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# Effect of Hand and Machine Rounding on Steamed Bread Quality

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## Introduction

Steamed bread is one of the major flour products consumed in the Asian-Pacific region. The texture and exterior shape varies from region to region. Most northern-style steamed breads are round in shape, with dense crumb and firm texture. Both processing and flour quality can significantly affect steamed bread quality. To objectively evaluate the suitability of a flour for steamed bread application, it is important that reproducible methods for making the steamed bread are used and the effects of processing are minimized. In our laboratory, we have found that water absorption, mixing time, and rounding are major factors which significantly affect end product quality. In this study, doughs prepared from different mixing times and water absorption levels were rounded by hand or machine, and the resulting steamed breads evaluated for exterior appearance, crumb structure, and eating quality.

## Materials and Methods

### FLOUR

Canada Western Red Winter (CWRW) wheats (c.v. AC Readymade, CDC Kestral, and CDC Clair) were milled separately using a Bühler test mill, and 70% extraction flours were obtained by combining selected mill streams. A composite flour was prepared by blending the three flours in equal proportions. The protein and ash contents (14% m.b.) were 11.1% and 0.39%, respectively. The composite flour was also characterized by Farinograph (absorption 58.2%; development time 4.5 min; mixing tolerance index 35 BU; and stability 8 min).

### STEAMED BREAD MAKING PROCEDURE

Flour (600 g), water, and yeast solution (3 g active dry yeast dissolved in 100 g of water at 40°C) were mixed in the GRL-1000 mixer for 30 sec at 45 rpm, then the dough was developed at 105 rpm for the time required. After 15 min of resting, the dough was sheeted by passing 20 times through a 5.5 mm gapped sheeter. The dough sheet was subsequently rolled into a cylinder. Four dough pieces (150 g each) were sampled, and then rounded either by hand or by machine (Brabender Extensograph dough homogenizer). The dough balls were placed in a covered steamer tray, proofed for 50 min (32°C, 85% RH), and steamed for 25 min in a commercial aluminum steamer.

### STEAMED BREAD EVALUATION

Steamed breads were allowed to cool in the covered tray for 30 min, and then weighed. Volumes were determined by rapeseed displacement. The width and height of each bread were measured at three different locations, and the average recorded. Breads used for sensory scoring were re-steamed for 10 min, and allowed to cool for 30 min before evaluating. Breads were scored by a trained sensory panel using the scoring system provided in Table 1.

Table 1. Sensory scoring system for northern-style steamed bread

Quality parameter	Score	Criterion
Exterior appearance	48	
Shape	(16)	very round and symmetrical shape
Smoothness	(16)	very smooth skin, free of wrinkles, dimples, blisters, and gelatinized spots
Skin color	(16)	very bright white
Crumb structure	20	very uniform and fine crumb
Crumb texture	32	
Firmness	(8)	high force required to deform and break crumb
Springiness	(8)	high recovery after compression with molar teeth
Stickiness	(8)	very low degree of stickiness to the teeth during biting
Chewiness	(8)	highly elastic and firm texture which requires a great deal of chewing before it can be swallowed
Total Score	100	

## EXPERIMENTAL DESIGN

Preliminary tests were conducted to determine the optimum water absorption and mixing time for steamed bread processing. Two series of experiments were then designed. The first series examined the effect of mixing time and rounding method on steamed bread quality at the optimum water absorption. The second series examined the effect of water absorption and rounding method at the optimum mixing time. Four levels of mixing time were used (-2, 0, +2, and +4 min of the optimum mixing time). Five water absorption levels were chosen at -5.0, -2.5, 0, +2.5, and +5.0% of the optimum level.

Figure 1A Effect of rounding and mixing time on steamed bread volume

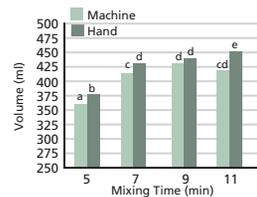


Table 2A. Effect of rounding and mixing time on steamed bread crumb structure\*

Mixing Time Min.	Crumb Structure	
	Machine	Hand
5.0	3.8 <sup>a</sup>	5.0 <sup>a</sup>
7.0	5.0 <sup>a</sup>	12.5 <sup>b</sup>
9.0	3.8 <sup>a</sup>	13.8 <sup>b</sup>
11.0	4.4 <sup>a</sup>	11.9 <sup>b</sup>

\* fixed water absorption at 43.5%

Table 3A. Effect of rounding and mixing time on steamed bread ext. properties\*

Mixing Time Min.	Exterior Appearance	
	Machine	Hand
5.0	28.5 <sup>a</sup>	30.0 <sup>ab</sup>
7.0	34.5 <sup>bc</sup>	36.5 <sup>c</sup>
9.0	34.0 <sup>bc</sup>	32.5 <sup>bc</sup>
11.0	36.0 <sup>c</sup>	36.5 <sup>c</sup>

\* fixed water absorption at 43.5%

Table 4A. Effect of rounding and mixing time on steamed bread textural properties\*

Mixing Time Min.	Crumb Texture	
	Machine	Hand
5.0	18.5 <sup>a</sup>	18.8 <sup>a</sup>
7.0	20.8 <sup>a</sup>	25.0 <sup>b</sup>
9.0	27.3 <sup>bc</sup>	28.0 <sup>cd</sup>
11.0	24.3 <sup>b</sup>	27.3 <sup>bc</sup>

