



TAB A
SUPPORTING EXHIBITS

KANSAS STATE UNIVERSITY
RESEARCH FINDINGS
RE: CITRAFIBER

INCLUDES RESEARCH TESTS FOR;
GLUTEN FREE BREAD
WHITE PAN BREAD
PIZZA CRUST
HAMBURGER BUNS

EFFECT OF CITRAFIBER™ ON WHITE PAN BREAD

Report

To

Alarma Corporation

January 2009

METHODS

Materials

Hard wheat flour containing 13.13% protein was used in this study.

Mixograph Study

The effect of CitraFiber™ in dough was evaluated with the mixograph using AACC Method 54-40A. Addition levels were 1.5, 2.5 and 3.5% (fwb). CitraFiber™ was added dry (blended with the flour) or hydrated (mixed with the water). Sufficient mixograms were produced to optimize the water level and ensure reproducibility.

White Pan Bread Preparation

Bread was baked as pup loaves using AACC Method 10-10B straight dough procedure with 90 min fermentation. The bread formula consisted of bread flour (100g, 14% mb), shortening (3 g), instant active dry yeast (2 g), sugar (6 g), salt (1.5 g) and ascorbic acid (50 ppm). CitraFiber™ was added at 1.5, 2.5 and 3.5% (fwb) in the dry and also hydrated forms. Water absorption and mix time were optimized for each level. The effect of CitraFiber™ on dough properties and crumb grain was evaluated subjectively. Loaf volume was measured by rapeseed displacement. All treatments were baked at least in triplicate.

The impact of CitraFiber™ on bread yield was determined by measuring moisture retention during baking. This was done by weighing proofed doughs before placement in the oven and weighing baked loaves immediately after removal from the oven. The loss in weight during baking was assumed to be moisture loss during baking. If CitraFiber™ increased dough absorption and that water was retained during baking, then there would be an increase in bread yield.

Bread Texture Measurements

Bread firmness was measured to determine if CitraFiber™ had an effect on bread staling. The elasticity of the bread was measured to determine if CitraFiber™ caused the bread crumb to become sticky, gummy or more elastic. Bread containing 0 and 2.5% dry CitraFiber™ was prepared as described above. After cooling, the loaves were double bagged and stored at room temperature. Bread firmness and elasticity was measured 2, 4 and 6 days after baking using the TA.XT2 Texture Analyzer (Stable Micro Systems/Texture Technologies) with a modified version of AACC Method 74-09. Loaves were sliced into 1" thick slices. The center three slices of each loaf were compressed 7 mm (25% compression) at a speed of 2 mm/sec using a 25 mm diameter cylindrical probe. The compression was held for 30 seconds. Firmness was taken as the grams force required for a 25% compression (6.25 mm depth) of the slice. Elasticity was taken as the force at 37 sec (force required to hold the compression for 30 sec at 7 mm) divided by peak force. Three loaves per treatment per day were evaluated.

The moisture content of the center slice of each loaf was measured using the AACC Method 44-15A 2-stage procedure. Moisture was measured on days 2, 4 and 6 after baking.

Dough Flow Properties

The spread test was used to measure the elastic and viscous properties of the dough. Full formula doughs containing 0 and 2.5% dry CitraFiber™ were mixed and punched as described in the pup loaf method for 90 min fermentation. Doughs were tested after mixing (0 min) and after 45 and 90 min of fermentation. At the testing time, doughs were mechanically moulded and placed on a smooth plate in a fermentation cabinet (30°C, 90% RH) for 1 hr then measured. Spread ratio was calculated by dividing dough width by height.

Each treatment was tested in triplicate. Viscous doughs (increased flow) exhibit higher spread ratio values while elastic doughs (expand rather than flow) exhibit lower spread ratios.

Hamburger Buns

Hamburger buns were prepared using a simplified commercial sponge and dough formula. The sponge ingredients consisted of flour (70 g, 14% mb), instant active dry yeast (1g) and water (46 ml). Dough ingredients were flour (30 g, 14% mb), sugar (7.5 g), olive oil (6.0 g), salt (2.0 g), monoglycerides (0.5 g) and water (opt). CitraFiber™ was added dry at 0 or 2.5% with the dough ingredients. Sponge ingredients were mixed for 1 min then allowed to ferment for 4 hours in a fermentation cabinet (30°C, 90% RH). The dough ingredients were added and the doughs were mixed to optimum development. Dough pieces weighing 100 g were placed in greased hamburger bun pans and proofed for 35 min in the fermentation cabinet. The buns were then baked for 15 min at 425°F. After cooling, bun height was measured and the buns were sliced and the grain was evaluated subjectively. Each treatment was baked in triplicate.

