

Sensory Profiling of Velva Made from Chaya Leaf (*Cnidoscolus aconitifolius*) and Pineapple (*Ananas comosus*)

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ABSTRACT

Background: The development of functional frozen desserts from plant-based ingredients has attracted increasing interest due to their potential health benefits and consumer acceptance. Chaya leaf (*Cnidoscolus aconitifolius*) is rich in bioactive compounds such as flavonoids and polyphenols that exhibit strong antioxidant activity, while pineapple (*Ananas comosus*) provides natural sweetness, vitamin C, and distinctive tropical flavor. This study aimed to evaluate the sensory profile of velva formulated from Chaya leaf and pineapple using the Quantitative Descriptive Analysis (QDA) method.

Methods: Three formulations were developed: F1 (50% Chaya leaf: 50% pineapple), F2 (75%: 25%), and F3 (100% Chaya leaf). Sensory evaluation was conducted by trained panelists assessing 19 attributes covering appearance, aroma, texture, taste, mouthfeel, and aftertaste using a 0–10 intensity scale.

Results: The results showed that all sensory attributes differed significantly among formulations ($p < 0.05$). F1 was characterized by dominant fruity, sweet, and sour notes, a more yellowish appearance, and a smoother texture. F2 exhibited an intermediate sensory profile, balancing both fruit- and leaf-derived characteristics. In contrast, F3 showed the highest intensity in green attributes, including green color, leafy aroma, fibrous texture, viscosity, and cohesiveness, but with reduced smoothness and the emergence of bitter taste and aftertaste. The fibrous mouthfeel increased with higher

proportions of Chaya leaf, while the itchy sensation decreased with lower pineapple content. Overall, increasing the proportion of Chaya leaf shifted the sensory profile from fruity-sweet to green, fibrous, and bitter characteristics.

Conclusion: F1 demonstrated a more generally acceptable sensory profile due to its familiar taste and aroma, whereas F3 showed potential as a functional product with distinctive sensory properties. These findings provide valuable insights for the development of plant-based velva products with balanced sensory attributes.

INTRODUCTION

Consumer demand for functional foods has increased significantly in recent years due to growing awareness of the relationship between diet and health. Functional foods not only provide basic nutrition but also contain bioactive compounds that offer physiological benefits and reduce the risk of chronic diseases¹. Among these products, plant-based frozen desserts have emerged as promising alternatives to conventional dairy frozen juice like sorbet or velva because they combine nutritional value, refreshing characteristics, and consumer acceptability².

Velva is a type of low-fat frozen dessert made primarily from fruit puree, water, sweeteners, and stabilizers^{3,4}. Compared to conventional ice cream, velva contains lower fat and higher natural antioxidants derived from fruit ingredients³. Therefore, velva has potential to be developed as a functional frozen product by incorporating plant materials rich in bioactive compounds. The quality of velva is generally evaluated based on several characteristics, including resistance to melting, uniform texture and appearance, appealing color, and a taste that corresponds to the fruit utilized as the primary raw material⁵.

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Chaya leaf (*Cnidoscolus aconitifolius*), also known as tree spinach, is a tropical leafy plant widely consumed in Central America countries such as Mexico and Brazil⁶. According to Jon Iannacone (2014), Chaya was introduced to Indonesia through the international Echo (Educational Concern for Hunger Organization) program to help improve family nutrition, especially in marginal lands in developing countries. The distribution of chaya in Indonesia began in 1998 with the distribution of chaya plant cuttings to 350 villages⁷. It is recognized for its high nutritional value and medicinal properties^{8,9}. Chaya leaf contains abundant phytochemicals such as flavonoids, phenolic acids, tannins, saponins, and alkaloids⁸. These compounds exhibit antioxidant¹⁰, anti-inflammatory¹¹, anti-diabetic effects¹², and cardioprotective activities¹³. The high antioxidant potential of chaya leaf makes it a promising ingredient for functional food fortification.

Pineapple (*Ananas comosus* var. Queen) is a tropical fruit favored for its natural sweetness, bright color, and refreshing flavor¹⁴. It is an excellent source of vitamin C¹⁵, bromelain enzyme¹⁶, and phenolic compounds¹⁷. Pineapple not only improves the sensory characteristics of food products but also enhances antioxidant capacity and nutritional quality.

The combination of chaya leaf and pineapple offers complementary benefits. Chaya leaves contribute functional bioactive compounds, including polyphenols¹⁸, which are known for their antioxidant properties^{13,19}, while pineapple improves palatability²⁰ and consumer acceptance^{14,21}. However, incorporation of leafy vegetables into frozen desserts may influence sensory characteristics, which is a critical determinant of product success. Therefore, evaluation of sensory attributes to determine the optimal formulation. In addition, this study also incorporated honey as a natural sweetener to improve the nutritional quality and sensory acceptance of the product. Honey is widely recognized as a natural sweetening agent that contains simple sugars, vitamins, minerals²², and antioxidant compounds^{23,24}, making it a healthier alternative to refined sugar. The addition of honey not only provides a natural sweetness but also contributes additional nutrients and bioactive compounds to the velva formulation. The results of the study indicate that the addition of honey to avocado velva significantly improved the product's quality. The formulation containing 30% honey yielded the best characteristics, as reflected by an overrun value of 18.39%, a melting time of 20.06 minutes, and antioxidant activity of 71.46%. Furthermore, organoleptic evaluation showed that this formulation exhibited a non-crystalline icy texture, along with flavor, texture, and overall acceptability that were moderately preferred by the panelists²⁵.

