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Sensory Profiling of Milkfish Otak-Otak from Gresik Regency with the Rate-All-That-Apply Method

Nabilla Nova Dwiyanti[1] *and Sri Winarti*[2.]

[1,2,3] *Food Technology Study Program, Faculty of Engineering, Universitas Pembangunan Nasional "Veteran" Jawa Timur, Surabaya, Indonesia*

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CORRESPONDING AUTHOR

*E-mail: nabilla.nova01@ggmail.com

A B S T R A C T

Milkfish *otak-otak* is a traditional food product from Gresik that is widely consumed by the community. It is produced by various small and medium enterprises (SMEs), resulting in diverse sensory characteristics across products. This study aimed to evaluate the sensory profiles of milkfish *otak-otak* from five SMEs in Gresik Regency using the Rate-All-That-Apply (RATA) method. The results revealed that each sample displayed distinctive sensory attributes. Samples B1 and B2 were characterised by orange, brown, and red colours, with a smoky aroma, a bitter taste, and an oily mouthfeel. Sample B3 was associated with sweet, coconut, and fishy aromas, along with sour and sweet tastes, and a dense and chewy texture. Sample B4 was identified by its yellow color, distinctive milkfish flavor, fibrous texture, dry mouthfeel, and throat irritation. In contrast, Sample B5 exhibited dominant attributes such as salty and savory tastes, herbs and spices flavor, spicy and seasoning aromas, spicy mouthfeel, and a soft texture. Preference mapping analysis indicated that Sample B5 had the highest liking score of 75%, driven by the preferred attributes of salty and savory taste, herbs and spices flavor, and seasoning aroma. These findings provide valuable insights for SMEs in improving the formulation and processing of milkfish *otak-otak* to better match consumer preferences.

Contribution to Sustainable Development Goals (SDGs):
SDG 2: Zero Hunger
SDG 3: Good Health and Well-Being
SDG 8: Decent Work and Economic Growth

1. INTRODUCTION

1.1. Research Background

Indonesia is a country with rich cultural, linguistic, and culinary diversity that reflects the identity and heritage of its regions. Traditional cuisine is typically prepared using local ingredients and simple techniques, resulting in distinctive flavours [1]. Culinary diversity illustrates the dynamic relationship between social, environmental, and cultural factors that have evolved over time. This potential establishes traditional cuisine as an essential asset that deserves both preservation and development.

Consumers are increasingly favouring fish-based processed products due to their high nutritional content, particularly in protein and omega-3 fatty acids, which are beneficial for health. Gresik Regency in East Java is recognised as one of the primary fisheries centres, with approximately 28,000 hectares of pond area and an annual fish production of around 87,000 tons [2]. Milkfish is the primary commodity in this region, containing 20–24% protein as well as essential amino acids, vitamins, and minerals necessary for the human body [3]. Abundant availability of milkfish provides strategic value both as a source of nutritious food and as an economic commodity.

The abundance of milkfish has encouraged the local community in Gresik to develop it into distinctive culinary products, one of which is *otak-otak bandeng* (milkfish cake). Processing involves separating the meat from the bones, mixing the meat with spices, reinserting it into the fish skin, and then steaming or grilling it. The production centre is located on

Sindujoyo Street, Gresik District, which has developed into a hub for small-scale home industries, as well as a typical regional souvenir market. The existence of this production center strengthens the culinary identity of Gresik while contributing to the local economy through small and medium enterprises.

Sensory characteristics, including taste, aroma, colour, and texture, play a crucial role in determining consumer preference, making sensory analysis an essential aspect of product development. The Rate-All-That-Apply (RATA) method is considered more comprehensive than the Check-All-That-Apply (CATA) method, since panelists are required not only to select attributes but also to evaluate their intensity. Previous studies have demonstrated that RATA provides clearer and more explicit descriptions of sensory attributes [4]. The present study aims to examine the sensory profile of milkfish *otak-otak* from several producers in Gresik using the RATA method, serving as a reference for improving product quality and establishing market standards.