Pizza Crust

The pizza crust formula consisted of flour (100 g, 14% mb), instant active dry yeast (2.4 g), sugar (1.6 g), salt (1.6 g), olive oil (1.6 g) and water (opt). CitraFiber™ was added dry at 0 and 2.5% (fwb). Water absorption and mix time determined in the pup loaf bread test were used. Mixed doughs were rested in a fermentation cabinet (30°C, 90% RH) for 15 min then sheeted to 6 mm thickness. Disks were cut, docked and baked for 20 min at 350°C in a reel oven. After cooling, crust diameter and thickness were measured. The crusts were cut

open and the interior crumb was evaluated subjectively. Each treatment was baked in triplicate.

RESULTS AND DISCUSSION

Mixograph Study

Water absorption increased by 6%, 8% and 12% for addition levels of 1.5%, 2.5% and 3.5% CitraFiber™, respectively (Table 1). Mix time of doughs containing 1.5% and 2.5% CitraFiber™ increased by 15 sec while the mix time of doughs containing 3.5% CitraFiber™ increased by 30 sec. These increases are significant; however, the mix times of all doughs were normal (3.5 to 4 min). Water absorption was not affected by the form of the CitraFiber™. Mix time increased as the level of dry CitraFiber™ was increased but was not affected by the level of hydrated CitraFiber™.

Table 1. Effect of CitraFiber™ level and form on mixing properties

CitraFiber™ Level (% fwb)	CitraFiber™ Form	Water (% fwb)	Mix Time (min)
0 (control)	dry	67	3.50
1.5%	dry	73	3.75
2.5%	dry	75	3.75
3.5%	dry	79	4.00
1.5%	hydrated	73	3.75
2.5%	hydrated	75	3.75
3.5%	hydrated	79	3.75

White Pan Bread Preparation

An even greater increase in water absorption was observed in the full formula bread doughs containing CitraFiber™ (Table 2). Water level increased by 6%, 11% and 18% for addition levels of 1.5%, 2.5% and 3.5% CitraFiber™ respectively. Mixing time also increased significantly as CitraFiber™ level increased. However, the mix times were within the target range for white pan bread doughs. The addition of CitraFiber™ did not have any effect on the handling properties of the doughs. All doughs were strong out of the mixer and exhibited

good viscoelastic properties at make-up. Adding the CitraFiber™ as a dry powder or hydrated with water did not affect water absorption, mixing time or dough characteristics.

There was no difference in weight loss during baking between the levels or forms of CitraFiber™. All loaves lost approximately 16% moisture during baking.

The form of CitraFiber™ did affect loaf volume and crumb grain characteristics. The addition of all levels of CitraFiber™ in the dry form significantly increased bread volume compared to the control containing no CitraFiber™. There was not a significant difference in volume between loaves containing the three levels of CitraFiber™. The low level (1.5%) of hydrated CitraFiber™ significantly increased bread volume; however, the higher levels did not.

The crumb grain of loaves containing 1.5% dry, 2.5% dry and 1.5% hydrated CitraFiber™ were similar to the control. However, loaves containing 3.5% dry, 2.5% hydrated and 3.5% hydrated CitraFiber™ were more open with larger air cells; thus poorer than the control loaves. Loaves containing 3.5% CitraFiber™ (both dry and hydrated) contained large holes introduced during moulding. This may indicate the doughs were dry and did not seal well during moulding. The color of the crumb (visual assessment) of loaves containing both dry and hydrated CitraFiber™ was similar to the control at the low level but became progressively darker as the CitraFiber™ level increased.

Based on volume and crumb grain characteristics, 2.5% CitraFiber™ added in the dry powder form was selected as the optimum.

Table 2. Effect of CitraFiber™ level and form on dough and bread^a

CitraFiber™ Level (% fwb)	CitraFiber™ Form	Water (% fwb)	Mix Time (min)	Volume (cc)	Wt loss in bake (%)
0 (control)		70	3.00	903 c	16.1 a
1.5%	dry	76	3.25	1005 a	15.9 a
2.5%	dry	81	3.50	980 ab	15.6 a

3.5%	dry	88	4.25	998 a	16.0 a
1.5%	hydrated	76	3.25	988 a	16.0 a
2.5%	hydrated	81	3.50	950 abc	17.2 a
3.5%	hydrated	88	4.25	933 bc	16.5 a

^a values in a column followed by different letters are significantly different ($p = 0.05$)

Bread Texture Measurements

Bread containing 0 and 2.5% dry CitraFiber™ was prepared as described above.