This study aimed to evaluate the sensory profile of velva formulated from Chaya leaf and pineapple using the Quantitative Descriptive Analysis (QDA) method.

METHODS

Design, Place and Time

The development of Chaya leaf combined with pineapple used an experimental design. Formula 1 included 50 grams chaya leaf and 50g pineapple. Formula 2 included 75g chaya leaf and 25 grams of pineapple, while Formula 3 included chaya leaf without the addition of pineapple. The additional ingredients used in the juice included 10 grams of honey. This research was conducted in January - June 2025. Analysis of The QDA (Quantitative Descriptive Analysis) was conducted in sensory evaluation Laboratory of the Nutrition Science Program, Department of Community Nutrition, IPB University, Bogor, Indonesia

Ingredients and Equipment

The ingredients used in the preparation of velva chaya leaf combined with pineapple include Sunpride brand pineapple (*Ananas comosus*), Chaya leaf (*Cnidoscolus aconitifolius*), and Honey (Rambutan Honey) which are mostly available in traditional markets. The equipment used in the research of Chaya leaf Combined with pineapple product development are digital scales, blender, stainless container and freezer.

The Development velva Chaya Leaf and Pineapple

The preparation of velva was initiated by separating chaya leaf from their stems, with only the leaf portions being utilized. The leaf were thoroughly washed under running water to remove adhering impurities, followed by boiling for 5 minutes to reduce antinutritional compounds²⁶. The treated leaf were then blended to obtain a smooth paste. Pineapple was peeled, washed, and cut into small pieces. The pineapple pieces were subjected to a blanching process by immersion in water at 40 °C for 4 minutes. This treatment was intended to inactivate enzymes such as polyphenol oxidase and peroxidase, which are responsible for undesirable changes in color, flavor, and texture during storage. Subsequently, the pineapple was blended with 47% water, 1% carboxymethyl cellulose (CMC) as a stabilizing agent, and 5% honey as a natural sweetener until a homogeneous mixture was achieved. The total final weight of each formulation was standardized at 212 g. The chaya leaf paste and pineapple mixture were then combined and homogenized according to the predetermined formulations (F1, F2, and F3). The final mixtures were poured into containers and frozen at -18 °C for 12-24 hours until a semi-solid velva texture was formed.

Procedure

The QDA (Quantitative Descriptive Analysis) procedure carried out in this study broadly consists of three stages: panelist preparation, stage, FGD and uantitative desceiptive test. Fresh chaya leaf were washed under running water and blanched at

100°C for 5 minutes to reduce anti-nutritional compounds. QDA was carried out on three velva product formulas, namely F1 (Chaya leaf combination with pineapple with a ratio of 50:50), F2 (75:25), F3(100:0). As many as eight trained panelists participated in the QDA test aged 20 – 35 years. Panelists were recruited based on experience conducting sensory tests and their interest, willingness, and accustoming to consuming herbal drinks or fruit juices. Panelists were trained, and products were evaluated using descriptive sensory analysis with the QDA method. The exclusion include smoker, pregnant and allergy, allergic to consuming herbs and fruits. The descriptive sensory test result data is presented in a standard radar graph.

Panelist Preparation

The eight trained panelists involved in this study were qualified by having attended and graduated from sensory attribute analysis training and certificates of completion as proof. They come from various backgrounds, including undergraduate and graduate students and alums of the Department of Community Nutrition and laboratory and academic staff of the Department of Community Nutrition. The number of panelists involved reached a number that was in line with the recommendations of Kemp et al. (2018) for the QDA test, which was 6 to 18 people.

FGD

FGD is a group discussion session conducted in a small scope for 1-2 hours with a moderator, which aims to get responses from panelists to the sensory properties of jelly drinks to be measured(27). Moderators and notulens are selected from the panelists to lead and direct the discussion process. The FGD began with the moderator delivering discussion topics related to the purpose of the research and a description of the product to be tested to equalize the panelists' perception of the product's sensory attributes in general. Next, the moderator guides each panelist to reveal the sensory properties of the formula and specific commercial products as much as possible. The sensory attributes assessed in this study consisted of 17 attributes. Reference to the sensory attributes of jelly drinks can be seen in Table 1.

QDA Test

100 ml of the product is presented in plastic cup packaging, randomly assigned a 3- digit numeric code, and stored at freeze temperature. In addition, drinking water, a container for spitting, tissues, and tongue cleaner (white bread) are also provided on a white plastic tray. Panelists are asked to fill in the sensory attribute column in the assessment sheet with all the attributes identified and agreed upon by the panelists in sensory evaluation Laboratory of the Nutrition Science Program, Department of Community Nutri-

tion, IPB University, Bogor, Indonesia. Next, panelists assigned scores based on the intensity of sensory attributes according to their perception, using a rating scale from 1 (extremely weak) to 10 (extremely strong) based on 22 with modification. The QDA test results are then tested differently and entered into a spider web diagram. The profile of sensory attributes of the jelly drink is divided into three groups, namely, group 1 (sensory attributes of appearance and texture), group 2 (sensory attributes of aroma), and group 3 (sensory attributes of taste, mouthfeel, and after-taste). The division is carried out to facilitate the reading of descriptive test results.

Data Analyzes

Analysis of organoleptic data on QDA using variety test (ANOVA). If there is a real effect between the three treatments and comparisons studied, the test is continued using Duncan's Multiple Range Test.