1.2. Literature Review

1.2.1. Milkfish otak-otak

Milkfish is a leading commodity in brackish and freshwater pond cultivation due to its various advantages, including easy seeding techniques, resistance to extreme environmental changes, the ability to be fed with commercial feed, and the potential to be cultivated in large quantities without cannibalism issues, making it a preferred choice for farmers seeking maximum yields with minimal risk. This species is also highly nutritious, containing 20–24% protein, fat, amino acids, fatty acids, macro minerals (Ca, Mg, Na, K), micro minerals (Fe, Zn, Cu, Mn), and vitamins A, B1, and B12. Its nutritional composition includes 129 kcal of energy, 20 g of protein, 4.8 g of fat, 20 mg of calcium, 150 mg of phosphorus, 2 mg of iron, 150 IU of vitamin A, and 0.05 mg of vitamin B1, with an edible portion of up to 80% [5].

Milkfish otak-otak is an innovative boneless product that enhances the market value of milkfish. It is made from milkfish meat mixed with spices and grated coconut, resulting in a distinctive flavor and higher economic value. The processing can be done by steaming, grilling, or smoking, using milkfish (Chanos chanos) as the main ingredient, which is known for its thick and strong skin, flavorful meat, and high protein content despite having many bones. The production process involves separating the meat from the skin and bones, mixing it with spices, and then returning it to the resilient skin, which prevents tearing during processing [6].

Milkfish otak-otak has a sensory profile that includes appearance, taste, texture, and aroma. Visually, the product maintains the shape of a whole milkfish, with a golden-brown color resulting from cooking and the Maillard reaction. This attractive colour enhances the perceived quality of the product and consumer acceptance. The distinctive taste of milkfish otak-otak, a blend of spicy, savoury, and slightly sweet flavours, is derived from spices and red chillies, providing a balanced flavour that many consumers favour. Its soft and elastic texture, influenced by protein and water content as well as the fish meat grinding technique, makes the product easy to consume for all groups. The savoury and appealing aroma is a result of the cooking process and the spice blend. The use of banana leaves or moringa leaves adds a distinctive aroma that further enriches the product's flavor [7].

1.2.2. Sensory evaluation

Sensory evaluation is an essential method for understanding market needs before a product is launched. This assessment is conducted by panellists using the five senses to subjectively evaluate the properties and quality of a product, as individual responses vary according to sensory sensitivity. Organoleptic tests evaluate colour, aroma, taste, texture, and overall product impression, allowing for the identification of the most preferred products among consumers. Sensory evaluation can be divided into objective testing with trained panellists and subjective testing with consumer panellists, which is crucial for describing sensory attributes, identifying development opportunities, and comparing competing products [8].

Panelists are selected and trained to consistently evaluate the aroma, taste, and texture of products. Methods involving untrained consumer panellists, such as Check-All-That-Apply (CATA) and Rate-All-That-Apply (RATA), enable the rapid and effective collection of sensory data. RATA enables the assessment of the intensity of each attribute, providing a more precise differentiation of product characteristics. Sensory data from RATA can be analysed using Principal Component Analysis (PCA), the Kruskal-Wallis test, and Preference Mapping. PCA visualises relationships between samples and attributes, as well as correlations among attributes, while the Kruskal-Wallis test detects differences in attribute intensity between samples. Preference Mapping illustrates the association between product characteristics and consumer preferences through contour plots with color gradients representing levels of liking. This approach enables an objective sensory evaluation while providing a comprehensive understanding of consumer perceptions of food products [9].

1.3. Research Objective

This study aims to identify the sensory attribute profiles of milkfish otak-otak products from five different MSMEs in Gresik and to compare the varying sensory attributes that contribute to consumer acceptance using the Rate-All-That-Apply (RATA) method.

