Pineapple Peel as Potential Fermented Functional Drink: Formulation and Sensory Profile

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Abstract. Pineapple peel contains basic nutrients and bromelain enzyme that provide positive effects on the fermentation process. This research were determine the formulation and sensory evaluation of the products. This research will be carried out in 3 stages, namely product formulation, product manufacture, and organoleptic testing. The research design in this study was experimental, using a Completely Randomized Design with F1 (700 gr palm sugar and 500 gr pineapple peel), F2 (500 gr palm sugar and 500 gr pineapple peel), and F3 (600 gr palm sugar and 500 gr pineapple peel). All of the formulation were fermented for 36 hours in room temperature. All of formulation products were successfully fermented. Sensory profiles were measured using hedonic rating with seven (7) point scale range, indicating the highest score down to one (1) for the lowest score. Followed by Duncan test, the formula F3 was a significant difference between F1, but not difference with F2 ($P<0.05$) in overall liking scores.

Keywords: Pineapple peel - Fermented drink - Sensory Profile

1 Introduction

The problem of food waste is becoming a global issue. The ecological, economic, and social impact of food waste is enormous. It contributes to resource depletion, greenhouse gas emissions, and lost economic opportunities. The growing awareness of the food waste crisis has increased interest in the utilization of food by-products from food processing. These by-products, including fruit peels, seeds, and pulp, are rich in nutrients, and bioactive compounds. Transforming food by-products into value-added products can be developed into functional foods and beverages that provide health benefits beyond essential nutrition.

The local foods that have great potential as functional foods include pineapples. Pineapple is a popular tropical fruit that is widely cultivated in regions such as Southeast Asia, Africa, and Latin America. Pineapple processing for juice, canned fruit, and other products generates a large amount of waste, with the peel constituting up to 40% of the total weight of the fruit (Hamzah *et al.*, 2021). Pineapple peel is high in nutrients and bioactive compounds, including dietary fiber, vitamins (such as vitamin C), minerals, and phenolic compounds. The presence of bromelain, an enzyme with various health benefits, further enhances its potential as a functional ingredient (Zhou *et al.*, 2021; Lasunon *et al.*, 2022; Nasoha *et al.*, 2023; Nordin *et al.*, 2023). These compounds can potentially benefit effects from reducing diabetes risk, anti-inflammatory, antimicrobial activity, antioxidant, monitoring nervous system function, and improve the digestive system, making pineapple peel a promising candidate for developing functional foods (Mohd Ali *et al.*, 2020).

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The beneficial properties of pineapple peels can be enhanced by fermentation into a functional beverage. Pineapple peel fermented beverage (tepache) has excellent potential as a source of probiotics and antioxidants. The unique sensory profile of pineapple peel, combined with the benefits of fermentation, offers an opportunity to create a novel product that can appeal to health-conscious consumers. This innovation can contribute to exploring the potential of pineapple peel as a base for a fermented functional drink. This study aimed to evaluate the process used to formulate and sensory profile.

2 Method

The research design in this study was experimental, using a Completely Randomized Design (CRD) with three treatments: F1 = using 700 gr palm sugar and 500 gr pineapple peel, F2 using 500 gr palm sugar and 500 gr pineapple peel, and F3 using 600 gr palm sugar and 500 gr pineapple peel. All of the formulation were fermented for 36 hours in room temperature. This research will be conducted in three stages (make the formulation, make the product, and sensory analysis for all formula). This research have been conducted in the Nutrition Study Program laboratory University State of Medan on March to August 2024. The panelists used for sensory analysis were consumer panelists who are familiar with or have consumed tepache drinks by filling out a provided form. The number of panelists used in this research are 30 and get inform concern before the test. The data in this research consists of primary data obtained through sensory analysis (rating test) at a 5% significance level using IBM SPSS version 26.

3 Result and discussions

3.1 Producing of tepache beverage

Tepache is a traditional fermented beverage originating from Mexico, has begun to be developed in Indonesia using pineapple peels as the main ingredient. Several studies have been conducted to optimize the formula for tepache to enhance its flavor, nutritional content, and product stability. One of formula that developed in Indonesia involves the addition of cane sugar and spices like cinnamon and cloves during the fermentation process. The addition of sugar increases the alcohol content and provides a balanced sweetness, while the spices add complexity to the flavor. Research has shown that this combination can improve the sensory acceptance of tepache among consumers (Dewi and Purnomo, 2022). In this study, the sugar used as a substrate is palm sugar, sourced from local farmers, which is rich in flavor. The formulation design in this study is shown in Table 1.