Results and Discussion

Quantitative Descriptive Analysis (QDA) is a sensory analysis method used to describe the characteristics and measure the intensity of a product's sensory attributes based on a single evaluation by trained panelists. This method identifies attributes such as appearance, aroma, taste, texture, *mouthfeel*, and *aftertaste* in a structured and quantitative manner using a scale of 0 to 10 for intensity ranging from very weak to very strong. Therefore, QDA is widely used to obtain a comprehensive picture of a product's sensory characteristics objectively and measurably²⁸. Table 2 shows the average ranking of the attributes of appearance, aroma, texture, taste, *mouthfeel*, and *aftertaste* of Velva products.

Based on Table 2, 19 sensory attributes of velva products were identified. The identified appearances of velva products were homogeneity, *greenness*, and *yellowness*. Meanwhile, the distinctive aromas that emerged from velva were the aroma of leaf, a *fruity pineapple aroma*, and a *sweet-like honey aroma*. The identified texture attributes were fibrous, viscosity, softness, and *cohesiveness*. Sour, sweet, *tart*, bitter, and pineapple flavors were also identified in velva products. The *mouthfeel* felt when consuming velva products was fibrous and *itchy*. The *aftertaste* felt after consuming velva products was bitter and sour. The results of the ANOVA test showed that all attributes had significantly different sensory values ($p < 0.05$).

Spider web graph is used to interpret QDA results. Through the *spider web form*, the entire sensory attribute profile can be seen comprehensively and facilitates comparison between attributes²⁷. Each attribute is represented by a straight line in the graph, while the sample intensity values are indicated by dots on each attribute which are then connected to form a pattern. In addition, the *spider*

Table 1. Sensory attribute references

Attribute	Definition	Reference
Appearance		
Homogeneity	The level of uniformity of velva is characterized by the absence of coarse particles from Chaya leaf.	Strong: no coarse leaf grains/particles.Weak: there are many leaf grains/particles.
Greenness	The intensity of the green color comes from Chaya leaf extract.	Strong: dark green color (dominant leaf extract)Weak: very pale/almost invisible green color
Yellowness	The intensity of the yellow color comes from pineapple.	Strong: dominant bright yellow color (tall pineapple)Weak: very pale yellow color
Aroma		
Leaf aroma (<i>green</i>)	Typical leafy and slightly "green/grassy" aroma	Strong: 10 g leaf + 30 ml waterWeak: 2 g leaf + 30 ml water
Pineapple aroma (<i>fruity</i>)	The distinctive aroma of pineapple is fresh, sweet, and slightly sour.	Strong: 100% pineapple juiceWeak: diluted pineapple juice (20% juice + water)
Honey aroma (<i>sweet-like</i> aroma)	The sweet aroma of honey.	Strong: pure honeyWeak: dilute honey solution (10% honey in water)
Texture		
Fibrous	The presence and intensity of leaf fibers that are felt when touched.	Strong: feel the coarse grains/particles of the leaf.Weak: no leaf grains/particles can be felt.
Viscosity	Viscosity level (flow rate when tilted/poured)	Strong: very thick, difficult to flowWeak: very liquid, flows easily
Softness	The degree of softness of the velva structure when pressed or scooped.	Strong: very soft, easy to pressWeak: hard/rough
Cohesiveness	Velva's ability to remain united and not easily break when pressure is applied.	Strong: compact and unified structureWeak: easily destroyed/separated
Flavor		
Sour	Velva with sour taste	Strong: 0.12% citric acid – waterWeak: 0.03% citric acid – water
Sweet	Velva with a sweet taste resembling sugar (sucrose)	Strong: 8% sucrose – waterWeak: 2% sucrose – water
Astringency	A stinging/abrasive sensation in the mouth	Strong: 10 g leaf + 30 ml waterWeak: 1 g leaf + 30 ml water
Bitter	Velva with a bitter taste	Strong: 0.03% caffeine – waterWeak: 0.12% caffeine – water
Pineapple	The distinctive taste of pineapple is sweet-sour and fresh.	Strong: 100% pineapple juiceWeak: diluted pineapple juice (520% juice + water)
Mouthfeel		
Fibrous	The sensation of fiber from leaf particles that is felt in the mouth when chewed or swallowed.	Strong: 10 g leaf + 30 ml waterWeak: 1 g leaf + 30 ml water
Itchy	A mild itching or irritation sensation in the throat.	Strong: 100% pineapple juiceWeak: diluted pineapple juice (520% juice + water)
Aftertaste		
Bitter	A bitter taste remains in the mouth after the product is swallowed.	Strong: 0.03% caffeine – waterWeak: 0.12% caffeine – water
Sour	A sour taste remains after the product is swallowed.	Strong: 0.12% citric acid – waterWeak: 0.03% citric acid – water

Table 2. Average ratings of the attributes of appearance, aroma, texture, taste, mouthfeel, and aftertaste

