Evaluation of sugar reduction on bread textural and topographical characteristics

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1. INTRODUCTION

Sugar, as a part of bread formula especially in Asian countries, considerably impacts on the bread quality.

The presence of sugar in dough helps to increase yeast activity by rising the fermentation rate and gas production. Hence, water binding capacity and loaf volume will increase (Simonson *et al*, 2003). There is a delay in the gelatinisation process in the presence of sugar due to absorption of liquids which leads to tenderer crumb texture (Ghiasi & Hoseney, 1983). Sugar plays a significant role in the production of surface brown colour and improvement of moisture retention in Maillard reaction (Pareyt & Delcour, 2008).

Reformulation of bread with a focus on the reduction of sugar and retention of final product quality will improve health outcomes of bread consumers, however it can pose serious challenges for bakers as a result of changes in dough mixing properties and bread quality.

The main objective of this study: Evaluation of the reduced sugar content (25%, 50%, 75% reduction) effect on bread quality of Australian commercial flour, using the doughLAB.

2. METHODS AND MATERIALS

Dough and bread samples were prepared based on the commercial formulation (Table 1).

TABLE 1 Bread recipe for control

Ingredients	Percentage (%)
Flour	100
Salt	2
Sugar	5
Yeast	1.5
Fat (shortening)	4
Water	(water absorption of flour% – 4%) x flour weight (g)/100 = Added water (ml)

Dough preparation

DoughLAB (Perten Instruments, Sweden) was used for mixing purposes to determine dough mixing parameters such as development time, total energy required for mixing and stability based on standard AACCI Method 54–70.01 (High-Speed Mixing Rheology of Wheat Flour Using the doughLAB).

FIGURE 1 doughLAB

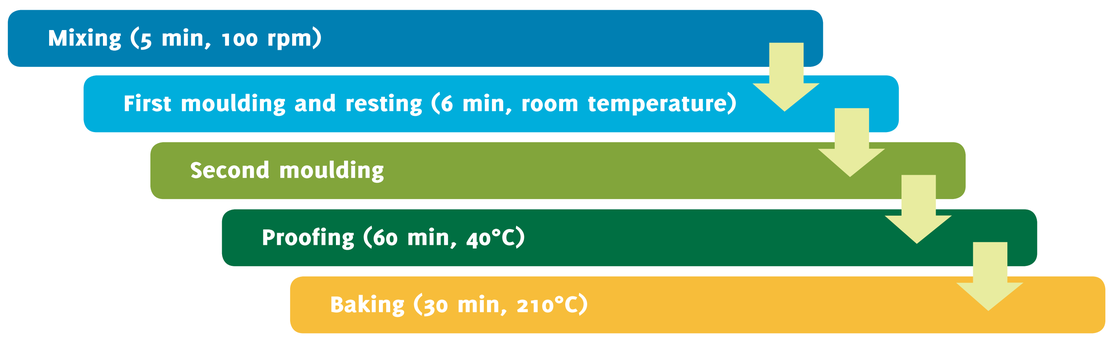

FIGURE 2 Baking method (No Time Dough)

Bread quality analysis

- **Bread Volume** by Bread volume analyser (BVM) based on standard AACCI Method 10–14.01
- **Crumb structure** by **texture analyser TA-XT2*iPlus*** (Stable Micro Systems, UK) based on standard AACCI. Method 74–09.01 to quantify multiple textural properties in one experiment.
- **Slice brightness** by **C-Cell** (Calibre Control International Ltd, UK).*

* Rest of parameters measured by C-Cell were discussed in another part of research.

FIGURE 3 Bread volume analyser

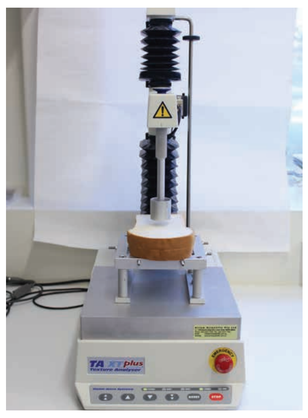

FIGURE 4 Texture analyser

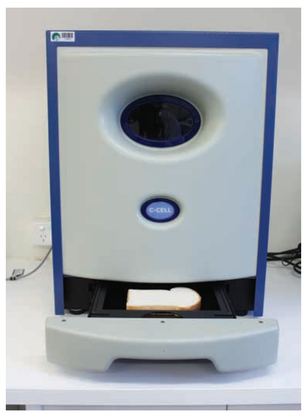

FIGURE 5 C-Cell

3. RESULTS AND DISCUSSION

Based on Bread Volume Analyser results, sugar reduction did not influence bread topographical properties significantly (P>0.01), except for the volume of bread.

