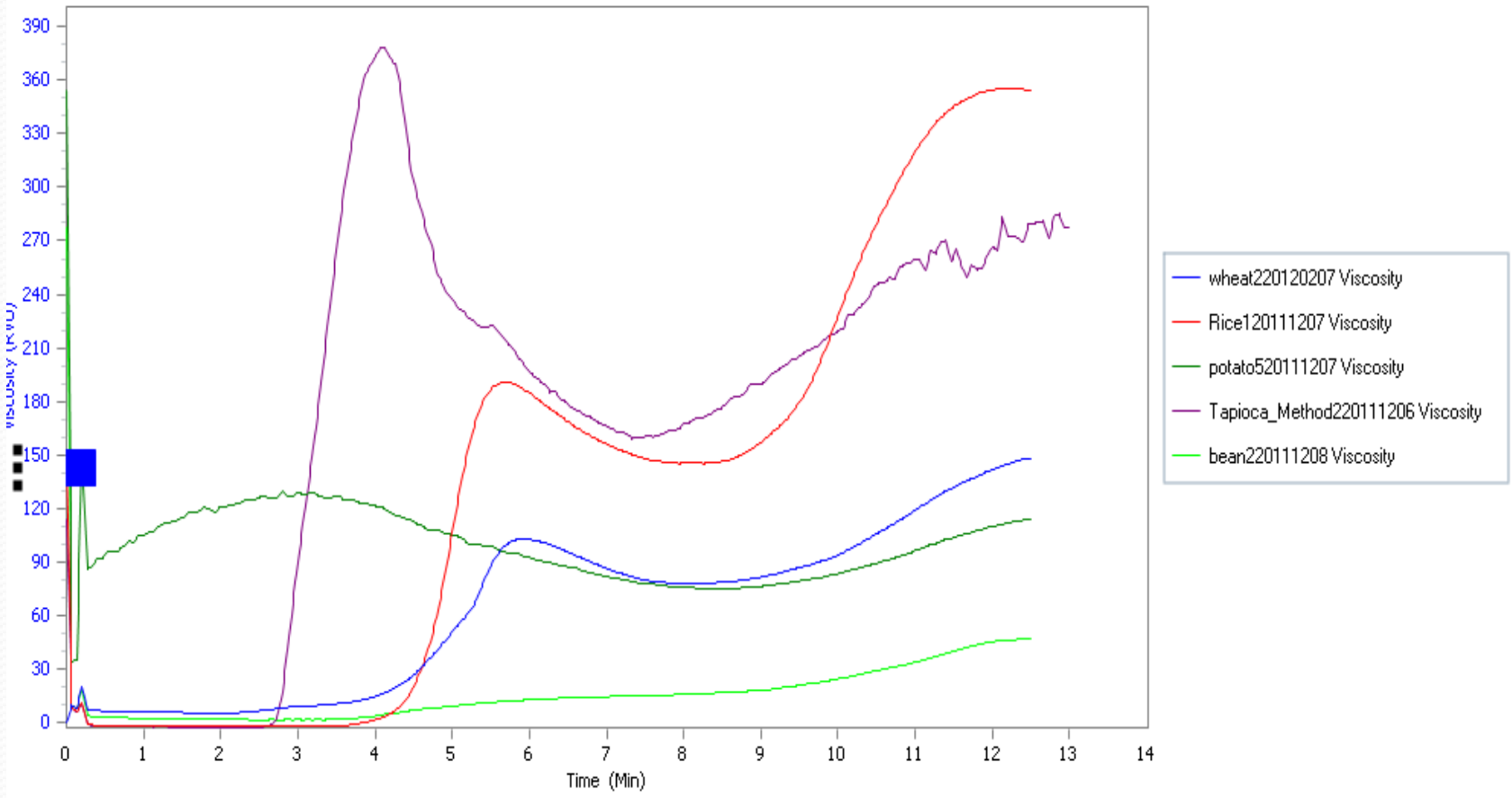
Graph Combination 75%/25% Flours & Wheat



Graph Flour Combinations Rice 50%/Bean 25%/Potato 25% & Rice 50%/Bean50% & Wheat 100%



