Sensory profile of five superior salak varieties in Indonesia

[Profil sensori lima varietas salak unggul di Indonesia]

Lerissa Aulia Siregar[1] , Dede Robiatul Adawiyah[2*], dan Dase Hunaefi[2]

[1] Program Studi Ilmu Pangan, Sekolah Pascasarjana IPB University, Bogor, Indonesia, 16680

[2] Departemen Ilmu dan Teknologi Pangan, Fakultas Teknologi Pertanian, IPB University, Bogor, Indonesia 16680

* Correspondence Email : dede_adawiyah@apps.iob.ac.id

ABSTRACT

Salak (Salacca zalacca) is a tropical fruit widely consumed in Indonesia. The fruit has scaly skin resembling snake scales, often referred to as snake fruit. This study aimed to describe consumer preferences through the sensory characterization of five superior salak varieties: Madu, Pondoh, Gading, Gula Pasir, and Sidempuan, using the Rate-All-That-Apply (RATA) sensory method and a hedonic rating test. The results showed that salak Madu was characterized by sweet, salak ID (typical salak aroma), juiciness, and mealy attributes. Salak Pondoh was described as sweet, fruity, floral/perfumy, and cohesive of mass. Salak Gula Pasir had sensory attributes such as crispness, firmness, chemical, and grittiness. Meanwhile, salak Gading and Sidempuan shared similar sensory profiles, including green, starchy, peel-like, fermented, sour, bitter, and astringent attributes. Salak Madu received the highest preference level, presumably due to its dominant sweet taste. Conversely, salak Sidempuan and Gading showed lower acceptance levels because of their high sourness and astringency intensities. Overall, varieties with sweet taste profiles, such as Madu, Pondoh, and Gula Pasir, aligned better with panelists' preferences than those with dominant sour and astringent characteristics, such as Gading and Sidempuan. These findings have important implications for product development and marketing strategies, particularly in selecting salak varieties that meet consumer preferences for fresh consumption and differentiation in processed products.

Keywords: consumer preference, hedonic rating, RATA, snake fruit, sensory evaluation

ABSTRAK

Salak (*Salacca zalacca*) adalah buah tropis yang banyak dikonsumsi di Indonesia. Buah ini memiliki kulit bersisik menyerupai kulit ular, sehingga sering disebut sebagai *snake fruit*. Penelitian ini bertujuan untuk menggambarkan preferensi konsumen melalui karakterisasi sensori terhadap lima varietas salak unggul, yaitu Madu, Pondoh, Gading, Gula Pasir, dan Sidempuan, menggunakan metode sensori *Rate-All-That-Apply* (RATA) dan uji rating hedonik. Hasil penelitian menunjukkan bahwa salak Madu memiliki profil sensori *sweet*, salak ID (aroma khas salak), *juiciness*, dan *mealy*. Salak Pondoh memiliki profil sensori *sweet*, *fruity*, *floral/perfumy*, dan *cohesiveness of mass*. Salak Gula Pasir memiliki profil sensori *crispness*, *firmness*, *chemical*, dan *grittiness*. Sedangkan Salak Gading dan Sidempuan memiliki profil sensori yang sama yaitu *green*, *starchy*, *peel-like*, *fermented*, *sour*, *bitter*, dan *astringent*. Salak Madu memperoleh tingkat kesukaan tertinggi, diduga karena rasa manisnya yang dominan. Sebaliknya, Salak Sidempuan dan Gading menunjukkan tingkat penerimaan yang lebih rendah karena intensitas rasa asam dan sepat yang tinggi. Secara keseluruhan, varietas dengan profil rasa manis seperti Madu, Pondoh, dan Gula Pasir lebih sesuai dengan preferensi panelis dibandingkan dengan varietas yang memiliki karakteristik rasa asam dan sepat yang dominan seperti Gading dan Sidempuan. Temuan ini memiliki implikasi penting bagi pengembangan produk dan strategi pemasaran, terutama dalam pemilihan varietas salak yang sesuai dengan preferensi konsumen baik untuk konsumsi segar maupun sebagai dasar diferensiasi produk olahan.

Kata kunci: evaluasi sensori, preferensi konsumen, RATA, rating hedonik, salak,

Introduction

Salak (*Salacca zalacca*) is a widespread plant in Southeast Asia and has long been cultivated and widely consumed in Indonesia. Salak has skin that resembles snake scales, so it is often referred to as snake fruit. In Indonesia, several regions have developed into major production centers for salak fruit, including Central Java, Bali, South Sulawesi, Yogyakarta, and North Sumatra (Handaru et al., 2024). Each of these regions produces salak varieties with diverse morphological and sensory characteristics. Salak has white and dense flesh, and a sweet, slightly sour, and astringent taste.

