DEVELOPMENT OF THE MATCHA CEREAL MILK PRODUCT

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INTRODUCTION

This study aims to develop Matcha cereal milk, a nutritious plant-based beverage, by combining protein, fiber, and mineral-rich cereals (oats, lotus seeds, mung beans, brown rice, white beans) with antioxidant-rich matcha. The goal is to optimize the production process, specifically examining the effects of enzymes (α-amylase, glucoamylase) on viscosity and reducing sugar content, the role of stabilizers (lecithin, guar gum), and assessing consumer preference. This product seeks to address the growing demand for healthy and sustainable food options.

OBJECTIVES

- To formulate a nutritious and appealing matcha cereal milk beverage by integrating a diverse range of plant-based ingredients.
- To optimize key processing parameters, including enzyme hydrolysis and additive concentration, to enhance product texture, flavor, and stability.
- To evaluate the physicochemical and sensory properties of the final product, ensuring it meets nutritional quality and consumer acceptability standards

MATERIALS AND METHODS

Oats, lotus seeds, mung beans, brown rice, and white beans were sourced from various Vietnamese companies. Enzymes (α-amylase and glucoamylase) and chemicals for reducing sugar quantification (DNS, NaOH, $C_4H_4O_6KNa.4H_2O$) were supplied by the Institute of Biotechnology and Food Technology, Industrial University of Ho Chi Minh City. Sucrose, lecithin (E322), and guar gum were procured from other specific companies.

Brown rice and oats were roasted; mung beans and white beans were soaked and dehulled; lotus seeds were cleaned and germ removed. The mixture was wet-ground at a 1:10 ratio, followed by starch hydrolysis with varying α-amylase and glucoamylase concentrations. The cereal milk was then filtered, mixed with sucrose, lecithin, and guar gum, homogenized, filled into heat-resistant pouches, and pasteurized at 95ºC for 15 minutes.

Reducing sugar was determined by the DNS method. Sensory evaluation used a 9-point hedonic scale. Experiments used a completely randomized design, replicated 5 times. Data were analyzed using one-way and two-way ANOVA, with differences determined by LSD test ($p < 0.05$), using Excel and R-Studio software.

RESULTS AND DISCUSSION

- **Experiment 1 and 2: Optimization of Enzymatic Hydrolysis**

Viscosity decreased with increasing α-amylase concentration (0.1% to 0.4%) and hydrolysis time (10 minutes to 20 minutes). However, the decrease in viscosity was not statistically significant when α-amylase concentration increased from 0.3% to 0.4% or when hydrolysis time increased from 20 minutes to 40 minutes.
An α-amylase concentration of 0.3% and a hydrolysis time of 20 minutes were selected as optimal, creating favorable conditions for the saccharification process.

- **Experiment 3 and 4: Effect of glucoamylase on reducing sugar content**

Reducing sugar content increased proportionally with glucoamylase concentration (0.1% to 0.3%) and saccharification time (10 minutes to 30 minutes).
The increase in reducing sugar was negligible when enzyme concentration exceeded 0.3% or saccharification time exceeded 30 minutes.
A glucoamylase concentration of 0.3% and a saccharification time of 30 minutes were selected as optimal to achieve the highest reducing sugar content.

- **Experiment 5: Effect of Lecithin and Guar gum on viscosity**

The viscosity of the cereal milk increased linearly with the content of added Lecithin and Guar gum.
A combination of 0.15% Lecithin and 0.15% Guar gum resulted in a viscosity (7.76±0.10 cP) that showed no statistically significant difference from the commercial control sample (7.84±0.09 cP).
Thus, 0.15% Lecithin and 0.15% Guar gum were selected as appropriate contents.

- **Experiment 6: Effect of Sucrose on Brix value**

Total solid content (Brix) in the milk gradually increased with increasing added sucrose content (4% to 10%).
An 8% added sucrose content (Brix 12.42±0.13) showed no statistically significant difference compared to the commercial control sample (Brix 12.22±0.13).
To achieve the desired Brix value similar to commercial products while considering sweetness, 6% sucrose and 2% maltodextrin were chosen.

- **Experiment 7: Consumer preference with Matcha addition**

Both product samples (with and without matcha) achieved an average sensory score greater than 5, indicating consumer acceptance.
The matcha-infused sample received significantly higher ratings for color (6.64 vs 6.04), odor (7.51 vs 7.02), taste (6.87 vs 6.60), and overall liking (6.93 vs 6.71) compared to the control.
The addition of matcha enhanced sensory attributes and was preferred by consumers.

Table 1. Effect of α-amylase concentration on milk viscosity

α-amylase concentration (%)	Viscosity (cP)
0.1%	$3.64^a \pm 0.15$
0.2%	$3.35^b \pm 0.09$
0.3%	$3.28^{bc} \pm 0.13$
0.4%	$3.10^c \pm 0.10$

Different lowercase letters in the same column indicate a statistically significant difference ($p<0.05$)

Table 2. Effect of hydrolysis time on milk viscosity

Time affecting (min)	Viscosity (cP)
10	$4.39^a \pm 0.03$
20	$3.89^b \pm 0.05$
30	$3.88^b \pm 0.05$
40	$3.90^b \pm 0.04$

Different lowercase letters in the same column indicate a statistically significant difference ($p<0.05$)

Table 3. Effect of glucoamylase concentration on the reducing sugar content in milk

Glucoamylase concentration(%)	Reducing sugar content (%)
0.1%	$6.81^c \pm 0.34$
0.2%	$13.19^b \pm 0.52$
0.3%	$18.06^a \pm 0.34$
0.4%	$18.81^a \pm 0.52$

Different lowercase letters in the same column indicate a statistically significant difference ($p<0.05$)