2. MATERIALS AND METHODS

This study was conducted from February to April 2025 at the Sensory Testing Laboratory, Department of Food Technology, UPN "Veteran" Jawa Timur. Samples consisted of milkfish otak-otak obtained from five MSMEs in Gresik Regency. The products varied in formulation and processing: four MSMEs used coconut milk, while one used roasted grated coconut. Differences were also found in the proportion and type of spices, such as chili, ginger, lemongrass, and turmeric, as well as in cooking methods, including direct charcoal grilling, banana leaf wrapping, and steaming prior to grilling, which contributed to distinct sensory characteristics.

The tools used included sample plates, questionnaires, labels, writing instruments, and XLSTAT software for statistical analysis. Sensory evaluation involved 10 panelists in a Focus Group Discussion (FGD) to determine attributes, and 100 untrained panelists with neutral preferences for the sensory test. The attributes assessed included aroma, taste, color, texture, and mouthfeel. The Rate-All-That-Apply (RATA) method was applied, where panelists identified relevant attributes and rated

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their intensity on a five-point scale, followed by hedonic testing on a six-point scale. Samples were coded with randomized three-digit numbers, and bottled water was provided for palate cleansing.

Data were analyzed using Kruskal-Wallis and Dunn's tests to identify significant differences among samples. Principal Component Analysis (PCA) was employed to visualize the relationship between attributes and samples through biplots, while preference mapping was conducted to display panelists' liking levels using contour plots with graded color scales ranging from high (red, 80–100%) to low (dark blue, 0–20%).

3. RESULT AND DISCUSSION

3.1. Focus Group Discussion (FGD)

The sensory profile of milkfish otak-otak from Gresik Regency was conducted using the Rate-All-That-Apply (RATA) method. The initial stage involved a Focus Group Discussion (FGD) with 10 panellists selected based on specific qualifications, including an understanding of the product's characteristics, no fish allergies, and physical and mental health, as well as having consumed otak-otak within the past month. The FGD aimed to identify and determine relevant sensory attributes of the product, including color, aroma, texture, taste, and mouthfeel. The FGD process was carried out in two stages. In the first stage, 23 attributes were identified; however, the "bland taste" attribute was eliminated as it was deemed less relevant. The second stage added three additional attributes, resulting in a final total of 25. Details of the sensory attributes determined during the FGD are presented in Table 1.

Table1. Sensory Attributes from FGD Results

No.	Attribute	Description
1.	Brown Color	The sample appears brown in color
2.	Orange Color	The sample appears orange in color
3.	Yellow Color	The sample appears yellow in color
4.	Red Color	The sample appears red in color
5.	Smoky Aroma	A characteristic aroma originating from the burning process
6.	Fishy Aroma	An aroma reminiscent of raw or strong sea fish
7.	Sweet Aroma	An aroma associated with sweetness or sugar
8.	Spices Aroma	An aroma associated with spices
9.	Spicy Aroma	An aroma associated with a spicy sensation
10.	Coconut Aroma	An aroma derived from coconut milk or grated coconut, giving a savory, natural sweetness and a traditional food fragrance
11.	Soft Texture	The sample has a tender texture and easily disintegrates
12.	Fibrous Texture	The sample has a fibrous texture due to undissolved fish meat
13.	Chewy Texture	The sample has a chewy texture due to the use of binding agents
14.	Firm Texture	The sample has a firm texture and does not easily crumble
15.	Savory Taste	A taste originating from glutamic acid/amino acids or natural flavor enhancers like protein-rich stock, similar to fried fish flavor
16.	Salty Taste	A taste associated with salt
17.	Sweet Taste	A taste stimulated by sucrose or other sweeteners
18.	Herbs and Spices Taste	A taste associated with spices and herbs
19.	Sour Taste	A taste arising from the presence of organic acids
20.	Bitter Taste	A taste caused by certain sharp or pungent compounds
21.	Characteristic Milkfish Taste	A taste characteristic of milkfish with a light aftertaste of sea or mud, not overly fishy
22.	Spicy Mouthfeel	A hot or burning sensation when consumed
23.	Oily Mouthfeel	A greasy sensation when consumed
24.	Throat Irritation Mouthfeel	A rough or harsh sensation when swallowing
25.	Dry Mouthfeel	Provides a dry sensation when consumed

The above attributes represent the sensory characteristics perceived by the FGD panelists in the milkfish otak-otak samples. Through direct observation and discussion, 25 attributes were identified as most representative of the product, providing a shared understanding among the panellists. These attributes will serve as a reference for the subsequent RATA testing.

