Healthier Baking Alternatives: Evaluating Stevia and Erythritol in Whole Wheat Bread Production

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Introduction

Sugar plays an important role in baking. However, sugar can cause many health-related issues such as high blood pressure, diabetes and even heart disease. What's more, studies have shown that sugar damages and ages our skin. Therefore, when baking bread, it is important to use the sugar substitutes to avoid these health concerns. Notably, sugar substitutes like stevia, erythritol contains few calories and suggest a better usage for a healthier diet.

Whole wheat bread, valued for its nutritional benefits, serves as an ideal candidate for such dietary improvements. However, replacing sugar with alternative sweeteners poses a challenge: it must retain the bread's desirable qualities while meeting health and dietary standards.

Literature

Excessive sugar intake can harm cardiovascular health and accelerate skin aging through the formation of advanced glycation end products (AGEs) (Danby, 2010).

Challenges in bread-making with whole wheat due to impacts on dough properties and bread texture (Brown, A., 2019).

Replacing sugar with substitutes like stevia and erythritol can alter bread's texture, volume, and shelf life (Kim and Park, 2019; Elena-Madalina Stefan et al., 2019).

Objectives

1. Examining the effects of stevia and erythritol in the production of whole wheat bread.
2. Identify how the stevia and erythritol influence the bread-making process, specifically in terms of yeast fermentation, taste, and texture

Methods

Anton Paar Rheometer to measure the complex viscosity and modulus of different doughs

Dough thickness test through ruler

Compression test of doughs

Conduct sensory tests

Measuring procedure

Pictures measure the thickness before and after one hour's fermentation

Sensory test

	firmness	humidity	Salt	Sweet
Bread with sugar	5	1	1	1
Bread with erythritol	5	1	3	3
Bread with stevia	5	1	3	5

1 → 5

Results

Complex viscosity of different doughs

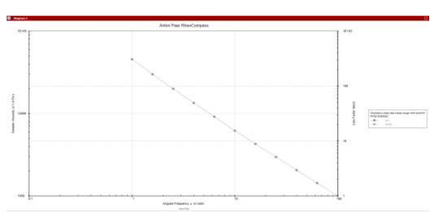

Figure 1.1: complex viscosity of erythritol dough

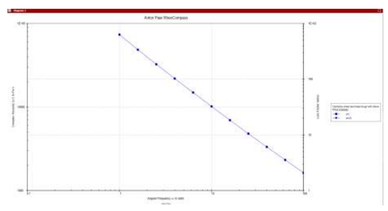

Figure 1.2: complex viscosity of stevia dough

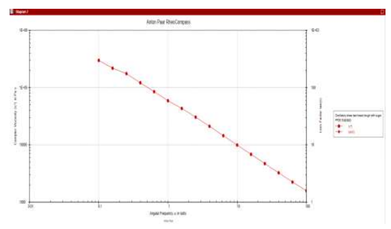

Figure 1.3: complex viscosity of sugar dough

Storage/loss modulus

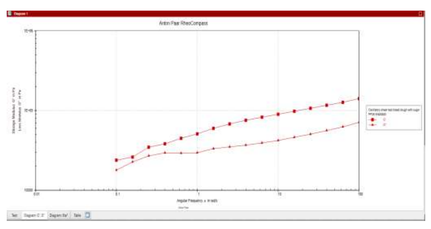

Figure 3.1: The storage and loss modulus of sugar dough

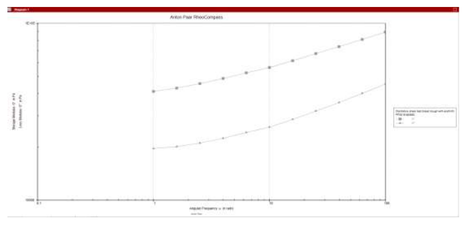

Figure 3.2: The storage and loss modulus of erythritol dough

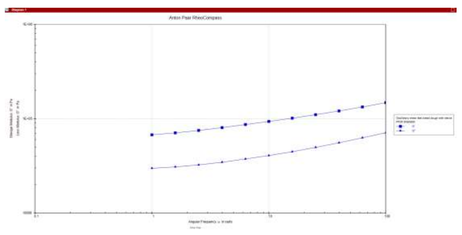

Figure 3.2: The storage and loss modulus of stevia dough

Compression test

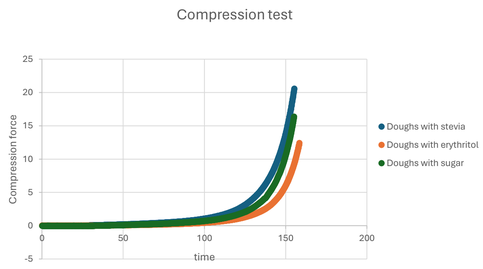

Figure 4: The compression test of doughs with stevia, erythritol and sugar

Findings

1. Bread with sugar has the best fermentation result, in this experiment, from 2.8cm thickness to 5.5 cm thickness
2. Erythritol and Stevia expands little with averagely 0.3 cm thicker
3. Before fermentation, sugar substitutes can reduce the absorption with water and have more moisture, which make sense that the doughs with sugar substitutes more viscous
4. After fermentation, doughs with sugar have the best elasticity, stevia next, erythritol last.
5. The bread with sugar is browner due to Maillard Reaction while bread with sugar substitutes do not change the color
6. Bread with sugar substitutes seem to be saltier than bread with sugar
7. Most participants would accept the choice of sugar-substituted bread if the issue of salty can be solved.

Reference

1. Brown, A. (2019). *The Science of Whole Grain Baking*. New York, NY: Flourish Publishing.
2. Danby, F. William.(2010) "Nutrition and aging skin: Sugar and glycation." Clinics in Dermatology, vol. 28, no. 4,, pp. 409–411, https://doi.org/10.1016/j.clindermatol.2010.03.018.
3. Stefan, E. M., Voicu, G., Constantin, G. A., Munteanu, G. M., & Ipate, G. (2019). Effect of sugar substitues on wheat dough rheology. *Scientific Study & Research. Chemistry & Chemical Engineering, Biotechnology, Food Industry*, *20*(2), 313-320.