Water absorption and mix time were 70% and 3.0 minutes for control doughs and 81% and 3.5 min for doughs containing 2.5% CitraFiber™ .

There was not a significant difference between the firmness of loaves made with and without CitraFiber™ on any of the testing days (Table 3). The moisture content of the loaves containing CitraFiber™ was significantly higher than the control loaves and did not change with time. There was no difference in crumb elasticity between the treatments on days 2 and 4 after baking. On day 6, the loaves containing 2.5% CitraFiber™ were significantly more elastic than the control loaves. This indicates that the CitraFiber™ did not make the bread crumb gummy.

Table 3. Effect of CitraFiber™ (CF) on bread firming, moisture and elasticity^a

Trt	Firmness (g force)			Moisture (%)			Elasticity (%)		
	Day 2	Day 4	Day 6	Day 2	Day 4	Day 6	Day 2	Day 4	Day 6
control	179 c	258 b	358 a	34.6 b	36.0 b	34.6 b	58.4 ab	59.2 a	51.5 c
2.5% CF	178 c	229 bc	320 a	38.7 a	38.6 a	38.0 a	60.6 a	59.2 a	55.8 b

^a values in a column followed by different letters are significantly different ($p = 0.05$)

Dough Flow Properties

The spread test was used to measure the elastic and viscous properties of the dough.

Doughs that are more viscous (increased flow) exhibit higher spread ratio values while doughs that are more elastic (expand rather than flow) exhibit lower spread ratio values.

Full formula bread doughs containing 0 and 2.5% dry CitraFiber™ were prepared as described above. Water absorption and mix time were 70% and 3.0 minutes for control doughs and 81% and 3.5 min for doughs containing 2.5% CitraFiber™ .

The spread ratio (dough width/height) decreased with time, indicating that the doughs became more elastic. There was not a significant difference in spread ratio between the two treatments on any of the testing days. This indicates that the CitraFiber™ did not alter the visco-elastic properties of the dough.

Table 4. Effect of CitraFiber™ on dough spread ratio^a

Treatment	Spread Ratio		
	0 min	45 min	90 min
control	2.34 a	1.61	1.45 a
2.5% CitraFiber™	2.28 a	1.53 a	1.41 a

^a values in a column followed by different letters are significantly different (p = 0.05)

Hamburger Buns

Hamburger buns containing 0 and 2.5% dry CitraFiber™ were prepared as described above. Water absorption and mix time were 67% and 2.0 minutes for control doughs and 78% and 2.5 min for doughs containing 2.5% CitraFiber™ . The same percentage increase in water absorption (11%) observed in white pan bread was also observed in hamburger buns. The increase in mix time was also observed; however mix time remained normal and reasonable. No differences in dough handling properties were observed.

Buns containing 2.5% CitraFiber™ flowed properly to fill the hamburger bun pan. The buns were similar in appearance, height and crumb grain to hamburger buns made without added CitraFiber™ .

Pizza Crust

Pizza crusts containing 0 and 2.5% dry CitraFiber™ were prepared as described above. Water absorption and mix time were 66% and 3.0 minutes for control doughs and 78% and 3.5 min for doughs containing 2.5% CitraFiber™. The same percentage increase in water absorption observed in white pan bread was also observed in pizza crusts. The increase in mix time was also observed; however mix time remained normal and reasonable. No differences in dough characteristics were observed. No difference in diameter, thickness or crumb grain was observed between crusts made with and without added CitraFiber™.

CONCLUSION

The optimum level of CitraFiber™ for pup loaf white pan bread was 2.5% added as a dry powder. At that level, CitraFiber™ significantly increased dough absorption 11% with only a minimal increase of 15 sec in mixing time and no noticeable effect on dough-handling characteristics. The CitraFiber™ increased bread volume with no change in appearance or gumminess of the crumb. Generally bread with higher moisture content is less firm. Surprisingly, CitraFiber™ did not improve the shelf life of the bread even though it had significantly higher water content than the control bread after baking.