Attribute	Average rating			<i>p-value</i>
	F1 (50% CL, 50% PN)	F2 (75% CL, 25% PN)	F3 (100% CL)	
Appearance				
Homogeneity	6.38 ± 0.58 ^b	5.20 ± 0.30 ^a	6.56 ± 0.53 ^b	0,001*
Greenness	3.76 ± 0.43 ^a	6.29 ± 0.37 ^b	8.69 ± 0.43 ^c	0,001*
Yellowness	4.24 ± 0.35 ^a	2.30 ± 0.43 ^b	0.00 ± 0.00 ^c	0,001*
Aroma				
Leaf aroma (<i>green</i>)	0.28 ± 0.44 ^a	1.37 ± 0.46 ^b	5.72 ± 0.44 ^c	0,001*
Pineapple aroma (<i>fruity</i>)	6.68 ± 0.43 ^c	3.49 ± 0.63 ^b	0.00 ± 0.00 ^a	0,001*
Honey aroma (<i>sweet-like</i> aroma)	3.50 ± 0.50 ^c	2.73 ± 0.44 ^b	0.86 ± 0.30 ^a	0,001*
Texture				
Fibrous	1.30 ± 0.43 ^a	2.62 ± 0.41 ^b	3.69 ± 0.43 ^c	0,001*
Viscosity	2.59 ± 0.47 ^a	3.29 ± 0.45 ^b	5.64 ± 0.49 ^c	0,001*
Softness	4.84 ± 0.34 ^c	3.58 ± 0.46 ^b	2.46 ± 0.47 ^a	0,001*
Cohesiveness	5.37 ± 0.45 ^a	5.09 ± 0.35 ^a	7.67 ± 0.43 ^b	0,001*
Flavor				
Sour	1.78 ± 0.97 ^b	1.89 ± 1.43 ^b	0.00 ± 0.00 ^a	0,001*
Sweet	3.58 ± 0.50 ^b	2.89 ± 0.33 ^a	2.48 ± 0.48 ^a	0,001*
Astringency	0.00 ± 0.00 ^a	1.81 ± 0.35 ^b	3.83 ± 0.35 ^c	0,001*
Bitter	0.00 ± 0.00 ^a	0.00 ± 0.00 ^a	0.94 ± 0.63 ^b	0,001*
Pineapple	4.94 ± 0.17 ^c	2.56 ± 0.46 ^b	0.00 ± 0.00 ^a	0,001*
Mouthfeel				
Fibrous	2.72 ± 0.44 ^a	5.11 ± 0.33 ^b	6.13 ± 0.38 ^c	0,001*
Itchy	1.06 ± 0.39 ^c	0.72 ± 0.36 ^b	0.00 ± 0.00 ^a	0,001*
Aftertaste				
Bitter	0.00 ± 0.00 ^a	0.00 ± 0.00 ^a	1.30 ± 0.43 ^b	0,001*
Sour	1.80 ± 0.31 ^c	1.00 ± 0.00 ^b	0.00 ± 0.00 ^a	0,001*

DJP=Chaya leaf; PN=Pineapple.

 *The results of the one-way ANOVA test showed a significant difference ($p < 0.05$). 'ns' indicates no significant difference.

web graph can also be used to identify sample profiles that are different or deviate significantly compared to other samples. The results of all panelists' assessments are processed and presented in the form of a spider web to compare the intensity of each attribute in the Velva product, which can be seen in Figures 1, 2, 3, and 4.

The spider web visualization in Figure 1, it can be seen that each formulation has a significantly different profile ($p < 0.05$) and is in contrast to each other in several key parameters. F3 (100% Chaya leaf) dominates the greenness attribute with the highest intensity with a value of 8.69 ± 0.43 indicating a very strong green color character, followed by

