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TECHNOLOGICAL AND NUTRITIONAL AND SENSORIAL INFLUENCES ON USING DIFFERENT TYPES OF HYDROCOLLOIDS ON BREAD

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Abstracts

Gums can be added at bred formula to increase the fibers content and reduce caloric value. If the arabic gum or a mixture of arabic gums with starch and alginates is added the fibers content increase proportionally but the caloric value doesn't change significant. At high levels of gums (10% on flour basis) the sensorial properties decrease significant and products have a very low acceptance. The mixture of gums relieves better results (farinographic, sensorial and technological) than arabic gums solely.
Keywords: *arabic gum, acacia gum, alginates, farinographic properties, sensorial evaluation, caloric value, fiber content*

Introduction

Bread and cereal products should represent the most important quantitative part (about 30%) from total daily food consumed. Wheat bread actual consumed is prepared from low extraction flours with a low dietary fiber content and nutritive values lower than high extraction flours (Florian, 1997b; Nelson, 2004). From this reasons we should work to improve the nutritionally properties of bread. We can add diverse products in wheat bread to obtain healthier breadstuff. One product which can be added is the gums (soluble dietary fiber) from different sources (Ognean, 2006). The addition of fiber (or any other product) modifies the technological properties of dough and properties of breads, positively or negatively. The addition of gums determines either increasing of dietary fiber content and decreasing of caloric

value by "diluting" the content especially through increasing water content (Stear, 1990; Florian, 1997a).

Hydrocolloids or also named gums are substances consisting of hydrophilic, long chain, high molecular weight molecules, that in water produce gels, highly viscous suspensions or solutions with low dry-substance content. Solutions of different gums with the same dry-content have different viscosity. Combining two gums or a gum with starch can often result in a synergetic effect. Gum Arabic is the dried, gummy exudates obtained from various species of Acacia trees of the Leguminosae family Gum arabic consist of highly branched molecules constructed from both neutral sugars and uronic acids. The approximate molecular weight is believed to be 250,000. There is a proteinaceous fraction, approximately 2% of the total weight. It is soluble in water at levels of up to 50% (w/w) and the viscosity is stable at pH 3-9. It is extremely soluble and forms solutions with low viscosity even at high level of concentration.

Sodium alginate is extracted from brown seaweeds. The alginate polymers are composed of β-D-mannuronopyranosyl and α-L-guluronopyranosyl units. These units occur in blocks of one or other uronic acid. There also can be region of the alginate molecule that consists of alternating mannuronic and guluronic acid monomers. The ratio of these blocks determined by the genus and species of seaweed that is extracted and this ratio determines gel strength, calcium reactivity, tolerance to a range of calcium concentrations.

The gums are usually used at low levels (0.4-2%) but in this study the levels was higher. The goal of study is to find what impact has the addition of gums at high levels on dough and bread properties. Because the dough has a great viscosity we thought the addition of gums at high levels couldn't affect dramatically the rheology of its.

Experimental

We evaluated two types of hydrocolloids, Tic Pretested® Ticaloid® 102-B and Tic Pretested® Gum Arabic FT Powder from Tic Gums Inc., named Ticaloid and Gum Arabic in further text. Ticaloid is a mixture of gum acacia, corn starch, ammonium alginate and calcium alginate and Gum Arabic is a gum extracted from Acacia. The gums

were added to bread formula in ratio 3, 5 and 10% based on flour weight. The recipes of breads are shown in table 1.

The dough was prepared using a lab mixer, the water was added until the desired consistency (the same for all samples) was achieved. Bulk fermentation last hour, after that the dough was molded, place into a pan and keep at 30ºC for proofing and than it was baked at 200ºC without steam.

The loaf volume of the loaves was determined by rapeseed displacement. The porosity of crumb was determined measuring the volume of a piece of crumb pressed and with a known volume by oil displacement. The volume determined was reported to known initial crumb volume. The elasticity of crumb was determined by pressing a crumb cylinder at half of initial height and keeping them one minute and measuring the final height after another minute. The final height was reported to initial height of crumb cylinder. The moisture of crumb was determined too.

Table 1. Bread formula

Raw material	Control sample	Ticaloid*			Arabic Gum*		
		T3	T5	T10	A3	A5	A10
Wheat flour, g	300	300	300	300	300	300	300
Fresh yeast, g	9	9	9	9	9	9	9
Salt, g	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Water, ml	190	253	324	353	256	317	572
Ticaloid, g	-	9	15	30	-	-	-
Arabic Gum, g	-	-	-	-	9	15	30

*The samples noted T3, T5 and T10 were prepared with Ticaloid in ratio 3, 5 and respectively 10% and the samples noted A3, A5 and A10 were prepared with Gum Arabic in ratio 3, 5 and respectively 10% based on flour weight.

