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Sensory evaluation, antioxidant activity, and vitamin C content of Chaya Leaf Velva combined with honey pineapple

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Abstract. Velva is a refreshing frozen drink with a combination of fruits and vegetables. It offers an excellent source of antioxidants. This study aims to develop a velva using Chaya leaf combined with honey pineapple and to evaluate its sensory characteristics, antioxidant activity, and vitamin C content. The study formulated three variations of Chaya leaf and honey pineapple velva using different ratio combinations: Formula 1 (100:0), Formula 2 (50:50), and Formula 3 (75:25). Sensory analysis was performed using a total of 30 respondents. The scale was 1 to 9, which ranges from disliked extremely to extremely like. Antioxidant activity was analyzed using the DPPH method. Meanwhile, vitamin C was analyzed following the titration method. The data were analyzed using one-way ANOVA and Duncan's Multiple Range Test (DMRT) to determine significant differences among the treatments. The results showed that Formula 2, which contained 50% Chaya leaf and 50% honey pineapple, showed a significantly higher hedonic score ($p < 0.05$) and the highest preference score of 7.11. A significant enhancement in antioxidant activity (23.76% inhibition) and vitamin C content (1.099%) was observed with Formula 2 ($p < 0.05$). Additional studies are required to thoroughly examine the nutritional content and sensory assessment with Quantitative Descriptive Analysis.

1 Introduction

In recent years, interest in natural and healthy foods has increased globally. This phenomenon is driven by a greater awareness of the importance of a balanced diet, resulting in more people choosing healthier foods than processed ones. Consequently, more natural food sources are required. Among these are natural foods derived from plant-based sources.

Chaya Leaf (*Cnidoscolus aconitifolius*) is one of the popular edible vegetables in Mexico and Central America due to their various practicalities. In addition to these function as a

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vegetable, this relatively unpopular leaves are also used as medicine. One study reveals that the Chaya Leaf have anti-inflammatory and antioxidant activity [1] and a potential involvement in cardioprotective benefits. Chaya Leaf have bioactive substances called Polyphenols, which contain quercetin and kaempferol as the primary phenolic compounds [2]. Meanwhile, Honey pineapples (*Ananas comosus) are a* type of fruit that provides a distinctive and refreshing taste when it is consumed. It has a combination of sour and sweet flavours. In addition, this food is nutritious and beneficial for human health. Pineapple is rich in vitamin C and a substance called bromelain, which is a digestive enzyme that acts as an antioxidant [3]. The combination of Chaya Leaf with honey pineapple can produce a product that provides increased levels of vitamin C and improves the quality of its nutrients. This interaction can provide a protective effect against oxidative stress, including lipid peroxidation and DNA damage. Studies have reported that combining flavonoids in citrus fruits with vitamin C significantly delays lipoprotein oxidation, which indicates their complementary antioxidant function [4].

The processing technique of Chaya Leaf in Indonesian cuisine is usually by boiling or stir-frying. Some people process them into further products such as *dendeng* and *rempeyek* to increase their variety and eliminate boredom. The use of Chaya Leaf in waffle production has also been explored and was found to be acceptable based on hedonic evaluation [5]. Meanwhile, processing the Chaya Leaf into *velva*, a dessert in the form of a frozen drink made from a combination of fruits or vegetables, is one practical way to make drinks functional. *Velva* has a characteristic of a high-fiber and low-fat composition due to its combination of nutritious fruits and/or vegetables. It also offers added value from certain fruits or vegetables, which are sources of antioxidants, vitamins, and minerals. Moreover, Velva has a longer shelf life because, as a frozen drink, it is stored and served at low temperatures or in cold conditions. All age groups easily like this type of food because of its natural aroma from the composition of fruits and vegetables. Thus, this likeable feature also increases the acceptability of this product [6].

Sensory testing is one of the important aspects of food product development, as it examines the acceptability of the product. This test measures human responses to the appearance of colour, texture, taste, and aroma. In making Chaya Leaf velva by combining it with honey and pineapple, the primary consideration is its taste and aroma. These sensory features can reduce consumer acceptance when the Chaya Leaf is processed into velva. Therefore, the addition of honey pineapple, which has a fresh, sour, and sweet taste, is expected to balance and disguise the distinctive taste of the leaves.