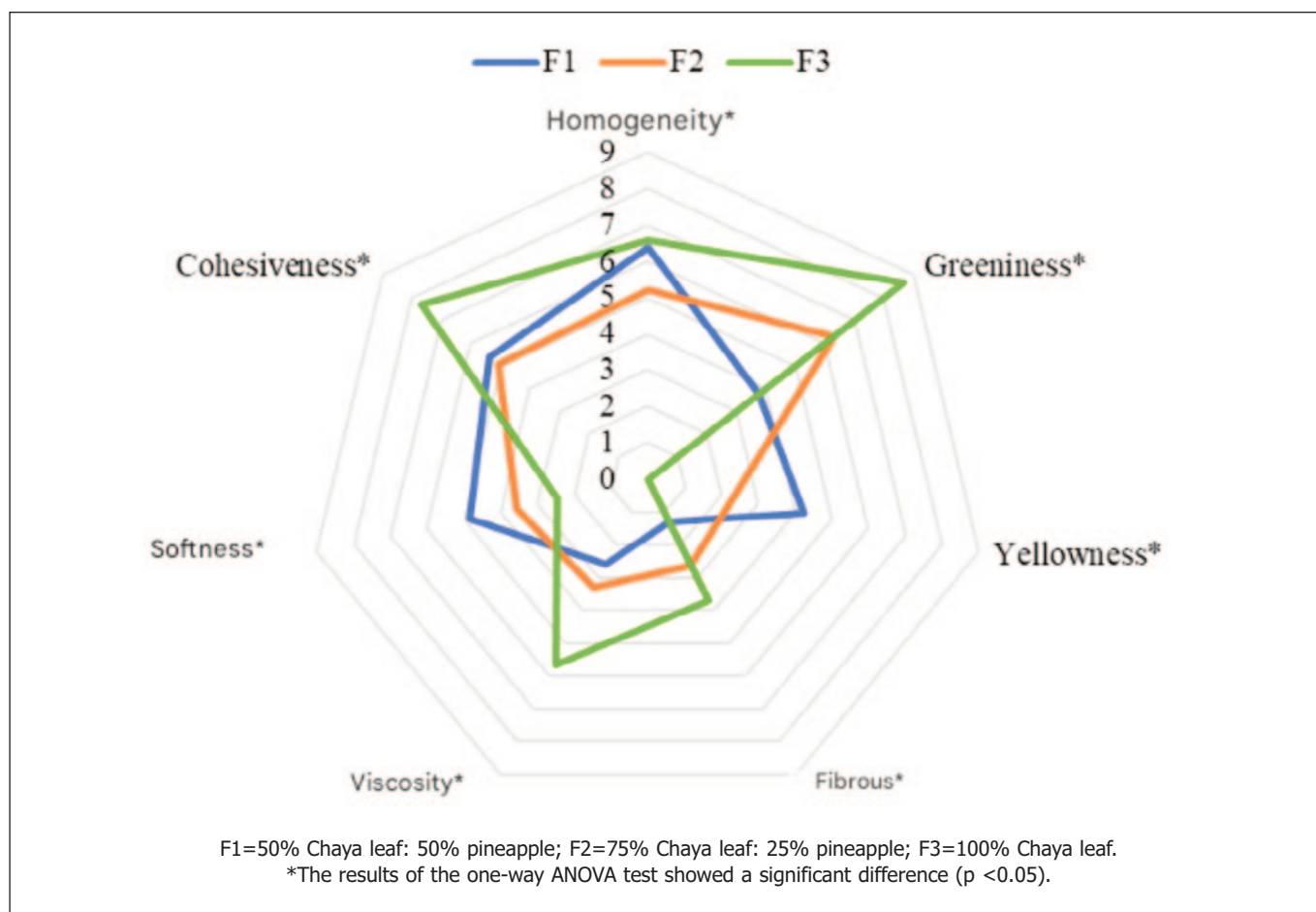


Figure 1. Profile of appearance and texture attributes of velva

F2 (6.29 ± 0.37) then F1 (3.76 ± 0.43). Conversely, the *yellowness* attribute is highest in F1 (50% Chaya leaf: 50% pineapple) with a value of 4.24 ± 0.35 and decreases drastically to undetectable in F3, reflecting the yellow color contribution from pineapple. In the homogeneity attribute, F1 and F3 appear to have relatively high and almost similar values, while F2 is lower. The low homogeneity value in F2 is thought to be influenced by the color contrast between the yellow component of pineapple and the green particles from Chaya leaf, so that the particle distribution appears clearer to the panelists. In contrast, in F3, the dominance of green color causes leaf particles to tend to be camouflaged, so that the product is perceived as more homogeneous (*camouflage effect*)²⁹.

In terms of texture attributes, the *spider web pattern* indicates that F3 has the strongest and most intense texture character compared to other formulations. This is evident from the high values of fibrousness (3.69 ± 0.43), viscosity (5.64 ± 0.49), and *cohesiveness* (7.67 ± 0.43) in F3, which form the largest area of the graph for all three attributes. In contrast, the softness attribute shows the opposite trend,

where F1 (4.84 ± 0.34) has the highest value, followed by F2 (3.58 ± 0.46), and the lowest in F3 (2.46 ± 0.47). F2 generally falls between F1 and F3 for most texture attributes, indicating an intermediate nature. In general, this visualization confirms that increasing the concentration of Chaya leaf results in a thicker, fibrous, and compact texture, but reduces the level of softness of the product. This increase in texture, resulting in a thicker, fibrous, and compact texture, can be explained by the high dietary fiber content in Chaya leaf. Fiber, particularly insoluble fiber, also provides a mechanical sensation of roughness, stringiness, and more pronounced particles. High-fiber foods tend to increase the perception of fibrous texture and viscosity⁶.

Based on the *spider web* on the aroma attributes presented in Figure 2, there are significant differences ($p < 0.05$) in the profiles that are very clear between the formulations, especially in the dominance of certain aroma characters. F1 shows the highest intensity of pineapple aroma (*fruity*) with a value of 6.68 ± 0.43 , followed by F2 (3.49 ± 0.63), while F3 does not show any pineapple aroma. In contrast, the aroma of leaf (*green*) increases