Table 1. Formulation of Product

No	Ingredients	units	Formulation		
			F2	F3	F1
1	Pineapple peel	gr	500	500	500
2	Palm sugar	gr	500	600	700
3	Fermentation time	Jam	36	36	36
4	Water	mL	1,5	1,5	1,5
5	Cinnamon stick	cm	10	10	10

Important Steps in the Production of Fermented Tepache Beverage:

1. Preparation of Pineapple Peels
   The primary ingredient is fresh pineapple peels, which must be thoroughly washed to remove dirt and pesticide residues. Since tepache relies on the natural microorganisms present on the pineapple peels, it is crucial to ensure that the peels are clean but not entirely stripped of their natural microorganisms. The peels should be cut into small pieces to facilitate the fermentation process.
2. Preparation of Palm Sugar Solution
   The palm sugar is first dissolved in water by boiling it for 30 minutes. Once dissolved, the sugar solution is poured into a glass jar and allowed to cool to room temperature for 4 hours. This cooling step is essential to ensure that the fermentation process with the pineapple peels proceeds effectively. If the solution is not adequately cooled, the resulting beverage may have a slimy consistency, indicating a failure in the fermentation process.
3. Mixing of Ingredients
   The mixing of ingredients should be done only after the palm sugar solution has reached room temperature. Start by adding the pineapple peels to the glass jar containing the palm sugar solution. Cinnamon sticks are also added to enhance the flavor of the beverage. It is crucial to ensure that the pineapple peels are fully submerged in the sugar solution, with the inner side of the peels making contact with the liquid, as this will affect the effectiveness of the fermentation process.
4. Fermentation
   Cover the jar with a clean cloth or plastic wrap with small holes to allow air to enter while protecting the contents from contamination. Store the jar according to the required fermentation time specified in the formulation. During this storage period, the fermentation process occurs anaerobically (Figure 1).
5. Straining
   After the desired fermentation time has been reached, strain the liquid using a cloth filter or fine strainer to separate the pineapple peels and spices from the tepache. Transfer the strained tepache into a clean container and store it in the refrigerator.

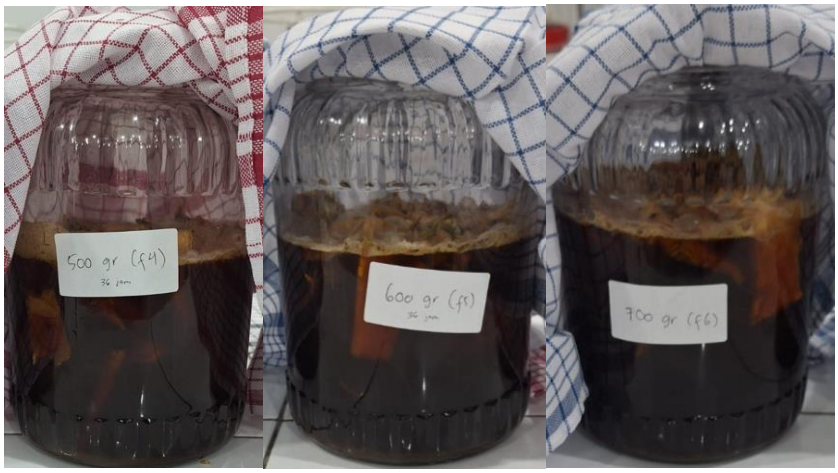

Fig 1. Fermentation process of tepache

Another formula that has been developed involves the use of microbial starters such as *Lactobacillus plantarum* and *Saccharomyces cerevisiae* to accelerate the fermentation process.

These starters aid in the production of lactic acid and ethanol, which contribute to the flavor and preservation properties of the beverage. Research has found that the use of microbial starters can reduce fermentation time and improve the microbiological quality of tepache (Wulandari & Nugroho, 2021). However, in this study, the fermentation process did not include the addition of starters, relying instead on the natural microbes and enzymes present in pineapple peel. Another formula was developed by Syahrial and Fadillah (2023), which involved varying the proportion of pineapple peel and water to determine the optimal concentration that produces the best flavor. Other variables, such as fermentation duration, have also been explored in the development of tepache. According to Putra and Hadi (2021), fermenting for 48-72 hours results in a tepache with a flavor profile most preferred by consumers, characterized by a sweet and balanced acidity. In this study, a fermentation duration of 36 hours was formulated to observe the characteristics of the product with a shorter fermentation period than in previous research.

3.2 Sensory analysis of tepache

The acceptance testing of tepache beverage products was conducted using a rating method to evaluate panelists' preferences for one formula over another. When comparing these formulas, a significant difference was found in the overall acceptance levels (Figure 2). The figure shows that Formula 3 had the highest level of preference, which was significantly different at a 95% confidence level ($\alpha = 0.05$). Formula 1 received an average score of 4.36, indicating a neutral-to-slightly liking level of preference, Formula 2 received an average score of 4.03, indicating a neutral level of preference, and Formula 3 received an average score of 4.8, indicating a slightly liking level of preference.