3.2. Sensory Attribute Profiling of Milkfish Otak-Otak

The attributes obtained from the FGD stage were used to profile sensory attributes using the Rate-All-That-Apply (RATA) method on five milkfish otak-otak samples. The sensory testing data collected using the RATA method were analysed with XLSTAT software. The data analysis was carried out in several stages, including the Kruskal-Wallis test, Principal Component Analysis (PCA), and preference mapping. This analysis aimed to determine differences among the samples and to describe the characteristics and overall preferences for each product. The results of the analysis showed the p-values for each observed sensory attribute, as presented in Table 2. These values were used to determine the significance of differences among samples for the respective attributes. The sensory testing results indicated that the type of milkfish otak-otak significantly influenced sensory attributes if the p-value < 0,05. Based on the analysis across all attributes, three attributes were found not to differ significantly among samples: fibrous texture (p-value 0.113), characteristic

milkfish flavour (p-value 0.137), and mouthfeel throat irritation (p-value 0.216). The variation in significance values was influenced by the intensity of the attributes perceived by the panelists in each sample. Differences in perceived intensity were closely related to variations in the composition of each product.

Table 2. *p*-values of Sensory Attributes in Milkfish Otak-Otak

No.	Sensory Attribute	p-value
1.	Brown Color	< 0.0001
2.	Yellow Color	< 0.0001
3.	Orange Color	< 0.0001
4.	Red Color	< 0.0001
5.	Smoky Aroma	< 0.0001
6.	Fishy Aroma	< 0.0001
7.	Sweet Aroma	< 0.0001
8.	Spices Aroma	< 0.0001
9.	Spicy Aroma	< 0.0001
10.	Coconut Aroma	< 0.0001
11.	Soft Texture	< 0.0001
12.	Fibrous Texture	0.113
13.	Chewy Texture	0.002
14.	Firm Texture	< 0.0001
15.	Savory Taste	0.002
16.	Salty Taste	0.000
17.	Sweet Taste	< 0.0001
18.	Herbs and Spices Taste	< 0.0001
19.	Sour Taste	0.016
20.	Bitter Taste	< 0.0001
21.	Characteristic Milkfish Taste	0.137
22.	Spicy Mouthfeel	< 0.0001
23.	Oily Mouthfeel	< 0.0001
24.	Throat Irritation Mouthfeel	0.216
25.	Dry Mouthfeel	< 0.0001

3.2.1. Panelists' Responses to Significantly Different Attributes

Significant differences in sensory attributes were assessed using the Kruskal-Wallis test in XLSTAT, as presented in Table 3. Attributes with p-values < 0,05 were considered statistically significant. A subsequent Dunn's post-hoc test at a 5% significance level was performed to identify specific differences among the samples. Panelists evaluated various sensory aspects, including aroma, color, texture, taste, and mouthfeel, providing a comprehensive characterization of each sample.

Table 3. Sensory Attribute Intensity of Milkfish Otak-Otak

Sensory Attribute	Sample				
	B1	B2	B3	B4	B5
Brown Color	2.61^{c}	2.91^{c}	1.93^{b}	1.17^{a}	1.89^{b}
Yellow Color	1.12^{a}	1.45^{ab}	1.87^{b}	4^{c}	0.99^{a}
Orange Color	3.81^{bc}	3.64^{abc}	3.53^{ab}	3.02^{a}	3.97^{c}
Red Color	3.29^{c}	2.58^{b}	2.27^{b}	0.67^{a}	2.25^{c}
Smoky Aroma	2.75^{b}	3.66^{c}	2.54^{b}	1.65^{a}	2.25^{ab}
Fishy Aroma	1.26^{a}	1.29^{a}	2.23^{b}	1.81^{ab}	1.23^{a}
Sweet Aroma	1.92^{bc}	1.83^{b}	1.79^{b}	2.45^{c}	1.09^{a}
Spices Aroma	3.65^{bc}	3.84^{c}	3.1^{a}	3.27^{ab}	4.04^{c}
Spicy Aroma	2.55^{b}	2.55^{b}	2.16^{ab}	1.77^{a}	4.18^{c}
Coconut Aroma	2.55^{cd}	2.26^{bc}	1.9^{ab}	2.95^{d}	1.32^{a}
Soft Texture	2.93^{ab}	3.16^{b}	2.39^{a}	2.89^{ab}	3.4^{b}
Fibrous Texture	3^{a}	3.33^{a}	3.43^{a}	3.45^{a}	3.33^{a}