The same increase in absorption with only a slight increase in mix time and no noticeable effect on dough-handling characteristics or final product quality was observed in hamburger buns and pizza crusts.

This is a major finding. CitraFiber™ significantly increased dough absorption but did not affect water loss during baking. This significantly higher water absorption leads to heavier dough weights and, more importantly, increased bread weights (~ 11%). The increased

dough and bread weight indicate increased bread yield and therefore increase profit for the baker.

Evaluation of Alarma CitruSmart in Gluten Free Pan Bread

October 2008

*Testing conducted by the KSU Wheat Quality Lab
Dr. Rebecca Miller, Director*

Testing Procedure:

Alarma CitruSmart was added to a gluten-free pan bread formula. The formula consisted of sorghum flour (70%), potato starch (30%), non fat dry milk (1%), salt (1.75%), sugar (1%), hydroxypropyl methyl cellulose (2%), instant dry yeast (2%) and water (100%). Ingredient proportions are on a flour weight basis (fwb) where the blend of sorghum flour plus potato starch is taken as the “flour” component. Alarma CitruSmart was added at 2.5% fwb. The CitruSmart was added either as-is with the dry ingredients or it was mixed with the water. Control loaves did not contain CitruSmart.

The dry ingredients were mixed 1 min in a pin mixer. The water was added and the batter was mixed for 1 min. Batter (250g) was poured into small loaf pans, proofed at 86°F (95% rh) for 30 min, then baked at 400°F for 30 min. After cooling, the loaves were cut open and the crumb grain was scored.

Findings:

Dry vs Hydrated CitruSmart

The method of CitruSmart addition did not affect the bread. The outer appearance and crumb grain characteristics of loaves made with dry and hydrated CitruSmart were similar.

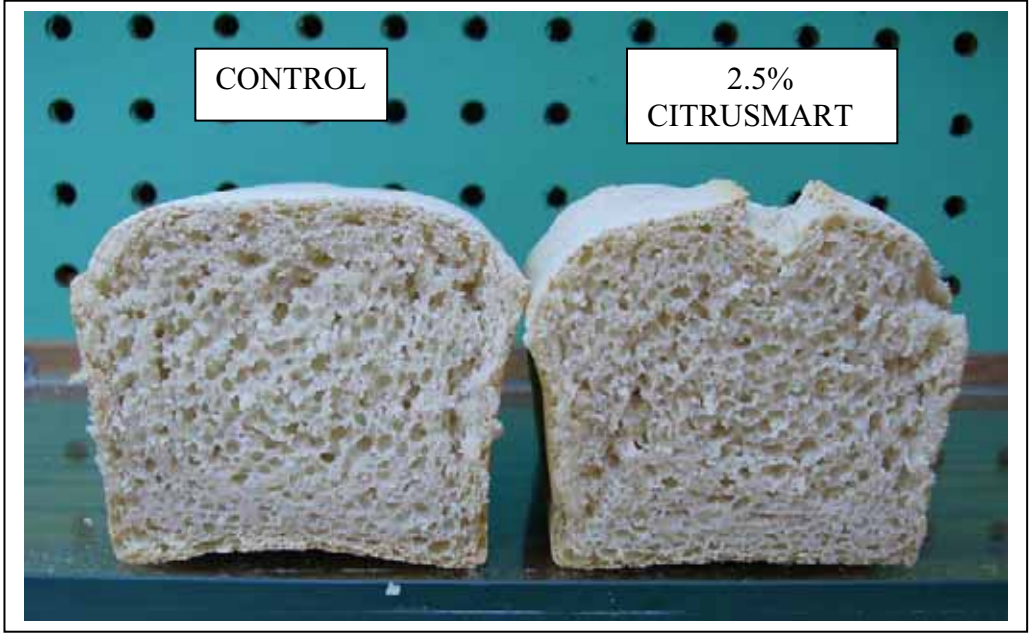
Effect of CitruSmart

Loaves containing CitruSmart were similar in size to the control loaves. However, the shape of the loaves differed. Loaves containing CitruSmart had a desirable round top crust vs an undesirable flat crust for the control bread. The crumb grain of loaves with and without CitruSmart was very similar.

The addition of CitruSmart to the formula increased the viscosity (thickness) of the batter. The water level of loaves containing 2.5% CitruSmart was increased by 10% (to 110% fwb) to produce a batter with similar viscosity (as determined by visual appearance) to the control loaves.