The fruit also has abundant nutritional content, such as vitamins, minerals, dietary fiber, and bioactive compounds that contribute to antioxidant activity (Boukaew et al., 2025). In Indonesia, there are five types of superior salak varieties: salak Pondoh, salak Madu, salak Gading, salak Gula Pasir, and salak Sidempuan. Salak Pondoh, salak Gading, and salak Madu varieties originate from Sleman, Daerah Istimewa Yogyakarta. The Gula Pasir salak variety comes from Karangasem, Bali, and the Sidempuan salak variety comes from Padang Sidempuan, North Sumatra (Pusat Data dan Sistem Informasi Pertanian, 2020). These varieties are widely distributed in the Indonesian market, but not all varieties are in demand or even known by consumers in Indonesia.

Sensory evaluation can be carried out by analyzing the sensory profile of the salak fruit to determine consumer acceptance of it. Sensory evaluation is a scientific method used to assess human response to a product through the senses of sight, smell, taste, and hearing (Shah et al., 2022). Sensory evaluation can be an important quality parameter because it determines the level of product acceptance by consumers. Sensory evaluation is conducted to evaluate the production process, assess the quality of the final product, and support product development (Afifah & Adi, 2024).

A quick and effective method is needed to obtain an accurate picture of the product profile to identify the sensory attributes that contribute to the distinctive characteristics of each salak variety. One method that can be applied is Rate-All-That-Apply (RATA), a modified version of the Check-All-That-Apply (CATA) method. In this method, participants select the appropriate term for the sample being tested from a list provided, then rate the term's intensity or degree of relatedness (Ares et al., 2014; Jariyah et al., 2024). The RATA method is considered advantageous because the CATA method only captures the presence or absence of attributes, making it less effective in differentiating products that share similar sensory profiles but vary in the intensity of those attributes. By adding an intensity dimension, RATA provides more sensitive and discriminative data while remaining time and cost-efficient. This advantage has led to its wide application in sensory profile characterization of various products, such as Italian wine (Rabitti et al., 2022), robusta coffee (Belgis et al., 2023), and pastry-based processed products such as nastar (Munarko et al., 2023) and non-wheat flour-based biscuits (Jariyah et al., 2024). In the case of salak fruit, which exhibits substantial variability in sweetness, aroma, and texture among its varieties, RATA is particularly relevant as it can capture nuanced intensity differences that reflect the fruit's unique sensory complexity.

Consumers usually choose based on price, appearance, and freshness when purchasing fruit. These characteristics are considered important indicators for assessing fruit quality. However, subsequent purchase decisions depend on satisfaction with the flavor and texture of the fresh produce. Nowadays, consumers are also increasingly concerned about products' nutritional value and safety. Based on the available information, no research addresses the sensory profile of salak fruit. Therefore, research is needed to describe consumer preferences through sensory characterization of salak.

Materials and methods

Materials and tools

The materials used in this study were salak fruits from five different varieties, namely salak Pondoh, salak Gading, salak Madu, salak Gula Pasir, and salak Sidempuan. Salak Pondoh, salak Gading, and salak Madu

were obtained from Turi-Tempel Street, RT 03/RW 26, Dedapan, Wonokerto Village, Turi Subdistrict, Sleman Regency, Special Region of Yogyakarta (55551). Salak Gula Pasir was obtained from Kesatrian Street, Karangasem Village, Karangasem Subdistrict, Karangasem Regency, Bali Province (80811), and salak Sidempuan was obtained from Merdeka Street, Padangsidimpuan Utara Subdistrict, Padang sidimpuan City, North Sumatra Province (22711). Besides salak fruit, mineral water was also used in this study as a neutralizer. The tools used in this study were plastic plates, small cutlery, questionnaires, and pens.