This study evaluated velva Chaya Leaf and honey pineapple's sensory characteristics and vitamin C content. Sensory analysis included the assessments of taste, texture, color, aroma, and overall preference by trained panelists to determine consumer acceptability of the product. Vitamin C content and antioxidant activity were then analysed to determine the antioxidant potential of Velva.

2 Material and methods

Sensory testing was conducted to determine product acceptability, which was assessed through hedonic tests on color, aroma, taste, texture, and acidity levels. Analysis of Vitamin C content was also conducted.

2.1 Research design

This study used a one-factorial completely randomized design (CRD) with two replications that is consisting of three formulations. The variation of the formulation was determined

based on the comparison of Chaya Leaf (*Cnidoscolus aconitifolius*) and honey pineapple (Ananas comosus), namely:
F1: 100% Chaya Leaf: 0% honey pineapple
F2: 50% Chaya Leaf: 50% honey pineapple
F3: 75% Chaya Leaf: 25% honey pineapple

The basis for selecting the formula is based on Chaya Leaf' nutritional content and components, referring to research by Guevara-Cruz *et al* [2]. Formulation 1 (F1) was used as a control to evaluate the effect of honey pineapple addition on sensory acceptance and the vitamin C content.

2.2 Sample preparation

Fresh Chaya Leaf was collected, cleaned with running water, and then boiled for 15 minutes to reduce cyanide levels [7]. Afterward, the leaves were crushed by using a chopper. Subsequently, the honey pineapple was peeled, cut, and mashed into juice without adding any water. Both ingredients were then mixed according to the predetermined formulation ratio. After that, water, CMC, and rambutan honey were added. Eventually, each formula was stored in the freezer to form a velva product with a soft and semi-solid frozen consistency.

2.3 Sensory evaluation, antioxidant activity and vitamin c content analysis

Sensory testing was conducted to assess each velva formulation's acceptance level. The panelists consisted of 30 semi-trained respondents who were randomly selected. Organoleptic assessment used a hedonic scale ranging from a value range of (1) “disliked extremely”, (2) “disliked very much”, (3)“disliked moderately”, (4)“disliked slightly”, (5) “neither liked nor disliked (nuetral)”, (6) “liked slightly”, (7) “liked moderately”, (8) “liked very much”, and (9)“liked extremely” [8]. The tested parameters included color, aroma, taste, texture, overall acceptance, and acidity level. The panelists were instructed to wash their lips with water before tasting each item to prevent taste blending. Antioxidant activity was analysed using the DPPH Method (% Inhibition) [9] and Vitamin C content in velva was analyzed using the iodometric titration method [10]. Starch was used as an indicator to homogenize and titrate a total of ±10 grams of liquid velva with 0.01 N iodine solution. The color change to stable blue-black marks the end point of titration.

2.4 Data analysis

Data was statistically assessed the sensory test findings to identify any significant variations between formulations using One-way analysis of variance (ANOVA). If a significant difference ($p < 0.05$) is found, further analysis is conducted using Duncan's Multiple Range Test (DMRT).

3 Result

3.1 Evaluation of organoleptic properties velva

An organoleptic assessment was conducted using three formulas of Chaya Leaf velva combined with honey pineapple (F1, F2, and F3). The parameters are color, aroma, taste, texture, acidity level, and overall preference. Panelists conducted the assessment using a hedonic scale. The utilized scale was 1 to 9, which ranges fromdisliked extremely to extremely like. The results are presented in Table 1.