Graph of Individual Flours



Texture Analyses of Breads

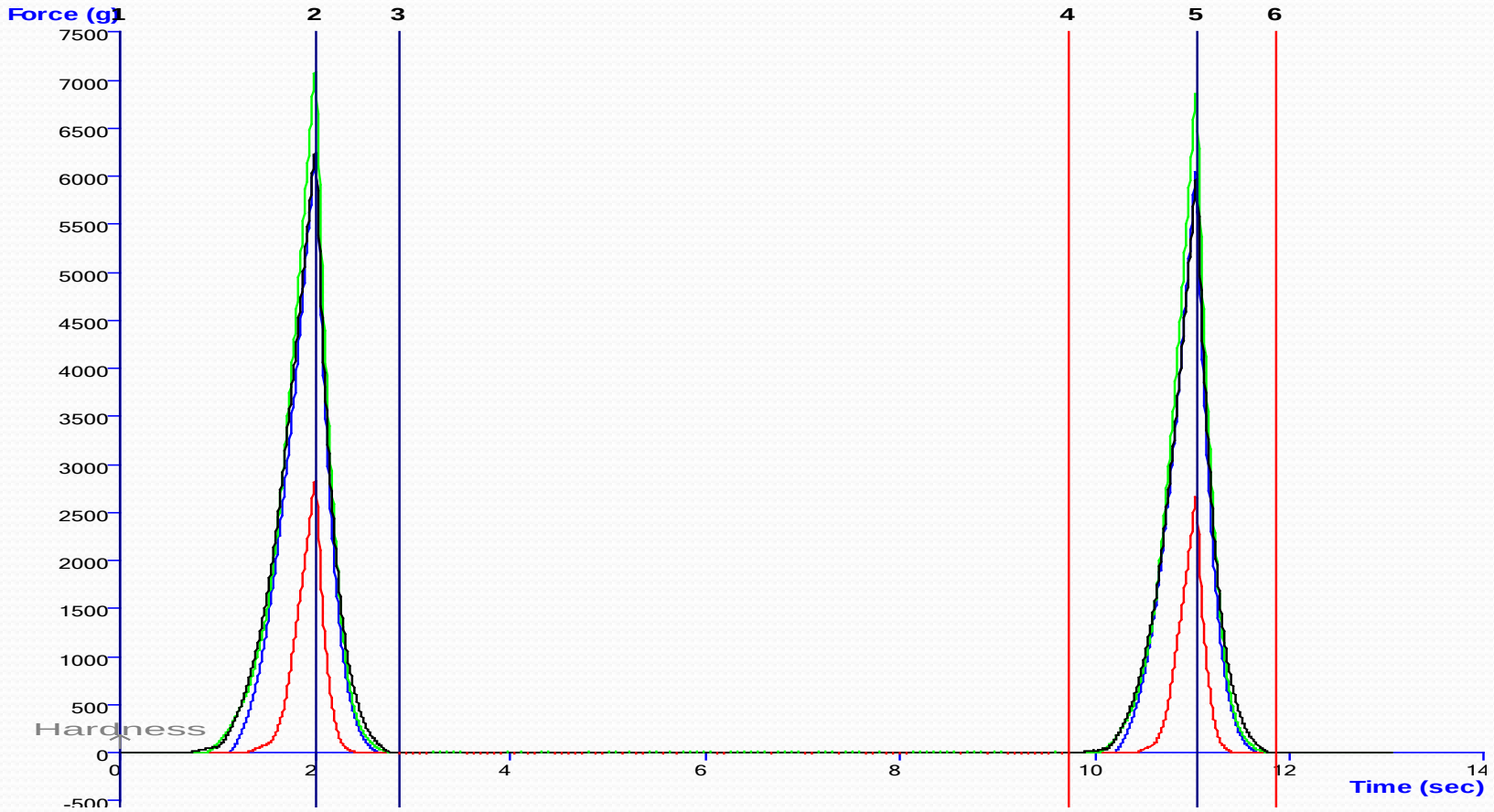
- Texture analyses was performed on the wheat, rice/bean, and rice/potato/bean French bread developed.

- This was done to determine the quality of bread including hardness, adhesiveness, resilience, cohesive, springiness, gumminess, and chewiness