Research method

This research was conducted in several stages, including making a preliminary questionnaire, testing the questionnaire with validity and reliability tests, recruiting assessors, FGD, and sensory analysis with the RATA method and hedonic rating. Sensory testing was carried out based on the results of ethical review No.1679/IT3.KEPMSM-IPB/SK/2025 by the Ethics Commission for Research Involving Human Subjects (KEPMSM-IPB). The target group was the general population. The number of assessors was determined based on SNI (BSN, 2006). The assessor selected was a non-standard (untrained) assessor who knew salak fruit and had consumed salak fruit. All assessors were recruited from IPB University. Sensory testing was carried out using the laboratory test method, in which assessors who had filled out and agreed to the informed consent (test involvement willingness form) were invited to the Sensory Evaluation Laboratory. RATA and hedonic rating sensory data analysis were processed using Microsoft Excel 2020, IBM SPSS® version 22 software with Kruskal-Wallis tools and Dunn test, and XLSTAT 2025 with RATA and liking data analysis tools.

Sample preparation

Sample preparation begins with a sorting process to separate damaged fruit. Next, the fruit was cleaned to remove dust and dirt still attached to the fruit skin. The fruit was stored overnight at room temperature before being used in the test. The fruit was peeled from the skin and one fruit was taken to be used in sensory testing, and a 3-digit random code was given. Samples were presented side by side (Lawless and Heyman, 2010) and mineral water was provided to neutralize the taste buds during the test.

Figure 1: Samples of five salak varieties.

| A | B | C | D | E |
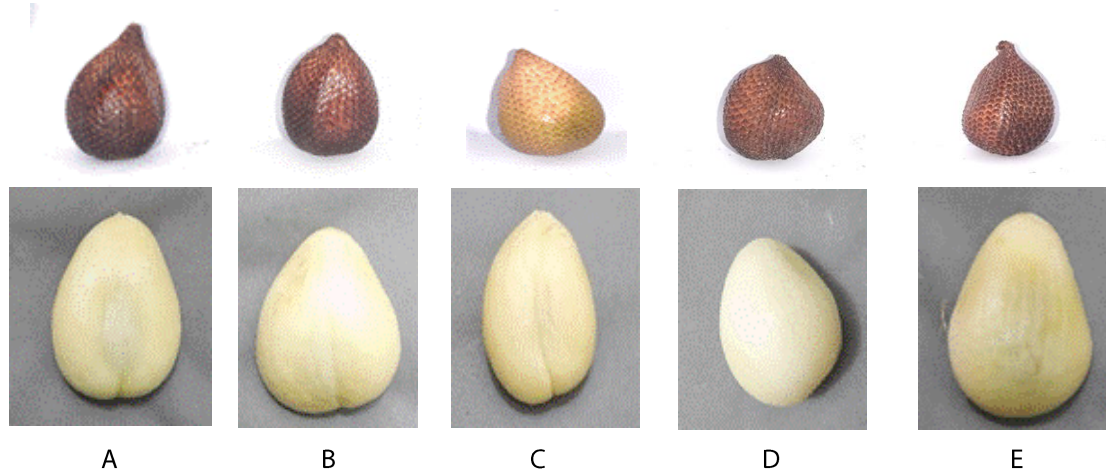
Description: Salak Madu (A), Salak Pondoh (B), Salak Gading (C), Salak Gula Pasir (D), Salak Sidempuan (E).

Focus group discussion (FGD)

The FGD was conducted offline with 12 untrained assessors recruited from IPB University students who had experience consuming snake fruit and were therefore familiar with its sensory characteristics. The use of these untrained assessors was intended to approximate actual consumer perceptions. The FGD lasted approximately 45 minutes and was conducted in the Sensory Evaluation Laboratory of IPB University. At the beginning of the session, the researcher explained the objectives of the activity and provided theoretical definitions of the sensory attributes. The assessors then tasted the product, recorded the

presence or absence of each attribute, and participated in a group discussion. The discussion was documented through written notes, and its results were used to establish the final list of attributes for the RATA test.

Sensory testing with RATA method and hedonic rating.

The sensory evaluation employed the RATA method with the participation of 30 assessors. Each assessor evaluated five samples, and during the session, they completed RATA questionnaires consisting of a list of sensory attributes used to describe the sensory profile of each sample. Assessors marked the attributes they perceived as present and rated the intensity of each attribute on a five-point scale (1 = very weak to 5 = very strong). Attributes that were not perceived were left unmarked. In addition, assessors provided a liking score for each sample using a six-point scale: (1) Strongly dislike; (2) Dislike; (3) Neutral; (4) Somewhat like; (5) Like; and (6) Strongly like.

