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Effects of green tea extract on large-deformation rheological properties of steamed bread dough and some quality attributes of steamed bread

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INTRODUCTION

Fortification of green tea extract (GTE) into bakery products can enhance the nutritional value of the products because it contains tea catechins that may provide health benefits such as anti-oxidative, anti-carcinogenic, anti-microbial, anti-viral and anti-inflammatory [1]. Previous researches have shown that GTE addition might affect baked bread and dough matrix [2]. The possible mechanisms behind included the interaction between tea catechin and gluten proteins during dough development, the inhibition of a-amylase activity by tea catechins, and the reduced yeast activity to produce adequate gas for leavening. This inhibition may decrease volume expansion during proofing, therefore contributing to smaller bread volume [2]. However, the effects of GTE on the processing and product characteristics of steamed bread have not been studied to date. This research aimed to investigate the effects of green tea extract on large-deformation rheological properties of soft dough through farinograph, and specific volume and textural properties of steamed bread.

MATERIALS & METHODS

Ingredients used in making steamed bread were low protein flour, yeast (1%), salt (1%) and sugar (1%). GTE was added to flour at levels of 0.25%, 0.50% and 0.75%. Large-deformation rheological properties of dough were determined using a Brabender Farinograph-E. Quality attributes of steamed bread were examined, including specific volume and texture attributes (Texture Profile Analysis). Specific volume was measured by a seed displacement method. The specific volume growth was modeled using the logistic model:

$$SV(t) = \frac{SVf}{1 + Ce^{-rt}} \quad with \quad C = \frac{SVf}{SVo} - 1$$

where *SV* is specific volume, *SVo* is initial specific volume and *SVf* is final specific volume, *r* is a constant and *t* is proofing/steaming time.

RESULTS & DISCUSSION

Water absorption (WA) and development time (DT) were not significantly affected by the addition of GTE. Increasing GTE concentration enhanced stability (ST) and reduced mixing tolerance index (MTI). Higher concentration of GTE resulted in higher ST. The formation of covalent bonding between thiols and tea catechins might have made the dough become more stable [3]. As shown in Table 1, increasing the GTE concentration up to 0.75% reduced the MTI. These results are contradictory to the previous study results showing reducing agents promoted thiol (SH)/disulphide bond (SS) interchange reactions and resulting in reduced mixing time and improved dough machinability [4]. Addition of GTE up to 0.75% increased

viscosity of the dough that might be affected by the formation of catechins-thiols covalent bonding. The dough with shorter time to break down (TTB) had lower dough extensibility. The shorter TTB indicated that the dough could be broken easily, therefore the dough was easily to be ruptured which led to the lowest specific volume of steamed bread containing 0.75% of GTE.

Table 1. Farinograph properties of steamed bread dough with GTE addition

	Control	GTE 0.25 %	GTE 0.50 %	GTE 0.75 %
WA (%)	53.93±0.23 a	53.77±0.21 a	53.67±0.12 a	53.77±0.06 a
DT (min)	1.13± 0.12 a	1.33±0.12 a	1.37±0.15 a	1.10± 0.17 a
ST (min)	1.00±0.10 a	3.27±0.42 b	5.23±0.38 c	1.19±0.17 d
MTI (FU)	83.00±8.19 a	62.00±4.36 b	44.33±2.31 c	41.33± 4.93 c
TTB (min)	1.60±0.00 a	2.50±0.44 b	2.10±0.26 b	1.67±0.25 a

All values are given as the mean of triplicate analysis ± standard deviation Different letters in the same row indicate significantly different values (P<0.05)

The specific volumes of dough during proofing among the control (i.e. GTE 0%) and those with the addition of various levels of GTE were not significantly different. This means that the addition ofGTE did not affect the yeast's activity of producing gas (i.e. CO_2) during the proofing. During steaming, the specific volumes of bread with GTE addition of 0%, 0.25% and 0.5% were statistically the same. At these three concentrations the dough could better attain the gas and produce a higher specific volume. Dough with GTE of 0.75% had the lowest specific volume because it had lower gas holding capacity. Logistic model developed for the growth of specific volume showed a good agreement with the experimental results in both proofing and steaming steps. The results had high R^2 values (above 0.96) and low root meat square error (RMSE) values, indicating that the developed models were valid. GTE affected the texture of steamed bread including firmness, cohesiveness and gumminess. The firmness and gumminess of steamed bread with addition of GTE at 0%, 025% and 0.50% were not significantly different. However, steamed bread with GTE of 0.75% had the highest firmness and gumminess and the lowest specific volume compared to those at the other three concentrations.

CONCLUSION

Large-deformation rheological properties can be used for determination of dough performance during mechanical handling and prediction of final product quality. GTE at the level of 0.5% of steamed bread flour can be applied to enhance the nutritional value of steamed bread without affecting the quality of the bread.

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