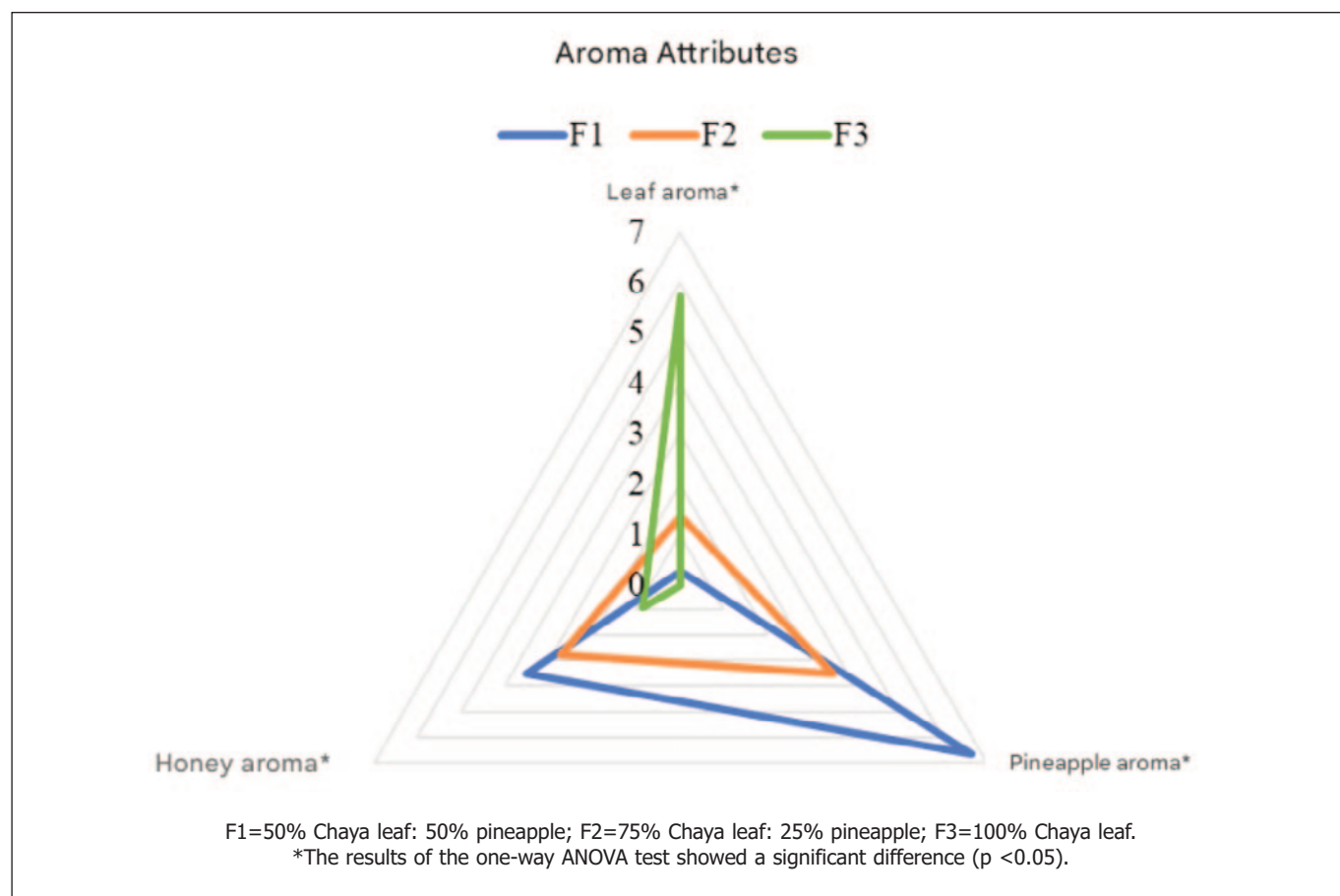


Figure 2. Velva aroma attribute profile

with the increase in the proportion of Chaya leaf, with the highest value in F3 at 5.72 ± 0.44 , then F2 (1.37 ± 0.46), and the lowest in F1 (0.28 ± 0.44). This indicates a shift in aroma character from *fruity* to *green* as the concentration of leaf material increases. In the honey aroma attribute (*sweet-like* aroma), the visible pattern tends to decrease from F1 to F3, where F1 has the highest intensity of 3.50 ± 0.50 , followed by F2 at 2.73 ± 0.44 , and the lowest in F3 with a value of 0.86 ± 0.30 . The high intensity of pineapple aroma (*fruity*) in F1 is thought to originate from the content of volatile compounds, especially esters such as *ethyl butanoate* and *ethyl hexanoate*, which are known to contribute to the sweet and distinctive aroma of pineapple³⁰. Overall, the graph shows that F1 is dominated by sweet and *fruity* aromas, F2 has a more balanced aroma profile (*intermediate*), while F3 is strongly dominated by green aromas with a significant decrease in sweet and *fruity* aromas. This pattern indicates that increasing the proportion of Chaya leaf directly affects the intensity and character of the overall product aroma.

The spider web visualization of the taste attributes shown in Figure 3, it can be seen that each formulation has a significantly different taste character ($p < 0.05$) and is opposite to

each other in several main attributes. F1 (50% Chaya leaf: 50% pineapple) is dominated by pineapple flavor (4.94 ± 0.17) and sweet (3.58 ± 0.50), with the highest intensity compared to other formulations. In addition, F1 also still has a sour taste character (1.78 ± 0.97), but does not show a bitter or *tart* taste. This shows that the contribution of pineapple provides a fresher taste profile (*fruity* pineapple and sour) and sweet, which tends to be preferred. In F2 (75% Chaya leaf: 25% pineapple), the flavor profile began to shift to become more complex with the emergence of the *cerassy attribute*, while the intensity of pineapple flavor (2.56 ± 0.46) and sweet (2.89 ± 0.33) in F2 was lower than F1. The sour taste was still detected in F2 but was not significantly different from F1 with almost the same value of 1.89 ± 1.43 , and the bitter taste had not yet appeared. Meanwhile, F3 (100% Chaya leaf) showed the most different flavor character, marked by the dominance of the *cerassy attribute* (3.83 ± 0.35) and the beginning of the bitter taste (0.94 ± 0.63), the presence of sweetness (2.48 ± 0.48), and the absence of pineapple and sour taste. The intensity of the sweet taste in F3 was lower than F1. Overall, increasing the proportion of Chaya leaf resulted in a shift in the flavor profile from predominantly sweet