Data analysis

RATA and hedonic rating data were analyzed using IBM SPSS® version 22, XLSTAT 2025, and Microsoft Excel 2020 software. In IBM SPSS® version 22, Kruskal-Wallis analysis was conducted, followed by Dunn's further test at 5% significance level (Jariyah et al., 2024). For RATA data, the analysis was conducted using the RATA Tools feature in XLSTAT 2025. Data visualization was carried out through several methods, namely significance test tables, spider web graphs created using Microsoft Excel 2019 to represent the overall sensory profile and allow comparison between attributes, and biplot graphs from Principal Component Analysis (PCA) to illustrate the overall relationship between attributes (Munarko et al., 2023). Meanwhile, for hedonic rating data analysis, the Liking Data Analysis feature in XLSTAT 2025 was used. The results of the analysis were then visualized in the form of a significance test table and a boxplot graph illustrating the distribution of the liking value of each salak variety based on the assessor's assessment.

Results and discussion

Results of FGD

The FGD stage is part of the RATA) testing process to explore and identify sensory attributes contained in the sample. The attributes obtained from the FGD results were then used as the basis for the preparation of the RATA test questionnaire. The FGD resulted in 12 flavor attributes, namely, Salak ID, fruity, fermented, floral/perfumy, peel-like, green, starchy, chemical, sweet, sour, bitter, and astringent, and six texture attributes, namely, firmness, cohesiveness of mass, mealy, crispness, juiciness, and grittiness. The list of sensory attributes obtained from the FGD stage is shown in Table 1.

Table 1. Result of FGD

No	Attributes	Definition
	Flavor	
1	Salak ID	Sweet fruit flavors associated with salak
2	Fruity	A combination of flavors that are sweet and reminiscent of different fruits
3	Fermented	Combination of sweet, slightly brown, overripe and slightly sour flavors
4	Floral/perfumy	A sweet and strong blend of flavors from a combination of slightly chemical and perfume-like flowers
5	Peel-like	Slightly sharp aromatic flavor, can describe a slightly sour and bitter taste commonly associated with citrus peel.
6	Green	Slightly sour flavor, generally associated with under-ripe fruit (astringent)
7	Starchy	Flavor that resembles starch or starchy ingredients
8	Chemical	General terms relating to different types of chemical compounds
9	Sweet	Flavor is related to all sweet substances
10	Sour	Flavor associated with all acidic substances
11	Bitter	Distinctive caffeine-like flavor sensation
12	Astringent	Dry and puckering sensation in the oral cavity
	Texture	

13	Firmness	Force required to start biting and cutting (from the outer edge) to completely biting the entire sample placed between the front teeth
14	Cohesiveness of mass	The degree to which a mass comes together after seven to eight chews
15	Mealy	Perception of fine, soft particles. These attributes are perceived as the crumbles easily like product being broken down during chewing but are geometric attributes powder in the product itself and are not created by the chewing process itself
16	Crispness	The number of sounds heard when the sample is first bitten with the front teeth
17	Juiciness	The amount of juice released by the sample when chewing with the back teeth
18	Grittiness	Presence of small jagged particles in the flesh

Panelist profile

Thirty untrained assessors conducted the sensory testing. Based on the questionnaire results, most assessors were female (83.3%), while male assessors were 16.7%. The age range of the assessor was dominated by the 21-25 years age group (53.3%), 60% of assessors consumed fruit more than once a week, and 46.7% consumed salak fruit more than once a month.

The most widely recognized salak fruit variety by the assessor was salak Pondoh (83.3%). This high level of recognition is because it is one of the oldest salak varieties officially released through a Decree of the Minister of Agriculture in 1988. In contrast, the least recognized variety is salak Gading, with a percentage of only 6.7%. The low level of recognition of salak Gading may be due to the sour taste characteristics of the fruit (Keputusan Menteri Pertanian, 2000), different from salak Pondoh and Madu, which have a sweeter taste and originate from the same region.