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Sensory Attribute	Sample				
	B1	B2	B3	B4	B5
Chewy Texture	1.66[b]	1.11[a]	1.59[b]	1.38[ab]	1.17[ab]
Firm Texture	3.13b	1.85[a]	2.58[b]	2.65[b]	1.49[a]
Savory Taste	3.22[ab]	3.14[ab]	2.84[a]	3.33[b]	3.5[b]
Salty Taste	2.41[a]	2.7[ab]	2.34[a]	2.96[b]	2.84[b]
Sweet Taste	2.99[b]	1.9[a]	3.12[b]	2.11[a]	1.87[a]
Herbs and Spices Taste	3.07[a]	3.85[b]	3.27[a]	2.76[a]	4.36[c]
Sour Taste	1.06[ab]	1.2[ab]	1.75[b]	1.34[ab]	0.97[a]
Bitter Taste	0.47[a]	1.63[b]	0.63[a]	0.41[a]	0.28[a]
Characteristic Milkfish Taste	3.54[a]	3.35[a]	3.62[a]	3.84[a]	3.65[a]
Spicy Mouthfeel	1.95[a]	3.68[c]	2.75[b]	1.8[a]	4.57[d]
Oily Mouthfeel	2.07[b]	1.95[b]	1.8[b]	1.19[a]	2.07[b]
Throat Irritation Mouthfeel	1.11[a]	1.51[a]	1.56[a]	1.41[a]	1.28[a]
Dry Mouthfeel	1.21[ab]	1.56[bc]	1.48[abc]	1.99[c]	0.97[a]

Keterangan: Nilai rata-rata yang diikuti dengan huruf berbeda menyatakan berbeda nyata antar kolom ($p \leq 0,05$) Kriteria skala: 1 (rendah), 2 (agak rendah), 3 (sedang), 4 (agak tinggi), 5 (tinggi)

Panelists observed differences in color intensity among the samples. Sample B2 had the highest brown colour intensity, followed by Sample B1, while Sample B4 had the lowest. This is likely due to the sautéing of spices in B1 and B2, which triggers the Maillard reaction. This reaction occurs between amino groups of proteins and reducing sugars at high temperatures, producing melanoidins that impart a brown color [10]. The highest yellow colour in B4 is attributed to the addition of turmeric. Curcumin in turmeric is heat-stable and acts as a natural pigment, maintaining its colour until the end [11]. The highest orange colour in B5 is due to direct roasting, whereas initial steaming in B4 retains surface moisture, resulting in a paler colour [12]. A higher proportion of red chili causes the highest red intensity in B1; beta-carotene in chili acts as a natural red-orange pigment [13].

Smoky aroma was highest in B2 and lowest in B4. This is related to the cooking technique, where direct heat in B2 produces phenolic compounds through the Maillard reaction, which contribute to a smoky aroma [14]. The use of banana leaves also preserves the product's natural aroma [15]. The sweet aroma was highest in B4 due to the gradual heating, which preserves volatile compounds such as maltol and furfural from the Maillard reaction, thereby providing a sweet scent [16]. The fishy aroma was highest in B3 because fewer spices were used, making the fish aroma more pronounced. In contrast, B5 used more spices, which masked the fishy odour [17]. The spicy aroma was highest in B5 because whole chillies were used without removing the seeds, thereby preserving capsaicin [18]. The coconut aroma was highest in B4 due to the use of roasted, grated coconut, where heating triggers the Maillard reaction and caramelisation, enhancing savoury and roasted notes [19].

