Monocaprin and Tricaprin in Breadmaking[1]

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ABSTRACT

The use of monocaprin and tricaprin as substitutes for shortening in breadmaking appears to be a way to produce a low-calorie bread. However, breadmaking tests have shown that tricaprin, and particularly monocaprin, interfere with dough formation and inhibit yeast fermentation. Thus, neither of the compounds will be useful for the production of low-calorie bread.

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A triglyceride containing C-10 fatty acids, tricaprin, is found in milkfat, palm kernel oil, and coconut oil. Tricaprin is one of the medium-chain (containing fatty acids of 8 to 12 carbons) triglycerides (MCT). When consumed, the MCT are not adsorbed by the lymphatic system as are other fats but instead are transported directly to the liver (Bach and Babayan 1982). Thus, tricaprin is metabolized more like carbohydrates than like fats. Ranhotra et al (1994) reported that tricaprin gave an average energy value of 6.9 cal/g compared to 9.0 for conventional fats. Other studies report that tricaprin is incorporated less effectively into body fat than are longer chain fats (Lavau and Hashim 1978, Geliebter et al 1983).

Tricaprin, usually in mixtures with tricaprylin, is used in foods as a solvent for colors and flavors, as an antistick or release agent for bakery products and candies, and as a dried yeast coating. The MCT also are used as energy sources for individuals with disorders of fat assimilation. Ranhotra et al (1994) suggested that replacing shortening with MCT may be useful for the production of reduced-calorie bakery products. The objective of this study was to examine the effect of tricaprin and monocaprin on bread quality.

MATERIALS AND METHODS

Materials

Two commercial bread flours with protein contents of 10.9 and 11.3%, moisture contents of 13.56 and 13.47%, and ash contents of 0.45% were used for baking bread. A monoglyceride with a fatty acid of 10 carbons (monocaprin, C10MG), a triglyceride (tricaprin, C10TG) also with C-10 fatty acids, and a triglyceride with C-18 saturated fatty acids (C18MG) were donated by Grünau of Illertissen, Germany. Wheat gluten was obtained from Midwest Grain Products, Atchison, KS.

Methods

Hydration of the monoglyceride. The C10MG, a solid at room temperature, was hydrated by combining 2 g with 20 ml of water at room temperature. Small particles of C10MG were produced by scraping the C10MG sample with a metal spatula. The desired amount of monoglyceride was weighed, added to the water, and heated in a 75°C water bath for 10 min. The sample was swirled by hand frequently during heating. After removal from the bath, the frequent swirling continued during cooling to room temperature.

Breadmaking. The straight-dough bake test procedure, AACC method 10-10B (AACC 1983), was followed to produce bread. Doughs were mixed to optimum (minimum mobility) in a National Special 100-g pin mixer (TMCO-National Mfg. Co., Lincoln, NE). The dough was fermented in a proof cabinet (TMCO-National Mfg. Co., Lincoln, NE) at 30°C and 90–95% rh for 90 min. During the fermentation, the dough was sheeted at a gap of 3/16 in. after 52 and 75 min. At the end of the fermentation (90 min), the dough was sheeted at a gap of 5/16 in. and molded in a drum molder (Thomson Co., Beltsville, NJ). The dough piece was panned (dimensions = top, 77 × 142 mm; bottom, 62 × 126 mm; depth, 57 mm) and proofed at 30°C and 90–95% rh for 33 min. The proofed dough was baked in a 12-1 pound electric reel oven (TMCO-National Mfg. Co., Lincoln, NE) at 218°C for 24 min. Immediately on removal from the oven, the loaf was weighed, and the volume was determined by rapeseed displacement.

Yeast gas production. The effect of C10MG on yeast activity was examined with a gasograph (D & S Instrument Ltd., Pullman, WA). Flour (10 g, 14% mb) was placed in the gasograph sample jar and combined with certain concentrations of C10MG (0.5, 1.3, and 2.0% flour weight basis [fwb]) and 0.076 g of instant active dry yeast. The control contained only flour. Water (15 ml) was added to the dry ingredients. The system was stirred with a glass rod and stoppered. The sample was placed in a water bath preheated to 30°C. After 2 min, the channel tube was connected to the stopper orifice. Gas production was monitored continuously on a strip chart recorder during fermentation (4 hr).

Soluble nitrogen. Distilled water (100 ml) was added to 20 g of wheat flour and 0.4 g of C10MG in a 250-ml plastic bottle. The capped bottle was shaken vigorously by hand 50 times, an additional 100 ml of distilled water was added, and the bottle was shaken 10 times. The capped bottle was placed on a wrist-action shaker (Burrell Corp., Pittsburgh, PA) for 1 hr. The resultant mixture was centrifuged for 15 min at 1,000 × *g*. The supernatant was filtered through glass wool with suction. Two replicates were prepared, and 50 ml of the filtrate from each was analyzed for nitrogen by Kjeldahl.