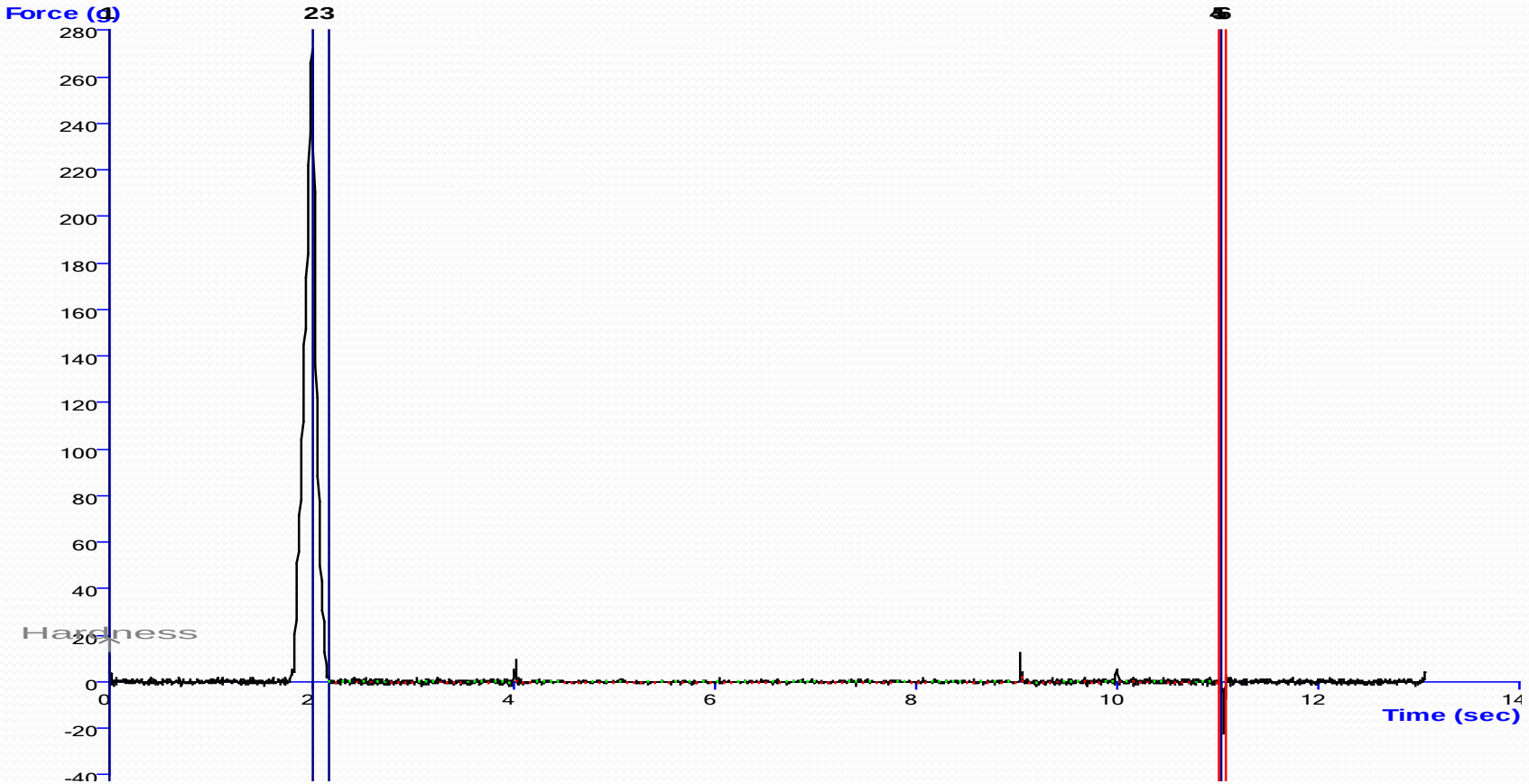
Texture Analyses of Breads

Bread		Hard-ness	Adhesiv e-ness	Resil-ience	Cohes -ive	Spring -ness	Gumm i-ness	Chewi ness
Rice/Bean	Average	10.1	-0.02	51.11	0.873	48.76	8.9	4.763
Rice/Bean	St.Dev	0.53	0.635	0.25	0.017	12.09	0.636	0.905
Rice/Bean	Coeff of Var	5.24	885	0.49	1.961	24.79	5.232	21.23
Rice/Potato/ Bean	Average	10.8	0.32	52.0	0.608	30.51	6.406	2.497
Rice/Potato/ Bean	St.Dev	1.53	0.575	15.4	0.421	21.70	4.68	1.784
Rice/Potato/ Bean	Coeff of Var	14.2	179.6	29.62	69.20	71.11	73.06	71.47
Wheat	Average	10.1	-0.243	43.51	0.808	67.52	8.13	5.484
Wheat	St. Dev	0.15	0.502	6.647	0.026	8.542	0.162	0.642
Wheat	Coeff of Var	1.51	206.3	15.28	3.215	12.66	1.991	11.71