The softest texture was observed in B5, and the firmest in B3, likely because the sautéed spices were more concentrated and oily, allowing for better integration with the mixture [20]. Fibrous texture was relatively uniform because the fish myofibril fibers remained dominant despite being ground. Chewy texture was highest in B1 due to the addition of eggs; proteins in egg white form an elastic structure when heated, while egg yolk supports hydration and texture development [21]. Firmness was highest in B1 due to protein coagulation forming a denser gel, whereas B5 was the lowest [22].

Umami was highest in B5 and B4, and lowest in B3. This is influenced by the glutamic acid content from fish protein and broth/seasoning, which enhances the umami perception [23]. Saltiness was highest in B4 due to higher salt usage, directly contributing to the salty taste [24]. Sweetness was highest in B3 and B1, corresponding to higher sugar content, which acts as both a sweetener and a flavor/color enhancer [25]. Herbs & spicy taste was highest in B5 due to optimal sautéing of spices, releasing maximum active compounds [26]. Sourness was highest in B3 due to the use of tamarind water, which naturally imparts sourness [27]. Bitterness was dominant in B2, related to the Maillard reaction and banana leaf wrapping, forming melanoidins and heterocyclic compounds that contribute to bitterness [28]. The characteristic fish taste remained stable due to consistent milkfish content.

Spicy mouthfeel was highest in B5 and B2, and lowest in B4, influenced by whole chilies retaining capsaicin [29]. The oily mouthfeel was lowest in B4, as roasted grated coconut reduces the oil content compared to coconut milk [30]. Throat irritation sensation was relatively uniform because gingerol from ginger provides a mild, consistent spiciness [31]. The dryness intensity was highest in B4 due to the two-stage cooking and the use of roasted, grated coconut, which reduces the moisture content.

3.2.2. Responses of Panelists to Milkfish Otak-Otak Samples

Milkfish Otak-Otak Samples can be seen in Figure 1. The results of the *Rate-All-That-Apply* (RATA) test are presented in the form of a spider chart, which depicts the sensory profiles of each milkfish otak-otak sample. The specific sensory attributes for each sample are shown in Figure 2. The visualisation illustrates variations in the panellists' evaluations of colour, aroma, taste, texture, and mouthfeel across the different samples. The distinct patterns observed in the chart indicate that each sample possesses unique sensory characteristics as a result of the processing methods applied. These findings provide a fundamental basis for

subsequent analyses to identify the sensory attributes that most significantly influence panelists' acceptance of milkfish otak-otak