Statistics. Data were evaluated using the Statistical Analysis System (SAS Institute, Cary NC).

RESULTS AND DISCUSSION

Monocaprin

The C10MG (2%, fwb) was preblended with flour in a Stein mill and mixed with the other bread ingredients. The dough did not readily form a cohesive mass (Table I). Increasing the mixing time from 4 min, the mixing time of the control dough, to 6 min did not help form a cohesive dough. Hydrating the C10MG before it was added to the flour did not help dough formation (Table I). Mixing flour with shavings of the C10MG formed a dough, but the mix time was increased from 4.0 to 5.5 min. The dough was sticky. Further, the dough did not expand during fermenta-

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TABLE I
Loaf Volume of Bread Made with Monocaprin and Tricaprin[a]

Treatment	Loaf Volume, cm^3
Bake 1[b]	
Control (shortening, 3%, unblended)	960a
No shortening	683b
C10MG, 2%, blended	. . .[c]
C10TG, 2%, blended	653b
Bake 2[b]	
Control (shortening, 3%)	918a
No shortening	700b
C10MG, as is, 2%	. . .[c]
C10MG, hydrated, 2%	. . .[c]
C10TG, as is, 2%	625c
C18TG, as is, 2%	915a

[a] Values followed by the same letter were not statistically different at the 5% level.
[b] Bake 1 and bake 2 were on different days and with different flours. C10MG = monoglyceride with a fatty acid of 10 carbons (monocaprin); C10TG = triglyceride with C-10 fatty acids (tricaprin). C18TG = triglyceride with C-18 fatty acids.
[c] This treatment did not form a dough when mixed for 6 min; mixing time for the other treatments was 4 min.

TABLE II
Effect of C10MG on Gas Production of Yeast[a]

Treatment[b]	Gas Production, GU[c]
Control[d]	49.6a
0.5% C10MG	32.3b
1.3% C10MG	12.5c
2.0% C10MG	9.0c

[a] Values followed by the same letter were not statistically different at the 5% level.
[b] C10MG = monoglyceride with a fatty acid of 10 carbons (monocaprin).
[c] Gasograph units are arbitrary units for the instrument.
[d] The control treatment contained flour, water, and yeast.

tion, and, thus, was not baked into a loaf of bread. The fact that dough did not expand may suggest that yeast activity was inhibited.

When the C10MG was added at 1.3%, a more normal dough was produced. After 4.5 min of mixing, the dough sheeted well and was relatively dry, slightly tough, and not sticky. However, no expansion of the dough occurred during fermentation, suggesting that the C10MG was inhibiting yeast activity.

A dough with good viscoelastic properties was obtained when 0.5% C10MG was added to the bread formula. Again, the dough felt dry and slightly tough. The dough expanded during fermentation but much less than the control dough.

Doughs produced with the C10MG had a distinct odor that become more noticeable during fermentation. The odor was reminiscent of aged cheese. The aged cheese odor may have resulted from the presence of traces of C-10 free fatty acids.

Gasograph tests confirmed that C10MG inhibited gas production of flour-yeast slurries (Table II). Thus, the C10MG negatively affected both dough-forming properties and gas production. The effect of C10MG on flour protein solubility also was determined. However, 2% C10MG did not significantly change the soluble protein of wheat flour (0.33 g of soluble nitrogen per 20 g of flour without C10MG and 0.34 g of soluble nitrogen per 20 g flour with C18MG).

Tricaprin

The C10TG was much less damaging to bread dough than was the C10MG. When blended with flour in a Stein Mill, 2% C10TG produced bread with loaf volume equal to the no shortening control (Table I). Thus, the C10TG gave no shortening response, i.e., it did not increase the loaf volume similar to shortening. Replacing 3% shortening in the bread formula with 2% (fwb) C18TG produced a loaf volume much larger than that produced by 2% C10TG and essentially equal to the shortening. When C10TG was added with no blending, the loaf volume was significantly smaller than the loaf volume of the no shortening control. High levels of MCTs were not used because of their detrimental effects.

CONCLUSIONS

Addition of C10MG adversely affected the formation of a viscoelastic dough. This was not caused by a change in gluten protein solubility. The C10MG inhibited gas production. Acceptable bread could not be produced when C10MG was present. C10TG was not as detrimental as was C10MG in breadmaking. However, the C10TG did not replace the function of shortening in the formula and, if added without preblending, gave significantly smaller loaf volume than did the no shortening control. Thus, neither C10MG or C10TG will be useful for the production of low-calorie bread.

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