Summary

The addition of 2.5% CitruSmart to the bread formula did not affect the volume (size) or crumb grain of the bread; however, it did improve the shape of the loaves. The addition of CitruSmart increased the water absorption. This may result in increased bread yield. Water is an inexpensive ingredient. Adding more water into the dough formula is an effective method of increasing bread yield with essentially no increase in processing costs. Thus increased dough absorption is important from an economic point of view.





EFFECT OF CITRAFIBER™ AND ACTIVATED CITRUS PECTIN ON WHITE PAN BREAD MADE BY A SPONGE AND DOUGH PROCESS

Report

To

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by

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September 4, 2010

METHODS

Materials

Commercial bread flour (King Arthur Flour, Norwich, VT) was supplied by Natural Citrus Products. It was a malted flour (290 sec falling number) containing 12.6% moisture and 12.9% protein. CitraFiber and Activated Citrus Pectin (ACP) were provided by Natural Citrus Products.

Sponge and Dough Bread Preparation

Bread was prepared using AACC Method 10-11.01 sponge-dough baking method modified for pup loaves. The sponge formula consisted of bread flour (60g, 14% mb), water (40 g), instant active dry yeast (0.8 g) and yeast food (0.5 g). The sponge was mixed for 1 min in a pin mixer then rested for 4 hrs in a fermentation cabinet set at 86°F with 95% RH. Dough was prepared by mixing the sponge with flour (40 g, 14% mb), sugar (6 g), shortening (3 g), salt (1.5 g) and water (variable). Water level was optimized for each treatment. Treatments included 1.5 g CitraFiber, 2.5 g CitraFiber, 3.5 g CitraFiber and 3 g Activated Citrus Pectin (ACP). A control containing no additives was also baked. CitraFiber and ACP were added at the dough stage. Mixed doughs were placed in bowls in a fermentation cabinet set at 86°F with 95% RH for 30 min. Doughs were then mechanically punched and moulded into cylinders which were placed in greased baking pans. The loaves were proofed in the fermentation cabinet for 60 min then baked in a reel oven set at 425°F for 22 min. Dough properties and crumb grain were evaluated subjectively. Loaf volume was measured by rapeseed displacement. All treatments were baked at least in triplicate.

RESULTS AND DISCUSSION

The addition of CitraFiber™ into the bread formula significantly increased water absorption (Table 1). Water level increased by 8%, 11% and 18% for addition levels of 1.5%, 2.5% and 3.5% CitraFiber™ respectively. Mixing time also increased significantly as CitraFiber™ level increased. The addition of 1.5% and 2.5% CitraFiber™ increased mixing time by 1 min which is still in the target range for white pan bread dough. However, the addition of 3.5% CitraFiber™ increased mixing time excessively to 6.0 min. All levels of CitraFiber™ did not have an effect on dough handling properties. All doughs were strong out of the mixer and exhibited good viscoelastic properties at make-up.

All levels of CitraFiber™ significantly increased loaf volume over the control. There was not a significant difference in volume between the different levels of CitraFiber™. The crumb grain of loaves containing 1.5% and 2.5% CitraFiber™ was similar to that of the control loaves. Loaves containing 3.5% CitraFiber™ were poorer than the control. These loaves also had a slight grey crumb color and strong bitter aftertaste. No aftertaste was observed in loaves containing 1.5% and only a very slight aftertaste was observed at the 2.5% level. The formula used is very basic so it is possible that the aftertaste may not be noticeable in a richer formula.

The Activated Citrus Pectin (ACP) is a wet paste. The water content of the product was unknown. The level of water added to the doughs prepared with ACP was the same as the control doughs. However, the actual water level is higher due to the water in the product. The addition of ACP significantly increased mixing time (Table 1) but did not affect dough handling versus the control loaves. The addition of ACP significantly increased loaf volume to the same level as the CitraFiber™. However, the crumb grain was poorer than the control loaves. No aftertaste was observed in the bread containing ACP.

Table 1. Effect of CitraFiber™ and Activated Citrus Pectin on dough and bread

CitraFiber™ Level (% fwb)	Water (% fwb)	Mix Time (min)	Volume^a (cc)
control	73	3.5	911 ± 16
1.5% CitraFiber™	81	4.5	1005 ± 14
2.5% CitraFiber™	84	4.5	1017 ± 20
3.5% CitraFiber™	91	6.0	1010 ± 0
3% Activated Citrus Pectin	73	5.5	1000 ± 21

^a average ± standard deviation