External and internal sensorial characteristics were evaluated by 25 students from bread making laboratory and score on a scale of 1 (least favorable) to 10 (most favorable). Products were considered acceptable if their scores were above 5 (the score for the lowest level of acceptability).

The effects of gum supplementation on rheology of dough were evaluated farinographic in accordance with Farinograph Method for

Flour AACC Method 54-21, constant flour Weight Procedure. There were determined:

- Dough Development Time (DDT) the time required for the curve to reach the maximum consistency;
- Stability (S) the time difference (in minutes) between point where top of curve first intersects and point where top of curve leaves 500 UB (Brabender Units) line or the line who define dough consistency;
- Tolerance Index (TI) difference (in BU) between the maximum of curve at peak to top of curve measured at 5 in. after peak is reached;
- Degree of Softening (DS) difference (in BU) between the maximum of dough consistency and the dough consistency reached after 12 min from consistency peak;
- Dough Consistency (C) line range which passes through the middle of the curve at the maximum consistency;
- Dough Elasticity (E) the curve width at the maximum consistency range.

For experiments was used a commercial flour from Baneasa Mill, type 650, with wet gluten content 28.9%, the deformation index 6 mm, Falling Number 265. Fresh yeast was commercial type too, with a dry content at 28% and fermentation power 12 minutes, determined through dough ball method.

Results and Discussions

The results of farinographic evaluations of gums addition are presented in table 2 and figure 1.

The additions of gum Arabic or Ticaloid have little effect on farinographic absorption (FA). When Ticaloid was added in proportion of 5% and Arabic gum in proportion of 3 and 5 % a second peak of consistency was observed, corresponding to the moment of gums complete water absorption. This determines increasing of stability (S) and Dough Development Time (DDT). Both, Ticaloid and Arabic Gums determine decreasing of elasticity, acting as plasticizers. Ticaloid and arabic gum increase dough softening on short time (Tolerance Index – TI) and stabilize the dough softening on long time.

Table 2. Farinographic evaluations of gums addition

Material	C (BU)	FA (ml)	DDT (min)	E (BU)	TI (BU)	DS (BU)	S (min)	Obs.
Control Sample	490	61.7	2	100	50	70	6	
T3	520	62	1.5	80	60	60	3	
T5	475	62	9.5	70	40	60	7	*
A3	500	60.3	8.5	80	60	90	11.5	**
A5	570	58.7	8.5	70	60	90	6.5	***

* after 8 min from first peak (1.5 min) it's observed a second peak with Consistency 475 BU considered to determine C, DDT, E, TI, DS, S
** at 1.5 min from water addition is observed first peak and after 8,5 min is observed the second peak considered to determine C, DDT, E, TI, DS, S
*** at 1.5 min from water addition is observed first peak with consistency 520 BU and after 8,5 min is observed the second peak considered to determine C, DDT, E, TI, DS, S

The gums addition determines decreasing of crumb elasticity, probably through interference between starch and protein gels from normal crumb with gums. Ticaloid reduce crumb porosity at high levels and arabic gum increases it. Probably Ticaloid reduce the stability of cells from dough and arabic gums stabilize them, so the gases are better retained by dough with arabic gum. That induce a higher loaf volume of sample with arabic gums but the differences aren't so significant. More important is the fact that we weren't able to determine the crumb elasticity and porosity because the crumb was very brittle at sample with 10% arabic gum added.
The loaves properties are presented in table 3.

Table 3. Loaves properties with gums added

Loaves properties	Control sample	Ticaloid			Arabic Gum		
		T3	T5	T10	A3	A5	A10
Moisture, %	44.2	43.9	42.7	42.5	44.2	43.6	40.5
Crumb Elasticity, %	95	91.2	80	91	83	92	-
Crumb porosity, %	70	70	60	60	75	75	-
Loaf volume, ml/100 g	287	290	293	270	313	283	260

