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Rheology of pound cake batters elaborated with chia (Salvia hispanica L.) mucilage gel for fat replacement

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Abstract

Concerns about health problems caused by diet increase the demand for foods with lower fat levels. However, consumers still expect that these products have characteristcs as close as possible to the full fat versions. Batter rheology is very important to determine cake quality. Thus, this study observed how palm fat replacement at 50% (F50) and 100% (F100) levels by chia mucilage gel affected the rheology of pound cake batters, compared to a control without fat replacement. An oscillatory frequency sweep and a temperature ramp test were carried out with cake batters. Mechanical spectra were similar for all batters, although fat replacement decreased both storage and loss moduli. For the temperature ramp test, moduli were lower as fat levels decreased, until 65°C, when F100 moduli became highest, followed by F50, and control showed the lowest moduli. Although fat replecement by chia mucilage gel made cake batters more fluid, batter behavior was similar for all batters, indicating chia mucilage gel as a potential fat replacer.

Key words:

pound cake, rheology, fat replacement

Introduction

Research correlating high fat levels in food to various health problems led to recommendations by organizations such as the World Health Organization to reduce fat. Nevertheless, this reduction implies in technological challenges, since fat is responsible for important quality characteristics, especially in products such as pound cake.

Considering that batter rheology is very important to determine cake quality, the aim of this study was to evaluate how the replacement of fat at 50% (F50) and 100% (F100) levels, in comparison to a control without fat replacement, affects rheological properties of pound cake batters using chia mucilage gel as fat replacer.

Results and Discussion

An oscillatory frequency sweep, from 0.1 Hz to 10 Hz, within the linear viscoelastic region was performed at 25°C. A temperature ramp test, from 25°C to 95°C, frequency of 1 Hz, within the linear viscoelastic region, was also carried out with cake batters.

Figures 1 and 2 show the oscillatory frequency sweep and the temperature ramp test, respectively.

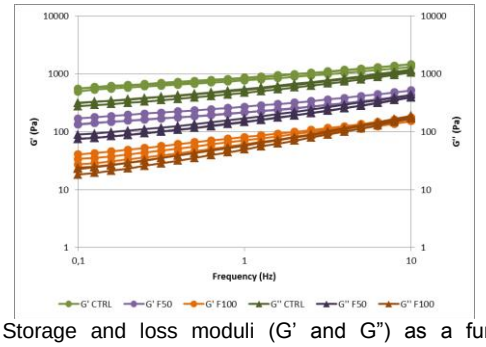

Figure 1. Storage and loss moduli (G' and G") as a function of frequency for CTRL (control), F50 and F100 (50% and 100% of fat replacement by chia (*Salvia hispanica* L.) mucilage gel, respectively).

It is possible to observe that all batters mostly had slightly higher G' than G", revealing a more elastic behavior in the samples. The highest moduli values were obtained for the control batter, without fat replacement. The slight difference between viscoelastic moduli values and small frequency-dependence indicate characteristics of a soft material[1], but with a clear weaker structure with the fat removal.

However, frequency increase made the G':G'' ratio decrease (weaker gel), which was more relevant for F100.

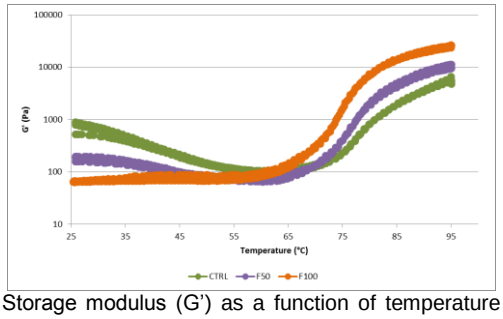

Figure 2. Storage modulus (G') as a function of temperature for CTRL (control), F50 and F100 (50% and 100% of fat replacement by chia (*Salvia hispanica* L.) mucilage gel, respectively).

The higher the fat level, the higher were the moduli values until 65°C. However, these values decreased for the control and F50, while for F100 they were almost constant up to 65°C. This can be explained because solid fat melts with the increase of temperature, making batter more fluid. At 65°C, the moduli started to increase due to the formation of cake structure (starch gelatinization) and an inversion occurred, with lower fat levels and higher starch content presenting higher moduli values. F100 showed the highest moduli because of the lower amount of fat (less sensitivity to temperature) promoting different interactions with other ingredients (stronger biopolymeric network).

Conclusions

Despite the obtainment of more fluid batters with fat replacement by chia mucilage gel at room temperature, pound cake batters showed similar rheological behavior (G':G" ratio), indicating that chia mucilage gel could be a potential fat replacer.

Acknowledgement

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[1] BAIXAULI, R. et al. Muffins with resistant starch: Baking performance in relation to the rheological properties of the batter. *Journal of Cereal Science*, **2008**, 47, 3, 502–509.