The impact of high sugar formulations on bread dough rheology and bread quality

L. Cato1, J. Ma1 and S. Cauvain2

1Australian Export Grains Innovation Centre (AEGIC), 3 Baron-Hay Court, South Perth, WA 6151, Australia  2BakeTran, 1 Oakland Close, Freeland, Witney, OX29 8AX, UK

Correspondence: larisa.cato@aegic.org.au

1. INTRODUCTION

In recent years, bulk of Australian wheat export has switched from the Middle East to the South East Asian region. Westernisation of the diet and rising income in many SEA countries have led to significant growth of the bread sector in this region. Main baking processes used in SEA are sponge and dough (S&D) for the industrial bread production and no time dough (NtD) for small-medium baking enterprises. In both cases, in most SE Asian countries sugar content of bread dough is significantly higher than in Australia and many other countries around the world. Sugar impacts dough rheological properties and subsequently bread quality. In order to best assist flour milling and baking industry in SEA on the use of Australian wheat in baking it is important to investigate and fully understand the role high level of sugar plays in different baking process and more importantly how Australian wheat varieties respond to high sugar bread recipes.

This preliminary study investigated the impact of sugar on dough rheology and bread quality using a typical bread dough recipe from the Philippines. Internal and external bread quality attributes were analysed.

2. MATERIALS AND METHODS

Experiments were conducted using four different flours (one from Australia, one Indonesia and two from the Philippines) and different levels of sugar (sucrose) zero, 5, 15 and 25%. All other ingredients were kept constant. NtD baking method replicating commercial practices commonly used in the Philippines was used for test baking.

Bread doughs were mixed with DoughLab (Perten Instruments). Bread volume was measured with a bread volume analyser (BVA), a C-Cell (Calibre Control International Ltd, UK) was used to characterise internal bread quality and bread crumb softness was measured using the texture analyser TA-XT2iPlus (Stable Micro Systems, UK).

3. RESULTS AND DISCUSSION

Dough Rheology: Using the same DoughLab mixing conditions, the total energy delivered into the dough decreased during mixing as the sugar percentage increased in the bread formulation (Figure 1a). Doughlab peak value followed similar trend. The proofing time of the dough first decreased when sugar content was changed from 0 to 5%, but then increased with higher levels of sugar, which is most probably due to additional osmotic pressure on yeast activity (Figure 1b).

External characteristics: The most immediately observable effect of high sugar content in bread recipe was on the crust colour of baked bread (more residual sugar available for browning) (Figure 2a). Bread volume generally decreased as sugar content increased for all four flours studied. Bread specific volume (Figure 2b) showed a decreasing trend but different flours behaved slightly differently. There was little change in bread specific volume at lower sugar addition from 0 to 5%, but at higher levels, bread specific volume decreased for all flours.

Internal characteristics: With increased sugar content, the average cell diameter increased. Different flours responded slightly different suggesting possible flour–sugar interaction. The crumb became less bright as the level of sugar addition increased (Figure 3a). When crumb hardness was normalised for loaf volume slightly softer crumb was observed with higher levels of sugar addition for some but not all samples (Figure 3b).

In conclusion, total energy delivered into the dough during the mixing decreased significantly with higher level of sugar. The proof time decreased from zero sugar to 5% sugar in the recipe but then significantly increased as amount of added sugar increased. Higher sugar additions, above 5%, are likely to inhibit yeast activity and delay the time required to proof the dough. On the other hand, small additions of sugar to bread recipes are considered beneficial for yeast activity – thus resulting in faster proofing time.

As expected, bread crust colour was darker with higher sugar content. Bread specific volume decreased with higher additions of sugar particularly at the highest sugar addition. Total number of cells per unit area decreased while the average cell diameters increased with higher sugar additions resulting in more open and coarse bread structure.

Further research is currently underway to understand how different varieties of Australian wheat respond to high levels of sugar in different baking processes in SEA.