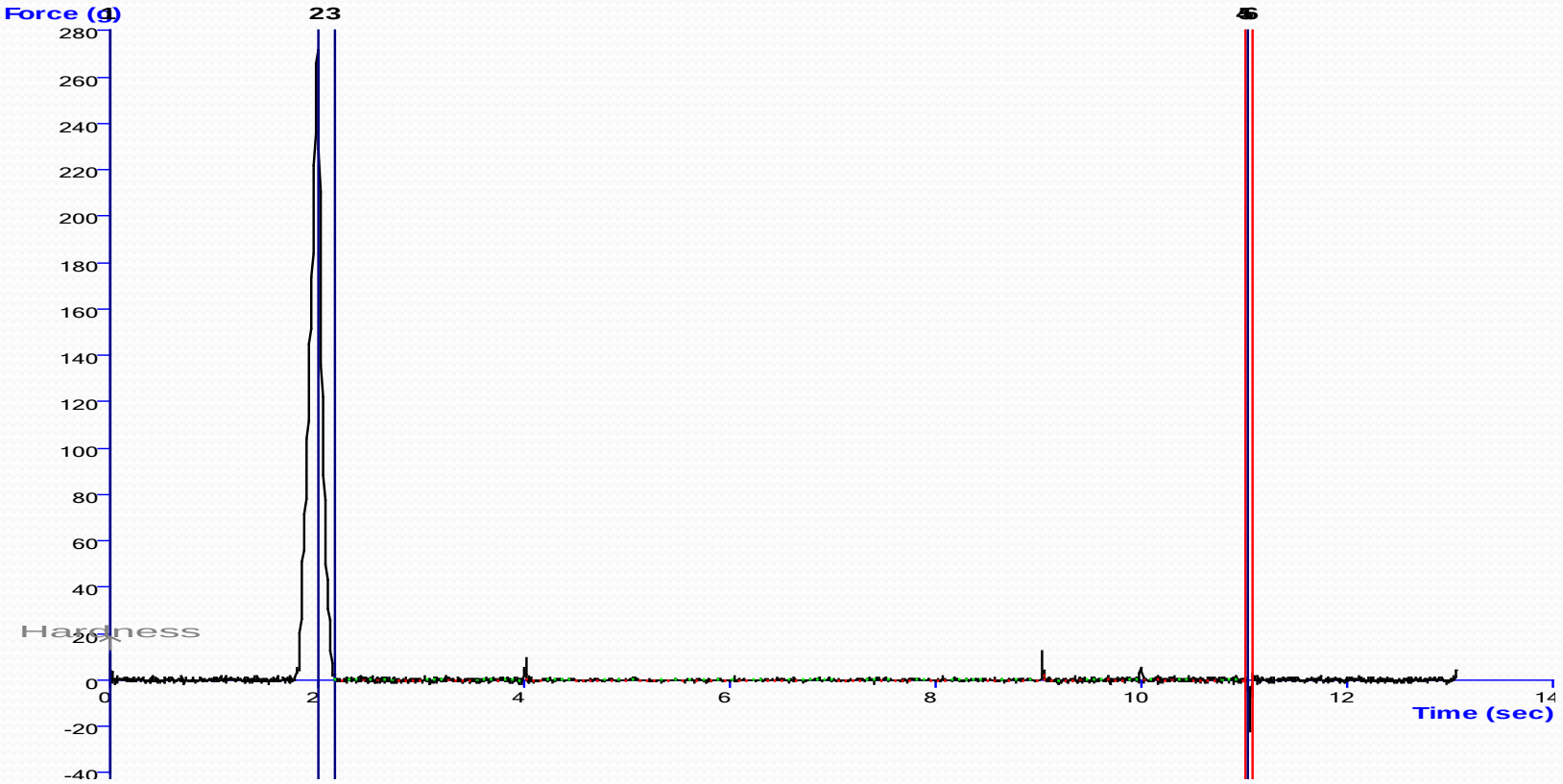
Rice 50%/Bean 50% Bread Combination Texture Analyses



Rice 50%, Bean 25%, & Potato 25 Bread Texture Analyses



Wheat Bread Texture Analyses



Color Analyses

- Color analyses of the French Bread was performed using the Minola CR 200 Meter.

Sample	# of Sample	L* Mean	L* StdDev	A* Mean	A StdDev *	B* Mean	B StdDev
Rice/Bean Bread	3	73.6	5.78	-0.89	0.99	16.9	1.82
Rice/Potato/ Bean Bread	3	70.8	2.85	-0.71	0.27	17.3	1.85
Wheat Bread	7	73.1	2.02	-0.96	0.43	16.6	0.95

Non-Celiac Population Sensory Evaluation

- General public of non-Celiac subjects in sensory study using the hedonic scale of 1 (dislike extremely) to 9 (extremely like)
- One gluten-free French Bread 50% rice flour & 50% bean flour. A second sample was 50% rice flour, 25% potato flour, & 25% bean flour.
- The subjects rated the gluten-free breads a marginally acceptable.
- There was a significant difference in the acceptance of the wheat bread compared to the gluten-free with an F value of 18.35 and Alpha level of <.0001

Celiac Population Sensory Study

- Celiac subjects were recruited to participate in a sensory study of the gluten-free breads.

- The Celiac population, the target subjects, of the French bread sensory results indicated both gluten-free breads as acceptable with hedonic rating over 5 in the 9 point scale.

CONCLUSION

- Store search indicate a lack of sufficient gluten-free milk-free bread products.
- Sensory studies of both the non-Celiac and Celiac population statically show the 2 gluten-free milk-free French breads are acceptable.
- Because of the multiple gluten-free grains there is a potential to develop highly acceptable gluten-free milk free French, Italian and other breads.