Salak fruit sensory profile

Figure 2 displays the sensory profile of five varieties of salak fruit based on assessor ratings. Based on Figure 2, the five varieties of salak (Madu, Pondoh, Gading, Gula Pasir, and Sidempuan) are known to have different flavor characteristics.
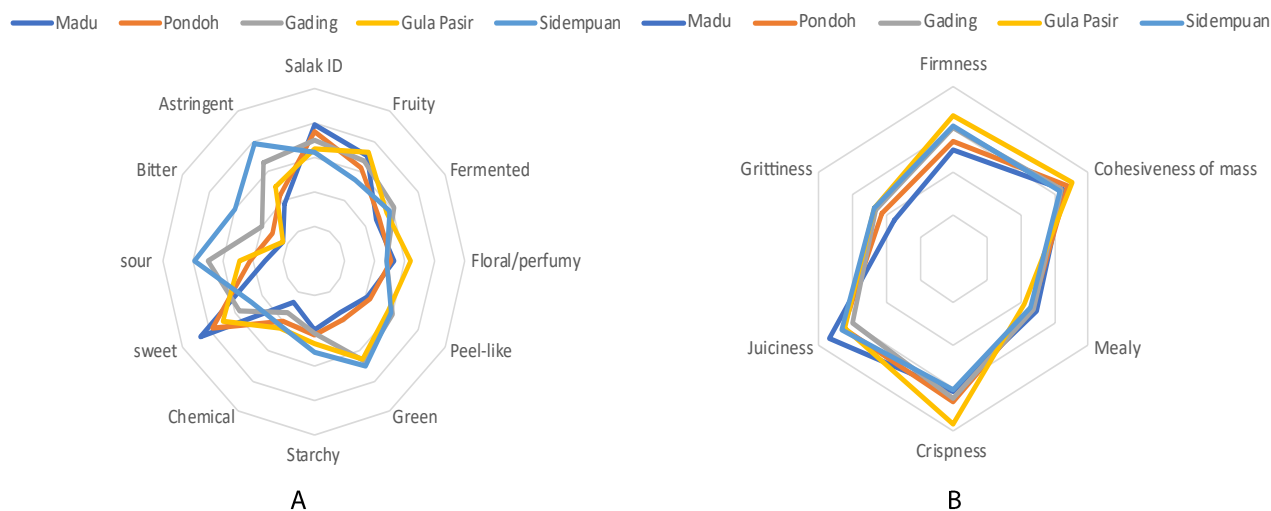

Figure 2: Spider web of sensory profiles, flavor (A) and texture (B) of five salak varieties.

The Madu variety stands out in the sweet attribute with the highest score compared to other varieties, and has low intensity in the bitter and chemical attributes. Gula Pasir and Pondoh varieties have relatively balanced profiles, although Gula Pasir has slightly higher fruity and floral/perfumy attributes. Meanwhile, Sidempuan and Gading varieties showed the highest intensity on sour, astringent, and bitter attributes, indicating a sharper and more complex profile and moderately high intensity on peel-like and green, which may reflect distinctive flavor characteristics.

To determine the intensity of sensory attributes in five varieties of salak, the RATA sensory method was conducted. Based on Table 2, the significant flavor attributes (p<0.05) are fruity, peel-like, green, sweet,

sour, bitter, and astringent, while the significant texture attribute is crispness. In the fruity flavor attribute, salak Gula Pasir had the highest score (3.63 ± 1.15), indicating a stronger fruit flavor than other varieties, while salak Sidempuan had the lowest score (2.70 ± 1.00). The peel-like flavor attribute obtained the highest score for salak Gading (3.03 ± 1.08), indicating the presence of peel-like flavor, with sharp, fresh, and distinctive aroma characteristics. In contrast, salak Madu had the lowest score (2.07 ± 0.85). For the flavor green attribute, salak Sidempuan had the highest score (3.47 ± 1.26), indicating a raw, fresh, sour, and slightly bitter or astringent taste, while salak Madu had the lowest score (1.70 ± 0.74).