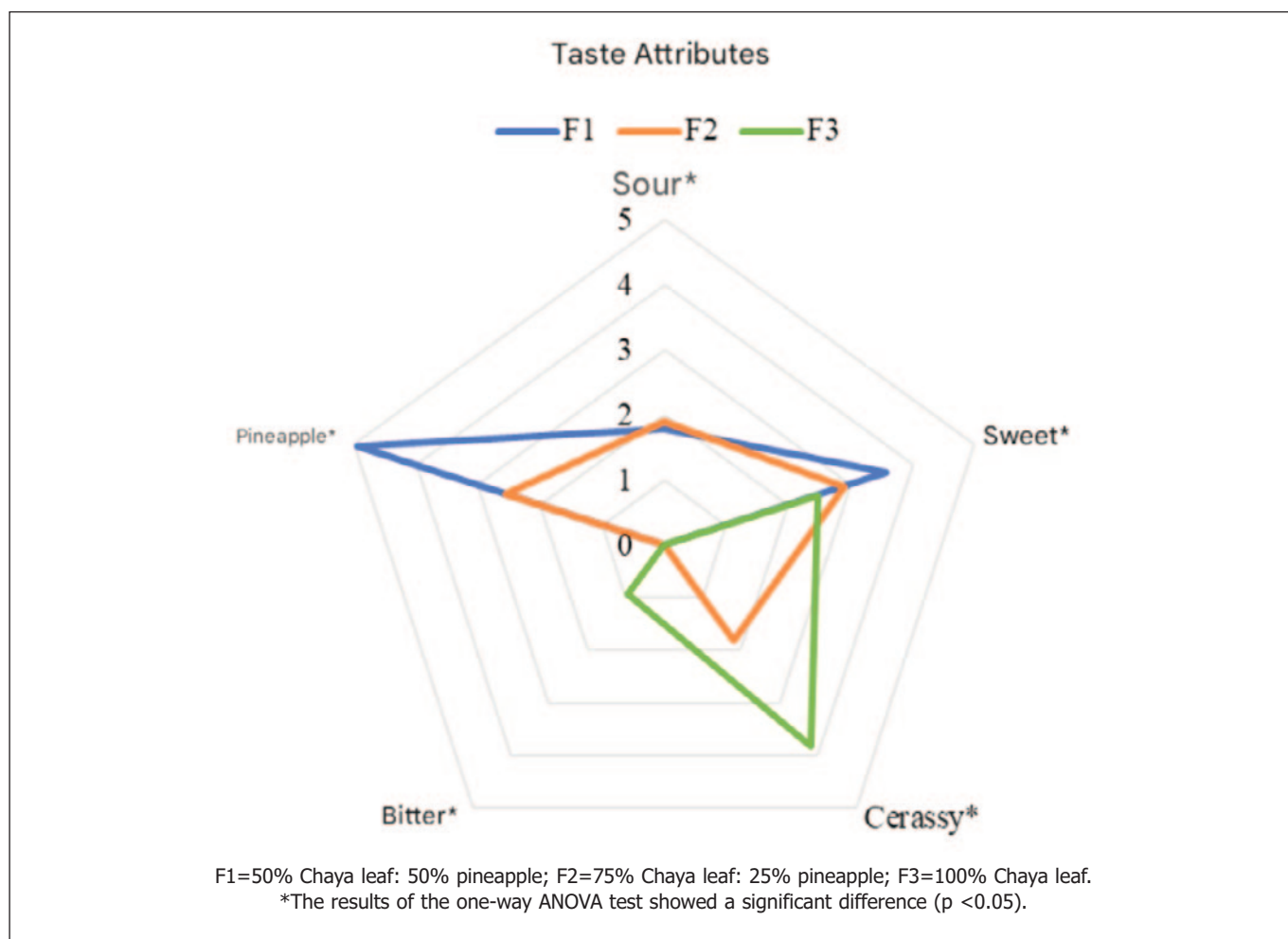


Figure 3. Velva flavor/taste attribute profile

and *fruity* to more leafy flavors, such as *tartness* and *bitterness*. The presence of bitter and *tartness* attributes in formulations with a higher proportion of Chaya leaf is related to the phytochemical compounds such as flavonoids, alkaloids, tannins, and polyphenols contained in Chaya leaf. These compounds are known to contribute to the bitter taste and the characteristic *green/herbaceous taste of the leaf*. Both flavors are present but not too sharp, sensorially, they can be said to be almost similar to the taste of spinach, which has a more neutral taste when compared to regular chaya leaf⁶.

In the *mouthfeel* attribute, all parameters showed significant differences between formulations ($p < 0.05$) as shown in Figure 4. The fibrous *mouthfeel* attribute showed an increase in intensity along with the increasing proportion of Chaya leaf, with the lowest value in F1 (2.72 ± 0.44), increasing in F2 (5.11 ± 0.33), and the highest in F3 (6.13 ± 0.38). This indicates that the fiber content of Chaya leaf provides a more pronounced fiber sensation when consumed. Conversely, the *itchy* attribute showed a decreasing trend from

F1 (1.06 ± 0.39), F2 (0.72 ± 0.36), until it was undetectable in F3 (0.00 ± 0.00). Meanwhile, the decrease in *itchy sensation* from F1 to F3 is thought to be related to the presence of the bromelain enzyme in pineapple. Bromelain is a proteolytic enzyme that can cause a mild irritation or “itching” sensation in the oral mucosa, especially at certain concentrations. The higher the proportion of pineapple (F1), the greater the potential for an *itchy sensation*. This is supported by research showing that bromelain can affect the protein network in the mucosa, causing a mild discomfort in the oral cavity¹⁷.