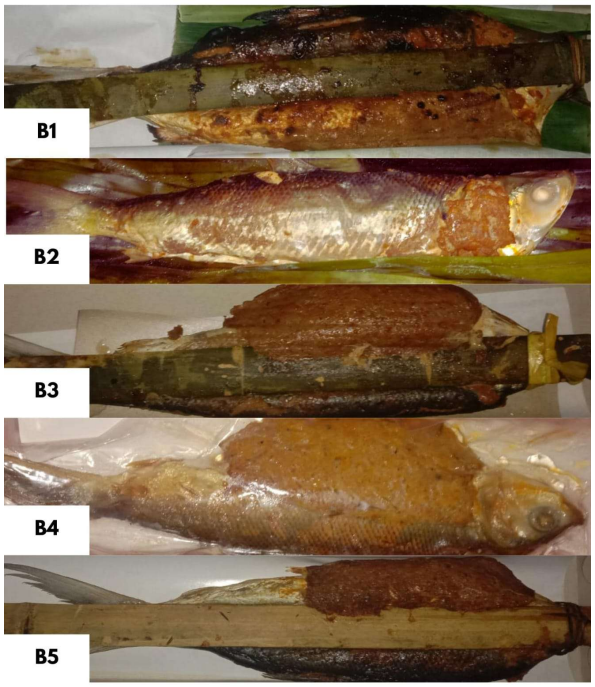

Figure 1. Milkfish Otak-Otak Samples

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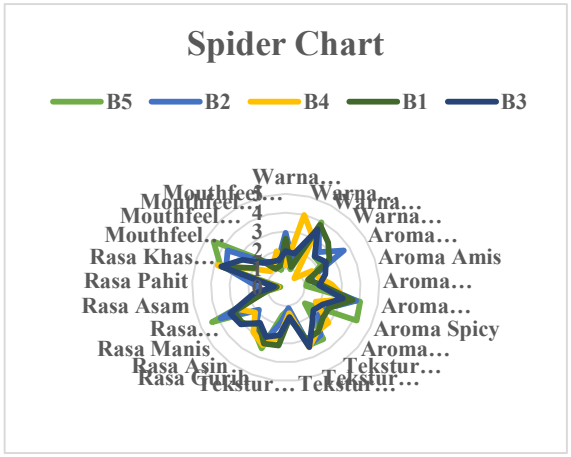

Figure 2. Spider chart of milkfish *otak-otak* samples

3.2.3. Principal Component Analysis (PCA)

Principal Component Analysis (PCA) is used to determine the relationship between sensory attributes and the characteristics of each sample, as well as to simplify complex data, especially in sensory tests using the RATA method, because it can show the influence of each attribute on panelist perception [32]. PCA results are usually presented in the form of a biplot graph that illustrates the relationship between attributes and samples; attributes that are close to each other indicate a strong correlation, and samples in the same quadrant exhibit similar sensory characteristics [33]. Loading plots show the projection of each attribute in the quadrants, and attributes that are located far from the center and close to each other have a strong positive correlation. The PCA biplot also displays a score plot indicating the position of each sample in the quadrant, so samples within the same quadrant share similar sensory characteristics.

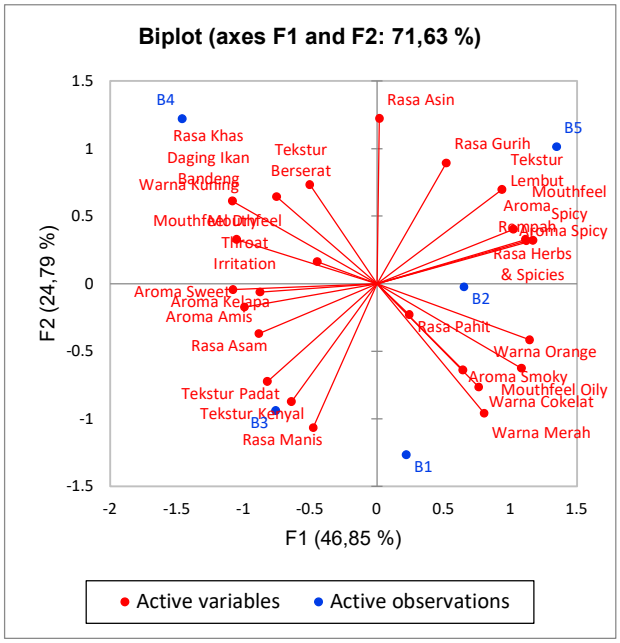

Figure 3. PCA bi-plot graph of milkfish brains

Based on the Principal Component Analysis (PCA) results, the milkfish otak-otak samples were grouped into four quadrants, reflecting differences in their sensory characteristics. The placement of samples in the PCA biplot facilitates the identification of the most prominent attributes and distinguishes the characteristics of each sample. A spicy aroma, a herbal and spicy taste, a spicy mouthfeel, a soft texture, a savoury taste, and a salty-umami flavour characterise sample B5. These characteristics are influenced by the addition of spices, coconut milk content, and the natural properties of milkfish, which is rich in amino acids that enhance umami taste [34,35].