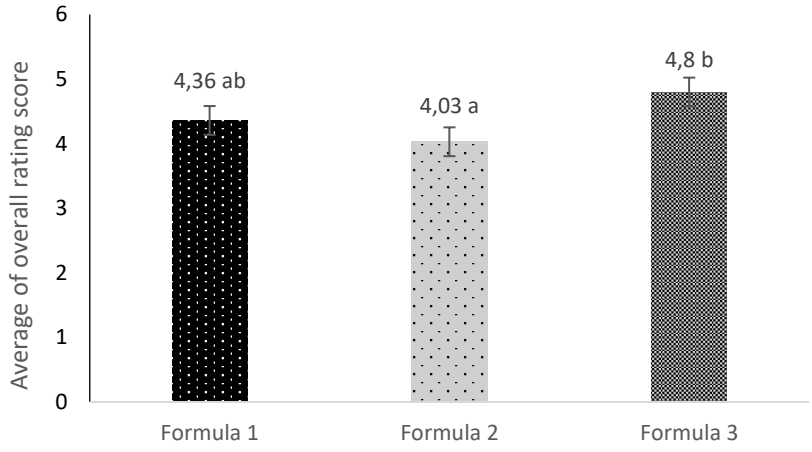

Fig 2. Average percentage of favorability between formulas

The significant difference in acceptance suggests that Formula 3 possesses sensory attributes that are more favored by the panelists compared to Formula 1 and Formula 2. Formula 1, with an average score of 4.36, falls within the "neutral-to-slightly liking" category, while Formula 2, with an average score of 4.03, indicates a "neutral" level of preference among the panelists. Although Formula 1 is still accepted by the panelists, its preference level is not as strong as that of Formula 3. This implies that modifications or improvements in the formula composition can lead to significant differences in sensory acceptance by consumers or panelists. Therefore,

Formula 3 can be considered the superior option in terms of consumer acceptance and is recommended for further development.
In studies of fermented beverages like tepache, such as the research by Pinto et al. (2022), sensory attributes like taste and aroma have been identified as key factors influencing consumer acceptance. The significant difference between these formulas may be attributed to variations in these critical attributes, reflecting the impact of different ingredient combinations and fermentation processes. This finding aligns with broader research in the field that emphasizes the importance of optimizing sensory qualities to find consumer preferences.

4 Conclusions

All of formulation products were successfully fermented for 36 hours. Sensory profiles were indicating that the formula F3 was a significant difference between F1, but not difference with F2 ($P<0.05$) in overall liking scores. Formula F3 indicating a slightly liking level of preference by panelists.

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References

[1] Dewi, R. K., & Purnomo, H. Development of Pineapple Peel-Based Tepache with Sugar and Spices Addition. *Journal of Food Science and Technology, 15*(2), p. 145-153 (2022).

[2] Hamzah, A. F. A. et al. Recent updates on the Conversion of Pineapple Waste (Ananas comosus) to Value-Added Products, Future Perspectives and Challenges', Agronomy, 11(11) (2021).

[3] Lasunon, P. et al. Total phenolic compound and its antioxidant activity of by-product from pineapple', Food Research, 6(4), pp. 107–112 (2022).

[4] Mohd Ali, M. et al. Pineapple (Ananas comosus): A Comprehensive Review of Nutritional values, Volatile Compounds, Health Benefits, and Potential Food Products', Food Research International. Elsevier Ltd, 137(April), p. 109675 (2020)

[5] Nasoha, N. Z. et al. Exploring Pineapple Peel Hydrolysate as a Sustainable Carbon Source for Xylitol Production', Scientific Reports. Nature Publishing Group UK, 13(1), pp. 1–11 (2023).

[6] Nordin, N. L. et al. Comparison of Phenolic and Volatile Compounds in MD2 Pineapple Peel and Core', Foods, 12(11) (2023).

[7] Pinto, T.; Vilela, A.; Cosme, F. Chemical and Sensory Characteristics of Fruit Juice and Fruit Fermented Beverages and Their Consumer Acceptance. *Beverages*, (8) 33. (2022)

[8] Putra, A. M., & Hadi, S. Optimization of Fermentation Time for Pineapple Peel Tepache Production. *Journal of Tropical Food Science, 11*(2), pp. 101-109 (2021)

[9] Wulandari, E., & Nugroho, A. Utilization of Microbial Starters in the Fermentation of Tepache from Pineapple Peel. *Indonesian Journal of Food Microbiology, 8*(1), 57-66 (2021)

[10] Zhou, W. et al. Purification and Characterization of Bromelain from Pineapple (Ananas comosus L.) Peel Waste', Journal of Food Science, 86(2), pp. 385–393 (2021).