In the *aftertaste* attribute, there was also a significant difference between formulations ($p < 0.05$). The bitter *aftertaste* attribute was only detected in F3 (1.30 ± 0.43), while it was not detected in F1 and F2. This indicates that the high concentration of Chaya leaf has a continued effect in the form of a bitter taste after consumption, which is thought to originate from phenolic compounds and tannins (6). Meanwhile, the sour *aftertaste* attribute showed a significant decreasing trend from F1 (1.80 ± 0.31), F2 (1.00 ± 0.00), until it was not

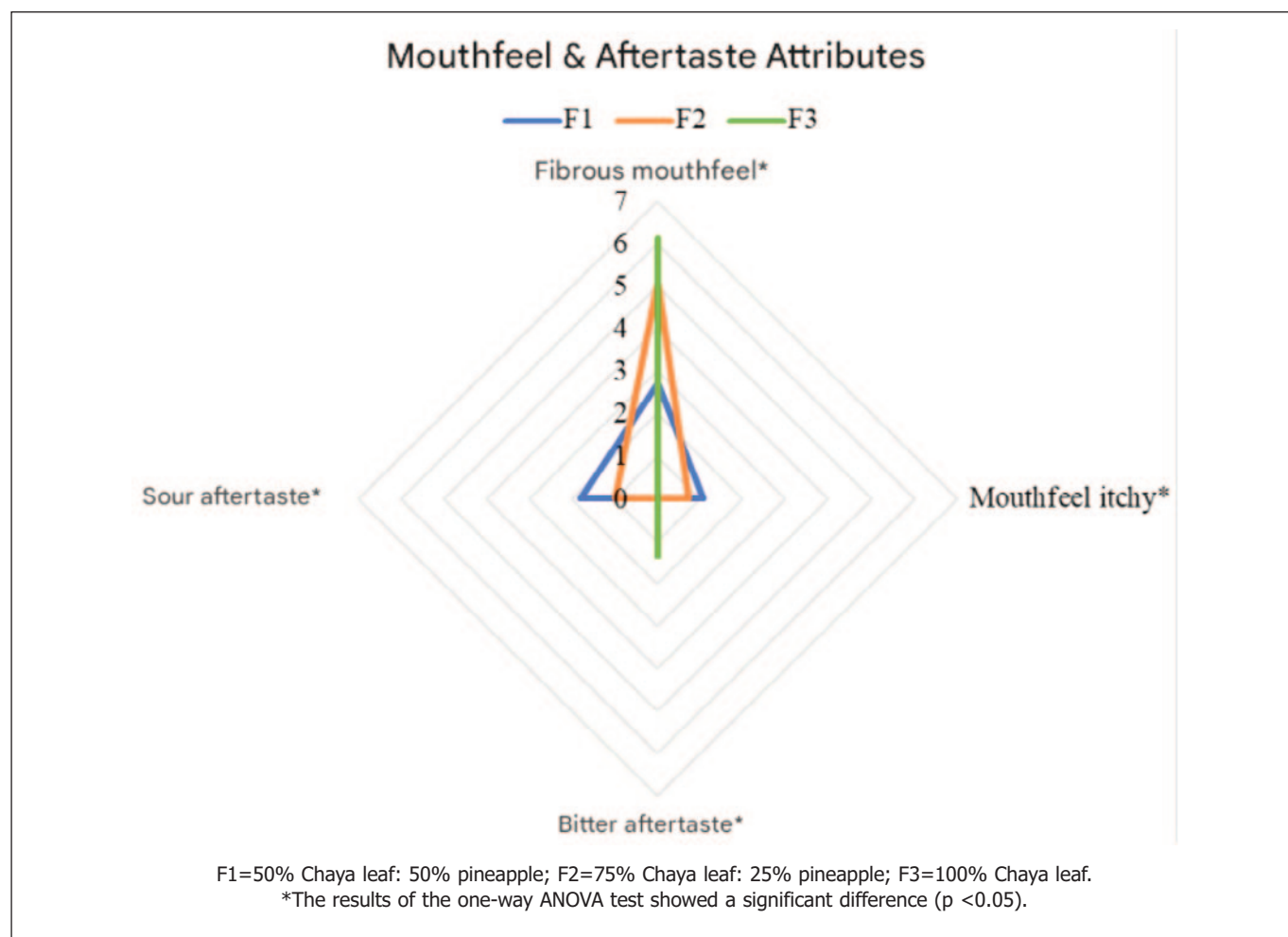


Figure 4. Mouthfeel and aftertaste attribute profile of Velva

detected in F3 (0.00 ± 0.00). This pattern is in line with the decreasing contribution of pineapple in the formulation, which is the main source of sour taste. Overall, increasing the proportion of Chaya leaf resulted in a more fibrous mouthfeel and reduced the itchy sensation, as well as introducing a bitter aftertaste and reducing the sour aftertaste.

CONCLUSION

The sensory profile of velva was strongly influenced by the proportion of chaya leaf and pineapple. The QDA method successfully identified 19 sensory attributes, all of which showed significant differences among formulations. Increasing the proportion of chaya leaf enhanced green color, leafy aroma, fibrous texture, viscosity, cohesiveness, and contributed to the emergence of bitter taste and aftertaste, while reducing smoothness, sweetness, fruity, and sour characteristics. Conversely, higher pineapple content contributed to a more yellowish color, fruity aroma, sweet and sour taste, and smoother texture. F1 produced the most balanced and gen-

erally acceptable sensory profile, while F3 exhibited the strongest but less familiar characteristics. Therefore, a combined formulation of chaya leaf and pineapple offers an effective strategy for achieving a well-balanced sensory profile in velva products. Furthermore, these findings highlight significant implications for the food industry, particularly in advancing the development of functional foods derived from natural ingredients.

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