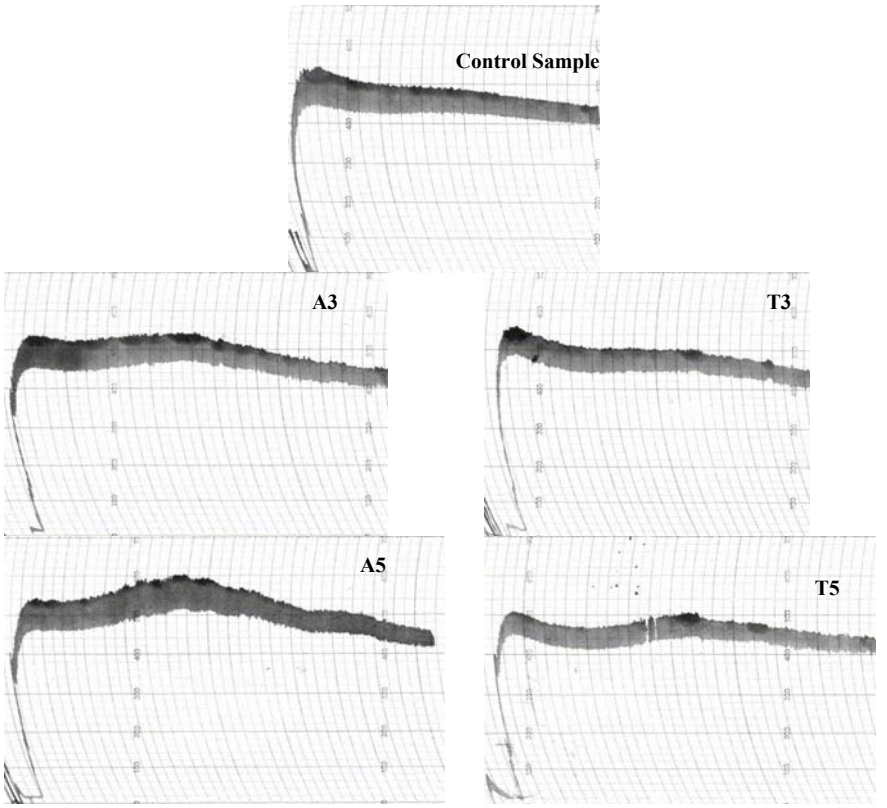

Figure 1. The farinographic curves of flours supplemented with Ticaloid and Arabic Gum

The results of sensorial evaluation are presented in table 4. The scores presented are average scores. In general when gums are added the crust color was more intense, the crumb color was lighter and more uniform. The differences between the control sample and samples with 3 and 5% gums aren't too significant; frequently the scores are even slightly higher. At 10% gums additions the scores fall with one exception – crust color. The sample with 10% arabic gum has a very brittle crumb and the moisture as easy detectable sensorial.

The nutritional properties of samples were calculated considering the recipe of samples and moisture raw materials and samples. The values are presented in tale 5.

Table 4. Sensorial evaluations of samples.

Sensorial attributes	Control Sample	Ticaloid			Arabic Gum		
		T3	T5	T10	A3	A5	A10
Crust overlooking	8.0	8.3	8.5	8.3	8.2	8.9	8.1
Crumb overlooking	7.3	8.1	8.4	7.6	8.1	8.4	6.6
Crumb porosity	7.2	8.2	8.4	7.9	8.1	8.5	6.4
Taste	7.3	7.8	7.9	7.0	8.6	8.1	6.6
Flavor	6.9	7.6	7.9	6.9	8.2	8.3	6.8
Elasticity	7.3	7.7	8.4	7.5	8.4	8.4	6.0
Mastication	7.8	7.7	7.9	6.7	8.4	7.8	5.6
Moisture	7.7	8.3	8.1	7.5	8.3	8.3	6.5
Crumb color	7.1	8.1	8.7	7.7	8.3	8.4	7.1
Smell	7.9	6.7	7.4	7.0	8.6	7.9	5.9
Overall score	7.1	8.0	8.2	7.2	8.6	8.3	6.3

As we expected, the fiber content increases proportional with addition level but the caloric value of samples with gums doesn't show significant changes. Because the moisture of sample are basically the same and even lower at high levels of gums, and the caloric value of gums is the same as for other polysaccharides, the caloric value of samples even slowly increases when high quantity of gums are added.

Table 5. Nutritional properties of samples

	Control Sample	Ticaloid			Arabic Gum		
		T3	T5	T10	A3	A5	A10
Fibers content, g/100 g	2.14	3.41	4.29	6.18	3.64	4.64	7.28
Increasing of fibers content, %	-	59.3	100.5	188.8	70.1	116.8	240.2
Caloric value*, kcal/100g	229	229	233	232	229	231	244
Caloric value**, kcal/100g	229	226	228	223	226	226	233

*caloric value was calculated considering the caloric value of gums 348 Kcal/100 g in compliances with FDA Regulations requiring the inclusion of 4 Kcal/g for all soluble dietary fiber.

**caloric value was calculated considering the caloric value of gums 1.74 Kcal/100 g, considering the caloric value of gums 2 Kcal/g

Conclusions

The Tic Pretested® Ticaloid® 102-B and Tic Pretested® Gum Arabic FT Powder from Tic Gums Inc can be added at bread recipe to increase the fibers content of bread but the sensorial properties and acceptability of products are low at high levels. The optimum level of additions is 5%. The supplementation of bread with these gums doesn't affect the caloric values because the quantity of water absorbed by dough is lower than the quantity absorbed by normal dough. The dough prepared with these gums is more plastic and sticky than normal dough. Even the main composition of gums is the same (arabic gum) some differences can be observed. These are caused by the other gums from Ticaloid, who improve the behavior of this.

Acknowledgements

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