Journal of Food Technology 8 (3): 95-98, 2010
ISSN: 1684-8462
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Evaluation of the New Fusant Improving Bread Textural Characteristics

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Abstract: The new fusant was constructed from protoplasts fusion *Schizosaccharomyces pombe* and *Aspergillus niger*. The new fusant and mixed fusant with commercial yeast were compared with the commercial yeast for improving bread textural without increase the produce cost. Farinograph analysis of dough making from the new fusant and the mixed fusant with commercial yeast performed better water absorption, longer dough development, higher stability and MTI but reduce elasticity. The extensograph parameters for dough resistance to constant deformation after 50 mm stretching (R 50) and extensibility showed the new fusant and the mixed commercial yeast better than the commercial yeast. Both good resistance and extensibility are desirable for good dough properties. Overall, the new yeast and mixed yeast performed better dough properties. The energy or work input (A) necessary for the deformation was reduced by the new fusant. The new fusant can improve crumb firmness and bread staling during bread staling at 4°C. Although the new fusant on the specific volume of fresh bread was lower than commercial yeast, the mixed commercial and fusant improved the quality of volume. In other test, bread moisture and the width/height ratio of bread making from the mixed yeast and the new fusant performed improving the bread quality. Overall, sensory evaluation the bread of visual appearance, flavor, aroma and crunchiness with adding the new fusant is able to improve the bread consumer acceptability.

Key words: Bread texture, farinograph, extensograph, sensory evaluation, fusant, yeast, commercial yeast, Taiwan

INTRODUCTION

Bread is consumed worldwide with variety types, flavors and characteristics and plays an important food. Several methods were used to improve bread properties such as adding vital gluten, emulsifier, oxidant, reductant, hydrocolloid and enzyme for the purpose of improving bread quality and extending the shelf-life of stored bread which is getting important for the bread industry (Azizia *et al*., 2003; Selinheimo *et al*., 2006; Wang *et al*., 2004; Mondal and Datta, 2008).

Enzyme was reported to use in baking to optimize baking properties and improve the quality of baked products. Optimal levels of fungal amylase was found the ability to increase the bread volume and reduce the staling rate of the crumb to prolongs the period of dough expansion in the oven to increase the maximum dough piece height and loaf volume (Cauvain and Chamberlain, 1988) to improve the crumb grain and to make the starch granule surface porous thus amylose may leach out of the granules. Hemicellulases were used in baking because of their ability to decrease water absorption by the dough and hydrolyzing the pentosan which reported to soften dough to crease loaf volume, to improve crumb structure and to decrease the number of insoluble cell-wall fragments (Autio *et al*., 1996; Wang *et al*., 2004; Mondal and Datta, 2008). Xylanase used to increase on bread volume is due to the redistribution of water from the pentosan phase to the gluten phase (Selinheimo *et al*., 2006). The increase in the volume of the gluten fraction increases its extensibility which will result in better ovenspring. The results of baking were better when α-amylase was used together with xylanase than when either of the enzymes was used separately. Laccase on bread have been extensively studied (Caballero *et al*., 2007; Selinheimo *et al*., 2006) and shown an effective improver in the conventional bread making process (Dobraszczyk and Morgenstern, 2003). Baking technology has researched the relation of bread texture and bread staling with baking ingredients, thermo physical

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properties, moisture content, baking time, profiling of temperature, moisture, pore volume, expansion ratio during making bread. Overall, enzyme plays important actor to improve bread texture but the cost is very high. In this research is to find a potential way for baking industry is to improve of product quality but do not increase the cost at the same time. Except of adding additives, a new developed fusant of yeast which was constructed by protoplasts fusion *Schizosaccharomyces pombe* and *Aspergillus niger* with a ability to release α-amylase activity 12.58 μ mL^{-1} to substitute the current commercial yeast is a potential way to reach at high quality and low cost.

MATERIALS AND METHODS

Quality characteristics of wheat flour moisture 13.4%, protein 12.8% and ash 0.55% (Table 1) was used in this study. The new fusant with protoplasts fusion *Schizosaccharomyces pombe* and *Aspergillus niger* was stored at -20°C for 4 months still keeping stable cell. Commercial yeast was used as control to compare with the new fusant and mixed commercial yeast (C + F) with the new fusant to evaluate the new fusant for improving bread textural characteristics.

Preparation of the fusant: The fusant was initially inoculated into a 5 mL minimum essential broth with potato starch as the sole carbon source incubated at 30°C overnight with shaking at 150 rpm. Thereafter, the culture was scaled up to 1000 mL at the rate 5% of this overnight broth and centrifuged at 2000×g for 20 min to harvest the new fusant cell and washed with distilled water and centrifuged again. The fusant cell was stored at -0°C to prepare to use.