Table 2. Sensory profile of five salak fruit varieties

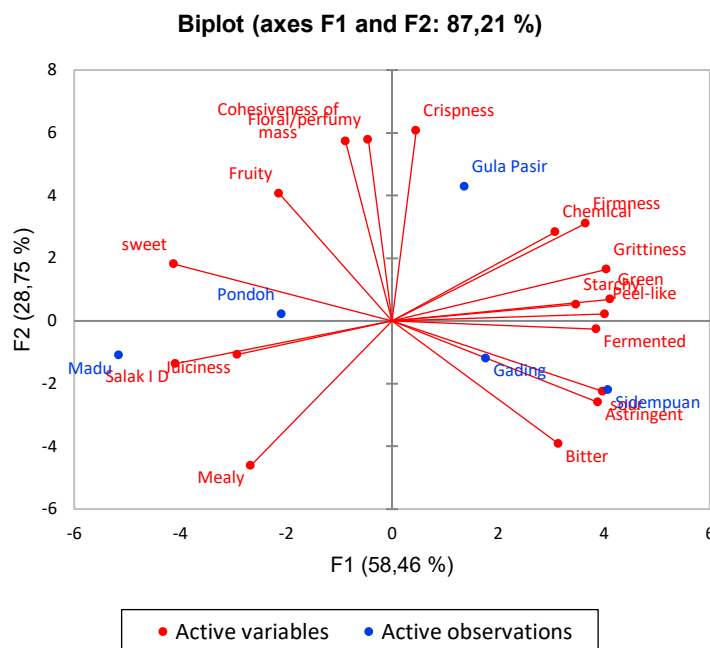| Attributes	Varieties				
	Salak Madu	Salak Pondoh	Salak Gading	Salak Gula Pasir	Salak Sidempuan
Flavor					
Salak ID	3.97 ± 0.95	3.77 ± 1.20	3.50 ± 1.28	3.23 ± 1.31	3.13 ± 1.18
Fruity *	3.50 ± 1.20[ab]	3.13 ± 1.26[ab]	3.33 ± 1.11[ab]	3.63 ± 1.15[a]	2.70 ± 1.00[b]
Fermented	2.37 ± 1.02	2.40 ± 1.23	3.07 ± 1.29	2.80 ± 1.12	2.90 ± 1.16
Floral /perfumy	2.67 ± 0.94	2.57 ± 1.36	2.40 ± 0.92	3.20 ± 1.33	2.43 ± 1.12
Peel-like *	2.07 ± 0.85[b]	2.17 ± 1.04[b]	3.03 ± 1.08[a]	2.83 ± 1.25[ab]	2.97 ± 1.20[ab]
Green*	1.70 ± 0.74[b]	1.93 ± 1.00[b]	3.30 ± 1.16[a]	3.27 ± 1.22[a]	3.47 ± 1.26[a]
Starchy	2.00 ± 0.93	2.13 ± 1.15	2.10 ± 1.02	2.40 ± 1.43	2.63 ± 1.35
Chemical	1.37 ± 0.66	2.00 ± 1.21	1.70 ± 0.97	2.23 ± 1.36	2.17 ± 1.29
Sweet*	4.37 ± 0.66[a]	3.87 ± 0.81[ab]	2.87 ± 0.76[bc]	3.50 ± 0.98[ab]	2.37 ± 0.98[c]
Sour*	1.60 ± 0.71[b]	2.10 ± 0.98[bc]	3.50 ± 0.99[a]	2.47 ± 0.83[c]	3.97 ± 1.05[a]
Bitter*	1.17 ± 0.37[a]	1.60 ± 1.05[a]	2.00 ± 0.89[b]	1.17 ± 0.57[b]	3.00 ± 1.48[a]
Astringent*	1.93 ± 0.93[b]	2.20 ± 1.08[b]	3.30 ± 1.04[a]	2.50 ± 0.83[b]	3.93 ± 1.03[a]
Texture					
Firmness	2.53 ± 1.12	2.73 ± 1.06	3.03 ± 0.87	3.33 ± 1.06	3.10 ± 0.91
Cohesiveness of mass	3.23 ± 1.02	3.40 ± 1.02	3.20 ± 0.83	3.50 ± 1.04	3.13 ± 0.85
Mealy	2.47 ± 1.02	2.33 ± 1.07	2.37 ± 0.95	2.10 ± 1.09	2.27 ± 1.00
Crispness*	3.10 ± 1.16[ab]	3.33 ± 0.94[ab]	3.23 ± 1.05[ab]	3.83 ± 0.88[a]	3.03 ± 0.98[b]
Juiciness	3.70 ± 1.07	3.27 ± 0.81	3.00 ± 0.93	3.23 ± 1.18	3.33 ± 0.79
Grittiness	1.77 ± 0.92	2.13 ± 1.06	2.30 ± 0.94	2.37 ± 1.23	2.37 ± 1.14

Notes: *: Indicates a significant difference (p < 0.05)
Within the same row data followed by different letters indicate a significant difference (p < 0.05)

On the sweet flavor attribute salak Madu had the highest score (4.37 ± 0.66), indicating the sweetest characteristics among the other varieties. In contrast salak Sidempuan showed the highest sour flavor (3.97 ± 1.05), indicating this variety tends to be more sour. The highest bitter flavor was also found in salak Sidempuan (3.00 ± 1.48), indicating a more dominant bitter taste. The highest astringent flavor attribute was also found in salak Sidempuan (3.93 ± 1.03), indicating a more pungent astringent taste.

For the texture attribute of crispness salak Gula Pasir has the highest score (3.83 ± 0.88), indicating the pulp is denser and crispier than other varieties. Salak Madu has the highest Juiciness value (3.70 ± 1.07), indicating more water or juice content than other varieties. Meanwhile salak Sidempuan and Gading showed the highest grittiness (2.37 ± 1.14 and 2.30 ± 0.94), indicating a more dominant gritty sensation.