The density, specific volume and dimensional parameters fluctuated slightly (P>0.01) and weight of breads considering adjustment of dough weight to 500g before proofing was in a similar range and did not demonstrate significant change (P>0.01) but volume became greater by lowering the amount of sugar. Samples with 75% reduced sugar possessed the highest volume followed by 50% and 25%, respectively. This result is in accordance with the previous studies of Trinh (2013) and Trinh & Martin (2014) illustrating that a high level of sugar in dough competes for water, making the water less available for starch gelatinisation and gluten forming. Resultantly, the number of gas bubbles decreased and produced a dense bread with less volume.

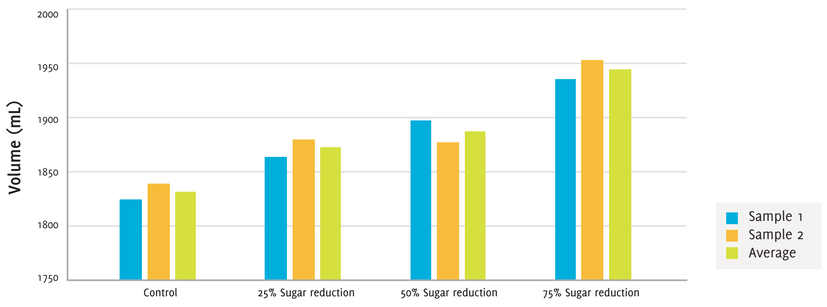

FIGURE 6 Bread volume

Results of structural parameters by texture analyser (TA-XT) could not demonstrate significant changes in bread characteristics by lowering the sugar level.

Springiness, cohesiveness, gumminess, chewiness and resilience were not significantly changed (P>0.01) by sugar level variation.

Areas and peaks in graph demonstrated negligible changes (P>0.01) in textural characters of each sample by altering sugar level. Hence, this did not provide sufficient evidence to support the quality difference in various sugar levels.

C-Cell results showed a significant change (P<0.01) in slice brightness which can be due to higher volume and open structure of bread in low sugar levels. Hence, bread with 75% sugar reduction had the lightest slice. Brighter colour was obvious on bread crust as well. This is confirmed by studies of Purlis and Salvadori (2009) which explained the caramelisation process of sugar in bread by heating helps to enhance crust colour and create a brownish-golden colour.

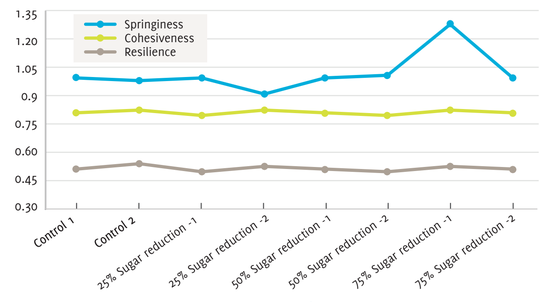

FIGURE 7 Bread texture analysis

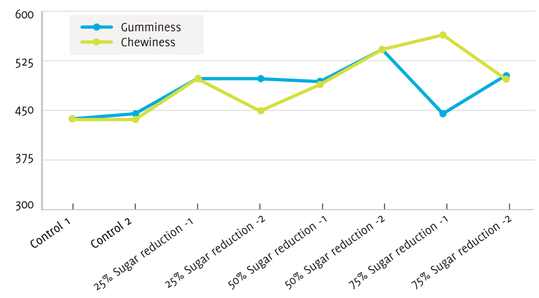

FIGURE 8 Bread texture analysis

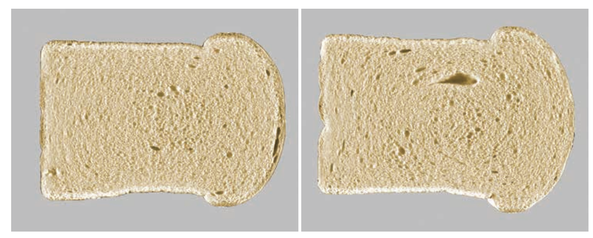

FIGURE 9 Slice brightness (Left: Control, Right: 75% reduction of sugar)

4. CONCLUSIONS

Overall, the results of the study showed sugar reduction had largely insignificant effect on bread topographic and textural characteristics which possess minimum technological and quality variations compared to breads with a standard recipe. However, the colour change of the slice and crust can raise an issue in bread production.

Recommendation

Extensive research should be conducted to minimise the effect of flour composition on results. Sensory evaluation is required to evaluate and analyse consumer responses to new bread formulations with reduced sugar for a comprehensive conclusion.

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Acknowledgment

- Stanley Cauvain for sharing his expertise and guidance
- Troy Adriansz, Junghong Ma and all laboratory staff for their help and support

Curtin University

Department of Agriculture and Food, Government of Western Australia

GRDC Grains Research & Development Corporation

AEGIC is an initiative of the Western Australian State Government and Australia's Grains Research and Development Corporation

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