Characteristic of bread texture: Moisture, ash and proteins were determined following standard (AACC, 1983). The parameters determined were: water absorption, Dough Development Time (DDT) and stability. The viscoelastic behavior of dough was determined by the alveograph test following the standard method (AACC, 1995).

Table 1: Farinograph analysis of dough of the new fusant

Treatments	Water absorption (%)	DDT (min)	Stability (min)	MTI (BU)	Elasticity (BU)
Control	54.6	2.6	10.6	32	93
Fusant	57.9	3.6	15.4	35	85
C + F	55.8	3.3	16.1	42	78

Values are the average of duplicates. DDT, time to reach maximum consistency stability, time during dough consistency is at 500 BU MTI, consistency difference between height at peak and to that 5 min later; elasticity, band width of the curve at the maximum consistency

Bread making process: The baking formula (flour basis) was 100 g flour basis consisted of yeast 2%, salt 2% and the amount of water required to reach 500 Brabender Units (BU) of consistency. The ingredients were mixed and dough fermented at 30°C for 30 min in a fermentation cabinet. Then dough was divided in 120 g molded and proofed at 30°C for 45 min. Bread dough loaves were baked for 12 min at 200°C. Baked loaves were cooled down at room temperature for 60 min and kept unpacked at 25°C and 75-85% HR for 24 h. Four replicates from three different sets of three types of baking yeast were analyzed and averaged.

Evaluation of bread quality: Bread quality analysis was measured including weight, volume (rapeseed displacement), specific volume index (specific volume of the control was taken as 100 and the specific volume of the samples was referred to the control), width/height ratio of the central slice, moisture content (AACC, 1983) and crumb texture were assessed.

The Texture Profile Analysis (TPA) was performed by universal test machine 5564 Instron (Canton, Mass, USA). A 25 mm diameter plunger at a crosshead speed of 1 mm sec^{-1} compressed a 25 mm thick slice to a depth of 80%. The height of the first compression curve measured the resistance of the crumb to the penetrating plunger and represented the crumb hardness. The texture analysis of the bread slice was performed after cooling and at 24 h of storage at 25°C. Three replicates from three different sets of three types of baking yeast were analysed.

Consumer panel sensory evaluation: About 2 days old bread slices were served to semi-trained consumer panelists for sensory evaluation using the approved AACC Method 74-30. Panelists used a hedonic scale of 1 (lowest) to 5 (highest) to judge the following sensory attributes: visual appearance, aroma, flavour and crunchiness and overall acceptability.

For each one of attributes average of judges' response was calculated. Overall acceptability was calculated by weighted arithmetic mean, given the following weight to each attributes: visual appearance 35%, flavor 15%, aroma 15% and crunchiness 35%, according the influence of each attribute on acceptance of the product by consumers. Breads were considered acceptable if their mean value for overall acceptability were equal or above 3.

RESULTS AND DISCUSSION

Farinograph analysis of dough of the new fusant: Water absorption was 54.6% for control, 57.9% for the new fusant and 55.8% for the mixed yeast of commercial and the new fusant yeast (Table 1). Water absorption was increased by adding the new fusant was expected due to increase the function group of hydroxyl to allow more water interaction through hydrogen bonding.

The time required for the Dough Development (DDT) was affected by the presence of the new fusant. The stability value is present the flour strength. The higher values of stability suggest with stronger dough. Dough adding the new fusant are exhibited higher stability than the control. The strongest dough was obtained by adding the new fusant was also reflected in the high stability and MTI (consistency difference between height at peak and to that 5 min later). Elasticity of the dough reduce with adding the new fusant which suggest due to elasticity incorporated with the dough stability structure.

Effect of the new fusant on the extensograph parameters at dough resting time: Dough extensibility and the deformation energy are an index of dough strength. Dough resting time at 45 min, resistance to constant deformation after 50 mm stretching (R 50) are 255 BU for control, 269 BU for the new fusant and 288 BU for the mixed yeast (Table 2). Dough extensibility (E) is 189 mm for control, 191 mm for the new fusant and 203 mm for the mixed yeast. R 50 E^{-1} is 1.42 for C + F and 1.41 for the fusant showing higher than the commercial yeast. Dough extensibility and resistance to extension give information for the viscoelastic behavior of dough (Caballero *et al.*, 2007). Both good resistance and extensibility are desirable for good dough properties. Overall, the new yeast and mixed yeast performed better dough properties. The energy or work input (A) necessary for the deformation was reduced by the new fusant.