A score plot shows the distribution and relationship between objects based on the Principal Component Analysis (PCA) results. In this plot objects with similar characteristics will be located close together while objects with different characteristics will be spread further apart Meanwhile, the loading plot illustrates the contribution of each attribute to the formation of the main component. The further an attribute is from the origin, the greater its contribution to forming that dimension. Loading plots also provides information about the relationship between attributes namely arrows close to each other indicate

a positive correlation, arrows in the opposite direction indicate a negative correlation and perpendicular arrows indicate that the attributes are not correlated (Sidou & Borges et al.,2020).

Figure 3. Biplot of PCA of sensory attributes of five salak varieties

Based on Figure 3, the attributes green and starchy sour and astringent. and juiciness and salak ID have arrows that are close to each other indicating a positive correlation. This means that an increase in the value of one variable tends to be followed by an increase in the other variable. In contrast, the sweet and bitter attributes have almost opposite arrow directions, indicating a strong negative correlation. This means that if the sweet attribute increases (getting sweeter) the bitter attribute tends to decrease (getting less bitter). Negative correlations are also seen between crispness and mealy and between juiciness and fermentation. Meanwhile, attributes that do not correlate or have a very weak relationship can be seen in the pairing of firmness and sweet, as well as juiciness and chemical.

PCA biplots can also identify the relationship between product and sensory attributes and more clearly visualize the pattern of characteristic differences. Based on the biplot in Figure 3, each salak variety has different sensory characteristics, Salak Madu is in the lower left quadrant of the position, indicating that it is likely to have a mealy texture and a Salak ID aroma. Meanwhile, Salak Pondoh is located close to the center point of the biplot, indicating that its characteristics are quite balanced. It is associated with sweetness juiciness and Salak ID aroma making it one of the salak types with a balance between aroma flavor and texture. Meanwhile salak, gula pasir in the biplot shows a dominant relationship with crispness which means that salak Gula Pasir has a crispier texture than other variations. In contrast to salak Madu, Pondoh and Gula Pasir, salak Gading and Sidempuan are in the lower right quadrant and are closely related to bitter, fermented sour and astringent attributes.

Different varieties of the same fruit can cause variations in flavor and texture attributes. This variation is due to the influence of growing location on gene expression in the plant body. Genes that are active in specific growing environments can affect the formation of cell walls (such as pectin, lignin, and hemicellulose) and the metabolism of sugars, amino acids, phenolic compounds and pigments. As a result fruits may exhibit different sensory characteristics such as firmness sweet or sour taste and color. Therefore even if they come from the same species the combination of variety and growing environment can produce fruits with different sensory characteristics (D'Esposito et al., 2024).

Assessor preference

The hedonic rating sensory method was conducted to determine assessor preference for five varieties of salak on a 6-point scale. The hedonic rating test method is an affective test that aims to assess consumers' subjective responses to the level of acceptance or preference of a product. This subjective response reflects consumer preference for the actual product (Adawiyah et al., 2020).

Table 3. Liking scores of five salak varieties

Varieties	Liking
Madu	5.13 ± 0.56[a]
Gula Pasir	4.67 ± 0.83[a]
Pondoh	4.43 ± 1.05[a]
Gading	3.40 ± 1.11[b]
Sidempuan	2.80 ± 1.14[b]

Notes: Different letters in each attribute indicate significant differences ($p < 0.05$)