\* fixed water absorption at 43.5%

Figure 1B Effect of rounding and water absorption on steamed bread volume

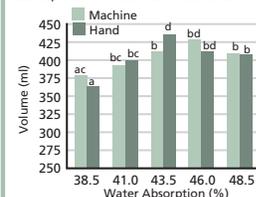


Table 2B. Effect of rounding and water absorption on steamed bread crumb structure\*

Water Absorption (%)	Crumb Structure	
	Machine	Hand
38.5	2.5 <sup>a</sup>	10.0 <sup>d</sup>
41.0	9.4 <sup>a</sup>	12.5 <sup>c</sup>
43.5	5.0 <sup>bc</sup>	12.5 <sup>c</sup>
46.0	3.9 <sup>c</sup>	15.0 <sup>c</sup>
48.5	2.5 <sup>a</sup>	8.8 <sup>d</sup>

\* fixed mixing time at 7 min.

Table 3B. Effect of rounding and water absorption on steamed bread exterior properties\*

Water Absorption (%)	Exterior Appearance	
	Machine	Hand
38.5	22.0 <sup>a</sup>	34.0 <sup>c</sup>
41.0	27.0 <sup>ab</sup>	40.0 <sup>c</sup>
43.5	34.5 <sup>b</sup>	36.5 <sup>c</sup>
46.0	33.5 <sup>bc</sup>	38.5 <sup>c</sup>
48.5	26.0 <sup>a</sup>	33.0 <sup>c</sup>

\* fixed mixing time at 7 min.

Table 4B. Effect of rounding and water absorption on steamed bread textural properties\*

Water Absorption (%)	Crumb Texture	
	Machine	Hand
38.5	26.8 <sup>a</sup>	25.3 <sup>a</sup>
41.0	25.5 <sup>a</sup>	26.0 <sup>a</sup>
43.5	20.8 <sup>a</sup>	25.0 <sup>a</sup>
46.0	25.0 <sup>a</sup>	25.8 <sup>a</sup>
48.5	21.3 <sup>a</sup>	24.0 <sup>a</sup>

\* fixed mixing time at 7 min.

## Results and Discussion

### PRELIMINARY EXPERIMENTS

The results of the preliminary experiments indicated that both water absorption and mixing time had very strong effects on overall steamed bread quality. In the preliminary trial, these two variables for the composite flour were optimized based on dough handling properties and final product quality. The optimum levels were 43.5% for water absorption, and 7.0 min for mixing time.

### EFFECT OF ROUNDING ON STEAMED BREAD VOLUME

All hand rounded steamed breads had greater volume than the corresponding machine rounded breads under the various levels of mixing time at fixed optimum water absorption level (Fig. 1A). The volume of steamed bread rounded by both methods increased significantly with increasing mixing time with the exception of the one mixed for 11 min and rounded by machine. The effect of rounding showed no general trend on steamed bread volume with varying water absorption levels at the fixed optimum mixing time (Fig. 1B). Steamed bread volume increased with increasing water absorption until it reached an optimum level (43.5%) at which point the volume began to decrease.

### EFFECT OF ROUNDING ON STEAMED BREAD CRUMB STRUCTURE

The steamed bread rounded by hand had significantly higher crumb scores than the corresponding machine rounded breads under all processing conditions (Tables 2A and 2B). The crumb quality of machine rounded bread usually had one or more dense and hard zones, showed less uniform gas cells, and more air holes than those of bread rounded by hand (Fig. 2). In terms of processing, high water absorption (48.5%) and short mixing time (5 min) rendered the final product with a poor crumb structure (Table 2).

### EFFECT OF ROUNDING ON STEAMED BREAD EXTERIOR PROPERTIES

There was no significant impact of rounding method on the exterior properties of steamed bread processed at the optimum water absorption level (Table 3A). Low mixing time significantly influenced exterior bread properties. The effect of rounding method was significant, however, on the exterior properties of breads processed under higher or lower water absorption levels than optimum (Table 3B). Also, the effect of water absorption on the exterior quality was much greater for the machine rounded breads than for the hand rounded breads. The breads rounded by machine appeared to be less symmetrical in shape and less smooth on the surface when they were produced at lower water absorptions (Fig. 3).

### EFFECT OF ROUNDING ON STEAMED BREAD TEXTURAL PROPERTIES

The effect of rounding method on bread sensory textural properties was minimal with the exception of the bread produced at optimum water absorption level and mixing time (Tables 4A and 4B). The water absorption levels also did not show significant effects on bread textural properties for the hand rounded breads. The steamed bread made from undermixed dough (5 min) had low springiness and a sticky texture.

## Conclusions

Laboratory processing procedures and quality evaluation protocols for northern-style steamed bread have been established in our laboratory. Water absorption level and mixing time can significantly affect steamed bread quality. The determination of their optimum values is important for flour quality evaluation. Rounding has been identified as a crucial processing factor in the overall quality characteristics of steamed bread. The hand rounding method is operator dependent, and reproducible results can only be achieved with experience. A proper rounding device for stiff dough needs to be developed to achieve desirable rounding results.

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