Crumb firmness of samples during bread staling at 4°C: During the storage time day 1-5, the bread firmness was increased from 12.6-22.5 by the new fusant, from 8.1-19.8 by the mixed yeast and from 7.9-35.6 by the commercial yeast (Table 3). Crumb firmness can be related with starch retrogradation and bread staling. The moisture decreases to favor the formation of hydrogen bonds among starch polymers or between starch and proteins yielding to a greater hardness. Retrogradation phenomena could be connected to bread moisture content and water redistribution among the bread constituents (Ottenhof and Farhat, 2004). Bread staling was connected with moisture content of the bread and firmness. From the point, the new fusant can improve crumb firmness and bread staling.

Effect of the new fusant on some parameters describing fresh bread quality: Effect of the new fusant on the specific volume of fresh bread was 92.5 which were lower than commercial yeast 100 (Table 4). But the mixed yeast performed 107.8 better than the commercial yeast. The fusant with the ability of α-amylase which directly ferment starch to produce alcohol and CO_2 contribute the dough development and gas retention. The fusant need take time to produce enough of these enzymes to break down significant quantities of starch in the bread. This may interasted for long fermented doughs such as sour dough and as same as caused bread flavor. With mixed yeast of commercial and fusant yeast was found inceasing the specific volume which suggests contribution from cooperation of two yeast. The bread moisture was found in the order of the fusant, the mixed yeast and commercial yeast (37.81, 36.33 and 35.79). The reason was caused by the the new fusant abbility of fermenting starch to increase water holding capacity. In another test, the width/height ratio of bread showed the mixed yeast has the highest ratio 1.49. Further to compare width/height ratio with specific volume index showed with a positive correlation. The mixed yeast of commercial with the new fusant performs improving the bread quality.

Table 2: Effect of the new fusant on the extensograph parameters at dough resting time 45 min

Treatments	R50 (BU)	E (mm)	R 50 E^{-1} (BU mm^{-1})	A (cm^2)
Control	255	189	1.35	113
Fusant	269	191	1.41	88
C + F	288	203	1.42	98

Values are the average of duplicates. R50: resistance to constant deformation after 50 mm stretching, E: dough extensibility, A: work input necessary to promote the deformation

Table 3: Crumb firmness of samples during bread staling at 4°C

	Storage time (days)				
Treatments	1	2	3	4	5
Control	7.9	16.3	27.8	32.1	35.6
Fusant	12.6	15.6	18.4	21.1	22.5
C + F	8.1	9.3	16.1	18.2	19.8

Table 4: Effect of the new fusant on some parameters describing fresh bread quality

Treatments	Specific volume index	Moisture (%)	Width/height
Control	100.0	35.79	1.44
Fusant	92.5	37.81	1.41
C + F	107.8	36.33	1.49

Values are the average of three replicates from two different, C+F: mixed control and fusant 1:1 (w/w); Specific volume of the control was taken as 100 and the specific volume of the samples was referred to the control

Influence of the new fusant on the sensory wheat bread evaluation: The sensory evaluate wheat bread with hedonic scale of 1 (lowest) to 5 (highest) in visual appearance showed control with 3.78, the new fusant with 4.11 and the mixed yeast with 4.14 (Table 5). Performance of flavor and crunchiness for C+F with 4.0 and 3.67 was the best among the test except aroma performing which

Table 5: Influence of the new fusant on the sensory wheat bread evaluation

Treatments	Visual appearance	Flavour	Aroma	Crunchiness	Overall acceptability
Control	3.78	3.36	4.42	2.87	3.49
Fusant	4.11	3.74	4.76	3.13	3.81
C + F	4.14	4.00	4.59	3.67	4.02

the new fusant was the best. Overall acceptability C + F performed 4.02 and the new fusant 3.81 was better than commercial yeast. Breads were considered acceptable if their mean value for overall acceptability were equal or above 3. The higher value presents higher consumer acceptability. Flavor, aroma and crunchiness also showed adding the new fusant working to improve the bread consumer acceptability.

CONCLUSION

Farinograph analysis of dough making from the new fusant, the mixed fusant and commercial yeast showed better water absorption, long dough development, higher stability and MTI but reduce elasticity. The extensograph parameters for dough resistance to constant deformation after 50 mm stretching (R 50) and extensibility were showed the new fusant and the mixed commercial yeast better than the commercial yeast. Both good resistance and extensibility are desirable for good dough properties. Overall, the new yeast and mixed yeast performed better dough properties. The energy or work input (A) necessary for the deformation was reduced by the new fusant. The new fusant can improve crumb firmness and bread staling during bread staling at 4°C. Although, the new fusant on the specific volume of fresh bread was lower than commercial yeast, the mixed commercial and fusant improved the quality of volume. In other test, bread moisture and the width/height ratio of bread showed the mixed yeast and the new fusant performed improving the bread quality. Overall, sensory evaluation the bread of visual appearance, flavor, aroma and crunchiness showed adding the new fusant working to improve the bread consumer acceptability.

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