Based on Table 3, the favorability scores of the five salak varieties showed significant differences ($p < 0.05$). The highest favorability score was obtained by the Madu variety (5.13 ± 0.56) which falls within the range between the like and like very much categories. This data indicates that assessors generally have a high level of liking for the Honey variety. The score was not significantly different from the Gula Pasir (4.67 ± 0.83) and Pondoh (4.43 ± 1.05) varieties. both of which were also in the "like" category. These three varieties belonged to the same group statistically indicating that the assessor gave them a good level of acceptance. This finding aligns with the study of (Djaafar et al., 2024), which reported that *Salak Pondoh Super* obtained liking scores of 3.69–3.91 across males female young (15–25 years) adult (25–51 years), and senior (>51 years) panelists. These values are close to 4 on the hedonic scale and are thus classified as "like".
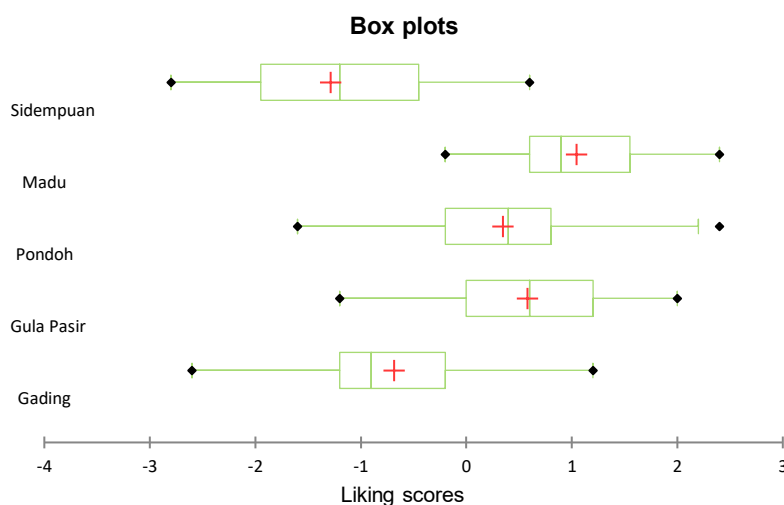
Figure 4. Box plot of the king score assessor of five salak varieties

In contrast the Gading variety (3.40 ± 1.11) obtained a mean score that fell between the neutral and slightly liked categories indicating that it was only slightly liked by the assessor. The Sidempuan variety (2.80 ± 1.14) scored close to the dislike category, indicating a low level of acceptance. These two varieties were statistically significantly different from the other three varieties, meaning that assessor preference for Gading and Sidempuan was significantly lower than for Madu, Gula Pasir, and Pondoh. To visualize the distribution of the liking scores of each salak variety the data were transformed into a box plot and displayed in Figure 4. The purpose is to include the median value, interquartile range, and the presence of outliers. Box plots serve as a data visualization tool based on statistical calculations, which helps reveal the main characteristics of the distribution of values (Williams et al., 2022). This visualization helps identify variability between varieties that may not otherwise be visible.

Based on the box plot diagram in Figure 4, the distribution of the favorability scores of the five salak varieties shows quite different variations. Salak Madu has a high median favorability score with a relatively narrow distribution of values indicating that most assessors gave consistent ratings to this variety. Salak Pondoh also shows a relatively concentrated distribution of data and a reasonably high median indicating that most assessors quite favor this variety.

Salak Gula Pasir has a broader distribution than Salak Madu and Pondoh indicating a variation in preference among assessors. Some assessors gave high scores while others gave lower scores. Salak Gading had a lower median than the other varieties with a broad data spread indicating inconsistent ratings and a tendency to dislike this variety. Meanwhile Salak Sidempuan had the lowest median favorability score among all varieties tested. The data distribution shows that the assessor gave very low scores. even negative ones. This data indicates that, in general Salak Sidempuan tends to be less favorable than other varieties Salak Madu, Gula Pasir, and Pondoh are known to have a sweet taste (Keputusan Menteri Pertanian, 2004; Keputusan Menteri Pertanian, 1994; Keputusan Menteri Pertanian, 1988), which may be a significant factor in the high level of liking for these three varieties. The dominant sweetness of these three varieties may be more in line with assessor preferences resulting in higher favorability scores. Meanwhile salak Gading and Sidempuan have sour and astringent flavors (Keputusan Menteri Pertanian. 2000; Keputusan Menteri Pertanian. 1999).

Conclusion

This study aims to describe consumer preferences through sensory characterization of five varieties of salak fruit. namely Salak Madu, Pondoh, Gading, Gula Pasir, and Sidempuan using the Rate-All-That-Apply (RATA) method and hedonic rating test. The analysis showed that the flavor attributes that differed significantly ($p < 0.05$) included fruity peel-like, green, sweet, sour, bitter, and astringent. Regarding texture Salak Gula Pasir had the highest scores on the attributes of cohesiveness of mass and crispness while Salak Madu showed the highest juiciness. Salak Sidempuan has more prominent crispness and grittiness attributes compared to other varieties. These sensory characteristics play a role in shaping consumer preferences. Salak Madu obtained the highest level of liking which correlated with its dominance in sweetness. In contrast Salak Sidempuan and Gading showed lower acceptance due to their strong sour and astringent flavor characteristics. Based on assessor perceptions varieties with sweet flavors such as salak Madu, Pondoh, and Gula Pasir, are preferred over varieties with sour and astringent sensory characteristics such as salak Gading and Sidempuan.

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