Sample B4 exhibits fibrous texture, distinctive milkfish taste, dry mouthfeel, throat irritation, and yellow color. These characteristics are likely due to the predominance of milkfish meat, the proportion of spices used, and natural ingredients such as turmeric, which impart a yellow colour [36,37]. Sample B3 shows sweet and sour taste, coconut aroma, sweet aroma, fishy aroma, firm and chewy texture. The sweet taste and aroma are attributed to the addition of sugar and heating, which induce caramelisation and Maillard reactions. The sour taste originates from tamarind water, while the coconut aroma develops from heating coconut milk, forming volatile compounds. Firm and chewy textures result from interactions between fish protein and coconut milk fat [38,39].

Samples B1 and B2 share similar sensory characteristics, including a bitter taste, smoky aroma, oily mouthfeel, and colours ranging from red to orange to brown. A bitter taste and smoky aroma arise from different cooking methods that produce similar compounds, while an oily mouthfeel is derived from coconut milk. The colour attributes result from the combination of red chilli, sugar, and fish protein undergoing Maillard and caramelisation reactions during cooking [40, 41].

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3.2.4. Panelists' Preference Map for Gresik's Traditional Milkfish Otak-Otak

The preference mapping analysis was applied to describe the relationship between sensory attributes and panellists' liking levels, which were visualised in a contour plot using colour gradients. The variation in panelists' preferences for each sample was illustrated through different colors representing the proportion of acceptance, ranging from the lowest to the highest category. This visualization provided a clearer picture of how panelists perceived the suitability of sensory characteristics in each sample.

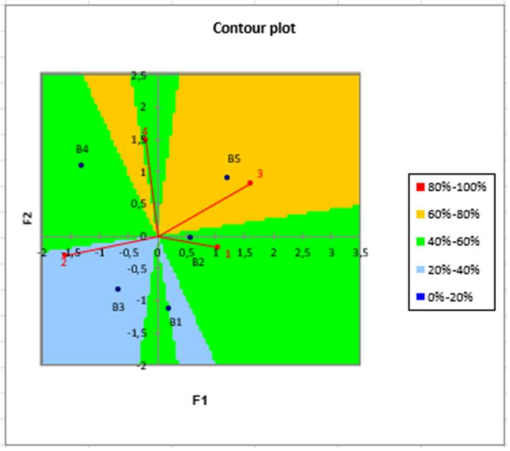

Figure 4. Preference Map of Gresik's Traditional Milkfish Otak-Otak

The results showed that panelists expressed different levels of preference toward each milkfish otak-otak sample. Sample B3 was positioned in the light blue region, indicating a low liking level of 25%. Samples B1, B2, and B4 were placed in the green region, reflecting a moderate liking level of 50%. Sample B5 was located in the yellow region, indicating the highest liking level of 75%, which suggested that its sensory characteristics were most aligned with the preferences of the majority of panellists. This finding indicates that B5 has a greater potential for consumer acceptance compared to the other samples and can serve as a reference for developing products with superior sensory quality.

4. CONCLUSION

This study successfully differentiated the sensory profiles of traditional milkfish otak-otak from Gresik. The analysis revealed five distinct profiles, with significant variations in color, aroma, flavor, texture, and mouthfeel among the samples. Samples B1 and B2 were characterised by smoky and bitter notes, accompanied by an oily mouthfeel. Sample B3 was characterised by a unique combination of sweet, sour, and coconut aromas, accompanied by a dense, chewy texture. Meanwhile, B4 was notable for its fibrous, dry texture and a throat-irritating mouthfeel. Based on the preference mapping, a clear correlation emerged between specific sensory attributes and consumer liking. Sample B5, with its dominant attributes of salty, savory, and herbal notes, achieved the highest liking score of 75%, indicating consumers most prefer these characteristics. Conversely, the dense texture and sour taste of B3 were identified as undesirable, leading to the lowest liking score of 25%. The moderate scores for B1, B2, and B4 further emphasise that a balanced flavour profile, rather than an intense or irritating one, is crucial to consumer satisfaction. In summary, this research confirms that consumer preference for Gresik's milkfish otak-otak is strongly driven by a harmonious blend of salty, savory, and herbal flavors. These findings can serve as a crucial guide for local producers aiming to optimize their product quality and meet market demands.

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