Table 4. Effect of saccharification time on the reducing sugar content in milk

Saccharification time (min)	Reducing sugar content (%)
10	$11.94^c \pm 0.52$
20	$13.19^b \pm 0.52$
30	$15.94^a \pm 0.52$
40	$16.81^a \pm 0.34$

Different lowercase letters in the same column indicate a statistically significant difference ($p<0.05$)

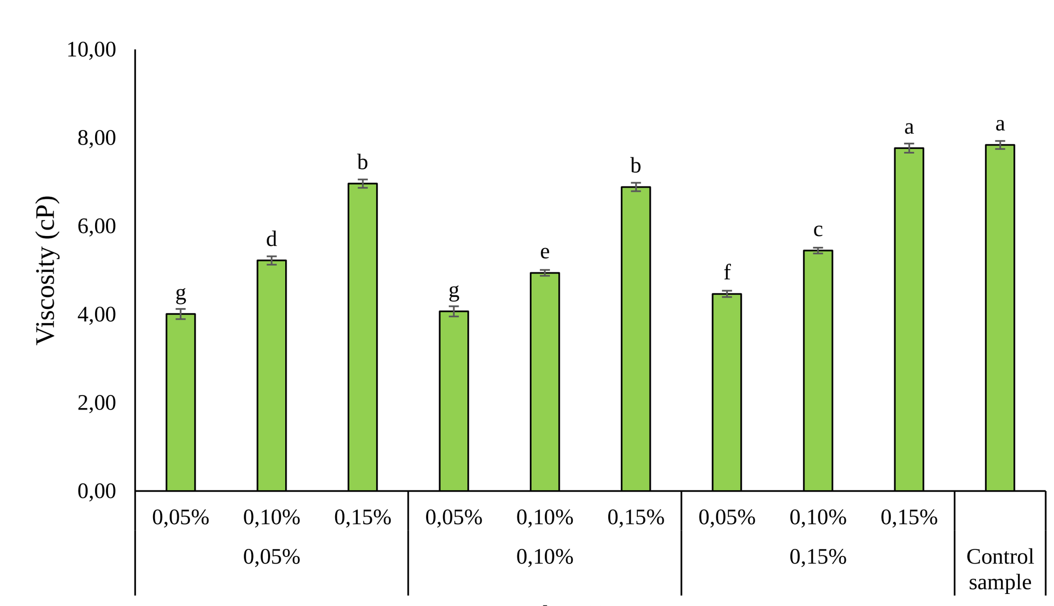

Figure 1. Effect of Lecithin and Guar gum on viscosity

Different lowercase letters indicate a statistically significant difference ($p<0.05$)

Table 5. Effect of added sucrose content on the Brix value of the grain milk product

Sucrose content (%)	Brix
4%	$8.38^d \pm 0.13$
6%	$9.92^c \pm 0.13$
8%	$12.42^b \pm 0.13$
10%	$14.00^a \pm 0.16$
Control sample	$12.22^b \pm 0.13$

Different lowercase letters in the same column indicate a statistically significant difference ($p<0.05$)

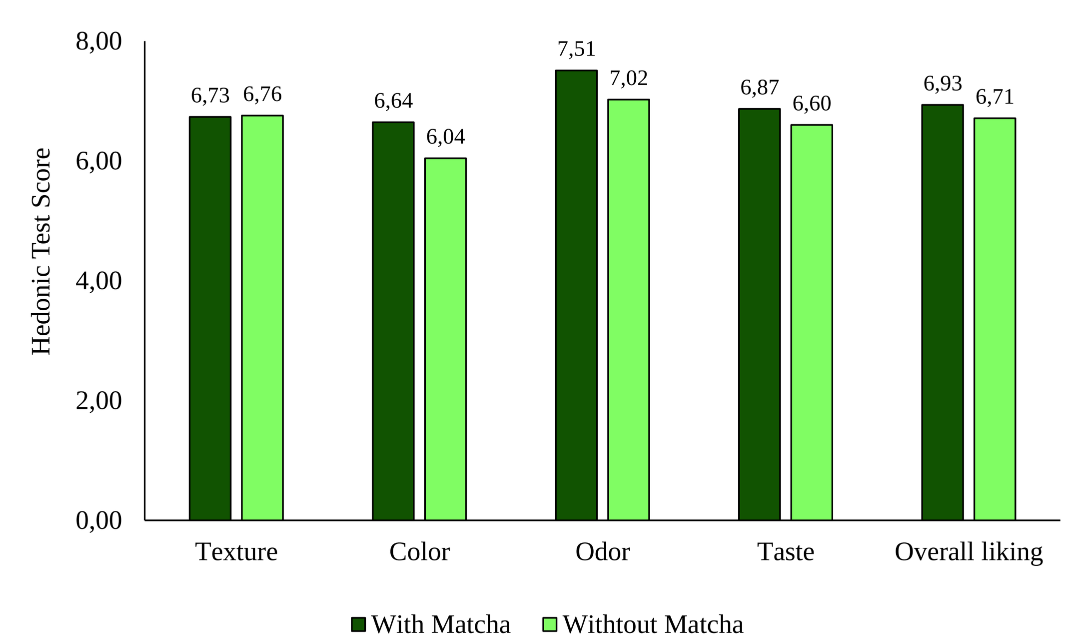

Figure 2. Hedonic test results – Consumer acceptance level of the product

CONCLUSION

The study successfully developed a matcha cereal milk beverage that integrates the health benefits of matcha with the nutritional value of diverse cereals. The final formulation achieved optimal viscosity, sweetness, and consumer preference through careful selection and optimization of enzymes and additives. The product exhibits strong potential for commercial application in the growing market of functional plant-based beverages. Future research will focus on evaluating the shelf life, stability under various storage conditions, and scalability of the production process to support broader distribution and commercialization.

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