Table 1. Evaluation of Organoleptic Properties Velva

Indicators	Formulas			p
	F1	F2	F3	
Color	5.96 [a]	5.67 [a]	6.19 [a]	0.581
Aroma	5.00 [b]	6.56 [a]	6.89 [a]	0.000
Flavor	4.70 [b]	7.26 [a]	6.48 [a]	0.000
Texture	4.59 [b]	6.52 [a]	5.63 [a]	0.000
Acidity	4.96 [b]	6.89 [a]	6.52 [a]	0.000
Overall	4.96 [b]	7.11 [a]	6.59 [a]	0.000

[a-b]Different letters in the same line indicate values are significantly different

Based on the results of the organoleptic tests, Formula 2 showed the highest level of acceptance by the panelists. It has the highest average score for sensory attributes: Flavor 7.26 (liked moderately), acidity 6.89 (liked slightly), and overall assessment 7.11 (liked moderately). Although Formula 2 generally demonstrated the highest level of acceptance across most organoleptic parameter, certain attributes score slightly lower than Formula 3. In terms of color, Formula 2 received a score of 5.67 (neither liked nor disliked/ nuetral), which fell within the neutral category, whereas Formula 3 scored higher at 6.19 (liked slightly), categorized as liked slightly. Similarly, Formula 2 obtained a favorable score of 6.56 (liked slightly) for the aroma parameter, which was still slightly lower than the score of Formula 3 that has reached 6.89 (liked slightly). These findings indicate Formula 3 was still well accepted by the panelists, particularly in terms of aroma and color.

Statistically, formula 2 was significantly different from formula 1 ($p < 0.05$), indicating that the panelists consistently preferred formula 2. Formula 3 was in second place in terms of preference. The scores were not significantly different from Formula 2 for most attributes but were still lower on average. This result indicates that formula 3 was still well accepted by the panelists, although it was not as superior as Formula 2. Conversely, formula 1 scored the lowest on almost all parameters and differed significantly from Formula 2 and Formula 3. This phenomenon indicates that this formula was the least preferred by the panelists. Nevertheless, in terms of color, no significant differences were found among the three formulas ($p > 0.05$), although formula 3 obtained the highest average score. Nevertheless, in terms of color, no significant differences were found between the three formulas ($p > 0.05$), although Formula 3 obtained the highest average score. This may be attributed to the fact that all three formulas exhibited a similar green color, and in the formulas containing honey pineapple, the color appeared as a yellowish-green hue. Thus, in terms of overall acceptability, the order of panelist preference was F2 as the most preferred formula, followed by Formula 3, and finally by Formula 1, which has the lowest acceptability.

3.2 Evaluation of antioxidant activity and vitamin c content of velva

Three velva formulations, including a honey pineapple and Chaya Leaf blend, were tested for their antioxidant activity and vitamin C content. Table 2 shows the amounts of antioxidant activity (% inhibition) and vitamin C in each formula based on the findings of the titration analysis. The results of the % inhibition and titration analysis that showing the levels of vitamin C in each formula are shown in Table 2.

Table 2. Evaluation of Antioxidant Activity and Vitamin C Content Velva

Indicators	**Formulas**			**p**
	F1	**F2**	**F3**	
Antioxidant Activity (% inhibition)	17.31	23.66	21.48	0.0004
Vitamin C (%)	0.89	1.099	0.89	0.0008

The results showed a statistically significant difference in antioxidant activity and vitamin C content between the three Velva formulas ($p < 0.05$). Formula 2, which contains Chaya Leaf and honey pineapple in a 50:50 ratio, demonstrated the highest antioxidant activity with a percentage inhibition of 23.66%, compared to Formula 1 (17.31%) and Formula 3 (21.48%). The 23.66% inhibition percentage indicates that the active compound in Formula 2 could inhibit or reduce 23.66% of DPPH free radicals under the test conditions. Furthermore, Formula 2 also found the highest vitamin C content at a 1.099% level. These values are significantly higher than Formulas 1 and 3, which have the same vitamin C content of 0,879 % ($p < 0.05$).

4 Discussion

The results of the organoleptic evaluation showed that the proportion of raw materials had a significant effect on the level of panelist acceptance. F2, which contained 50% Chaya Leaf and 50% honey pineapple, consistently obtained the highest aroma, taste, texture, acidity, and overall assessment scores. This finding indicates that the balance between the taste of the Chaya Leaf and the fresh, sweet-sour taste of honey pineapple can produce the most harmonious sensory profile preferred by panelists. The green coloration of Chaya Leaf can be attributed to chlorophyll, rutin, quercetin, and kaempferol [11]. Adding honey pineapple to the velva formulation contributes to the sensory quality of the product, especially in terms of aroma and taste. Including honey pineapple in the velva formulation enhances the product's sensory qualities, particularly its flavor and taste. One factor contributing to this condition is the pineapple's volatile organic compounds (VOCs). Volatile substances like citric acid and esters are found in honey and pineapple. They are known to enhance tropical fruits' fresh flavor and aroma [12]. Meanwhile, storage at cold temperatures preserved volatile compounds and ascorbic acid content. George claimed that approximately around 480 volatile chemicals have been found in pineapple, but only roughly 40 of these molecules enhance the fruit's unique flavor and fragrance [13]. The presence of VOCs in the velva formulation, especially in F2, which contains 50% honey pineapple, facilitates the strengthening of the fresh and attractive taste associated with the product.

The evaluation showed that F2 produced the highest antioxidant activity compared to the other formulations. Based on DPPH free radical % inhibition data, F2 achieved an inhibition percentage of 23.66% which was higher than F1 (21.48%) and F3 (17.31%). This difference was statistically significant ($P < 0.05$) because it indicates that the raw materials composition significantly influences the Velva product's antioxidant capacity. The high antioxidant activity of Formula F2 originates from the synergistic interaction between the bioactive compounds in the Chaya Leaf and honey pineapple. Chaya Leaf are known to be rich in phenolic compounds and flavonoids [2], whereas pineapple contains vitamin C and the enzyme bromelain, which also have antioxidant properties [3]. A balanced combination of 50% of these two components is believed to have a synergistic effect in neutralizing free radicals. The interaction between vitamin C and flavonoids enhances their antioxidant potential because flavonoids can regenerate vitamin C from its oxidized form, thereby prolonging its antioxidant activity. Moreover, hydroxyl groups in flavonoids facilitate hydrogen transfer and boost their antioxidant power [14].

The evaluation also showed that Formula F2 produced the highest vitamin C content compared to the other two formulas. The combination of ingredients in this formula creates a balanced interaction, where the contribution of vitamin C in the honey pineapple can be optimized without experiencing excessive degradation during the processing. The high vitamin C content observed in Formula 2 is likely attributed to the interaction between the flavonoids in the Chaya Leaf and honey pineapple, along with the substantial vitamin C content of honey pineapple. This interaction may contribute to the delay of lipoprotein oxidation, indicating a complementary antioxidant function between flavonoids and vitamin C [4]. In contrast, Formula F1, which only uses Chaya Leaf, has a lower vitamin C content, although Chaya Leaf naturally contain vitamin C and other antioxidant compounds such as flavonoids. However, the vitamin C component of Chaya Leaf is likely less stable to temperature and oxidation during velva production. This phenomenon is possible because heat, light, and oxygen easily damage ascorbic acid, a water-soluble vitamin [14]. Meanwhile, Formula F3 (75% Chaya Leaf and 25% honey pineapple) showed vitamin C levels equivalent to Formula F1. This result indicates that adding pineapple in small amounts (25%) to the composition was not significant enough to increase the vitamin C content in the final product. The effectiveness of adding vitamin C-rich ingredients is highly dependent on the proportion and treatment during the production process. According to a previous study, vitamin C loss can occur up to 50% during food processing, primarily if the additives are not used sufficiently to withstand degradation [15].

5 Conclusion

Based on the results of this study, it can be concluded that the combination of Chaya Leaf and honey pineapple velva in Formula 2 is the best formulation. This formula has the highest vitamin C content of 1.099 % and obtains the highest score in the hedonic test compared to the average overall value of 7.11 (liked moderately). The panelists favored Formula 2 the most regarding its taste, texture, and acidity. The statistical analysis results showed that the differences between the formulations were significant ($P < 0.05$). The balanced combination of ingredients and proper processing are thought to contribute to the sensory quality, antioxidant activity, and vitamin C content of Formula 2.

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