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Profiling of Sensory Attributes of the Fish Bonggolan from Gresik Using the RATA (Rate-All-That-Apply) Method

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A B S T R A C T

Fish bonggolan is a traditional fish-based snack from Sidayu District, Gresik Regency, produced by local micro, small, and medium enterprises (MSMEs). Variations in raw material composition and processing methods among producers lead to differences in sensory characteristics and consumer acceptance. This study aimed to identify the sensory attribute profiles of fish bonggolan from six different MSMEs in Sidayu District using the Rate-All-That-Apply (RATA) method and to determine sensory attributes influencing consumer preferences. Sensory attributes were identified through a Focus Group Discussion (FGD) involving 10 semi-trained panellists, yielding 17 attributes grouped into aroma, colour, taste, and texture parameters. Sensory evaluation was conducted by untrained panellists using the RATA method combined with a hedonic test. The data were analyzed using the Kruskal–Wallis test followed by Dunn's post hoc test, Principal Component Analysis (PCA), and preference mapping. The results showed significant differences ($p < 0.05$) in most sensory attributes among samples, except for leafy aroma and umami taste. PCA revealed distinct sensory profiles for each sample. Preference mapping indicated that sample P2 had the highest consumer liking score (80–100%), while sample P6 had the lowest (20–40%). These findings demonstrate that specific sensory attributes strongly influence consumer acceptance and may serve as a basis for product improvement and market standardization of fish bonggolan.

Contribution to Sustainable Development Goals (SDGs):
SDG 2: Zero Hunger
SDG 3: Good Health and Well-Being
SDG 8: Decent Work and Economic Growth
SDG 12 : Responsible Consumption and Production

1. INTRODUCTION

1.1. *Research Background*

Each region in Indonesia has unique traditional foods and snacks influenced by its geographical conditions and local natural resources. For example, Gresik Regency is home to a wide variety of traditional foods and snacks. Gresik Regency is one of the regions in Indonesia known for its rich diversity of traditional culinary products[1]. In Gresik Regency, there is a sub-district that produces traditional fish-based snacks, namely Sidayu District, where fish bonggolan originates. Fish bonggolan is one of the flagship products of Sidayu District, an area with abundant fisheries resources.

Bonggolan is a traditional snack made from minced fish meat mixed with seasonings and tapioca flour [2]. A savoury flavour, a distinctive fish aroma, and a chewy texture characterise Bonggolan. The chewy texture of bonggolan is influenced by the filler used, namely tapioca flour. Traditionally, payus fish (*Elops hawaiiensis*) is commonly used as the main raw material for bonggolan production. Payus fish is known to have a high protein content (18.44%) and a low fat content (1.16%) [3].

The characteristic fish flavor of bonggolan produced by micro, small, and medium enterprises (MSMEs) in Gresik Regency often varies. These differences are primarily caused by variations in the composition of the fish raw materials used. In general, product quality assessment cannot rely solely on objective property analysis but must also include sensory attributes. Sensory testing of fish bonggolan can be conducted to identify sensory characteristics and consumer acceptance, commonly referred to as sensory analysis or sensory evaluation [4]. Sensory attribute profiling is one of the most important methods for measuring, analyzing, and comparing the sensory properties of food products [5].

Currently, the *Rate-All-That-Apply* (RATA) method is one of the most popular consumer-based sensory evaluation approaches. This method allows differences in sensory attributes among samples to be objectively identified through direct assessments by panellists or consumers [6]. Therefore, this study aimed to identify the sensory attribute profiles of fish bonggolan produced by several producers in Sidayu District using the RATA (Rate-All-That-Apply) method and to analyse the sensory attributes that influence consumer preferences, as a basis for product quality improvement and market standard determination.

1.2. Literature Review

1.2.1. Fish Bonggolan

Bonggolan is a traditional fish-based snack from Gresik and represents the creativity of coastal communities in utilizing marine resources. This snack is cooked by wrapping it in banana leaves and steaming it, resulting in an elongated, chewy shape [7]. Generally, payus fish (Elops hawaiiensis) is the main raw material for bonggolan due to its high protein content (18.44%) and low-fat content (1.16%). Its limited availability has encouraged communities, particularly MSMEs in Gresik, to switch to milkfish (Chanos chanos) as an alternative raw material, as it has a similar flavor profile and higher protein content (20.49%) with lower fat content (0.853%) compared to payus fish [3].

Sensory attributes identified in fish bonggolan include a strong savory aroma from garlic, a fishy aroma from fish, and a caramelized aroma resulting from sugar heating; a chewy texture from the raw materials used and a hard texture when consumed cold; a brownish color caused by the Maillard reaction and a bright color derived from flour; as well as savory taste from fish, garlic, and salt, salty taste from salt, and sweet taste from sugar that acts as a salt neutralizer [3].

1.2.2. Sensory Evaluation

Sensory properties are attributes of food products that can be assessed using the human senses. Sensory analysis can be conducted to evaluate production processes, inspect final product quality, or support new product development [8]. Sensory testing is an important method for evaluating food products using human senses, including color, aroma, taste, texture, aftertaste, and overall acceptance [9]. Sensory evaluation can be conducted using product- or consumer-based approaches [6]. One widely used consumer-based sensory profiling method for determining food product sensory profiles is the Rate-All-That-Apply (RATA) method [10].

The advantage of RATA lies in its ability to generate intensity scores for specific sensory attributes that cannot be obtained through the CATA method. RATA testing is commonly conducted alongside hedonic tests to assess consumer preference levels [11]. RATA testing includes four stages: determination of sensory attributes, panelist selection, product testing, and data analysis [12].

1.3. Research Objective

This study aimed to identify the sensory attribute profiles of fish bonggolan products from six different MSMEs in Sidayu District and to compare sensory attributes contributing to consumer acceptance using the RATA method.

2. MATERIALS AND METHODS

The study was conducted from September to January 2025/2026 and involved sensory attribute profiling of fish bonggolan at the sensory evaluation laboratory of UPN Veteran East Java and in the Sidayu District area. The material used in this study was fish bonggolan obtained from six different MSMEs in Sidayu District, Gresik Regency. The six samples differed in processing methods and formulation. Five samples used mixed marine fish, while one sample used payus fish or kuniran fish as the raw material. Differences were also found in the proportions of raw materials and fillers used, namely between fish, tapioca flour, and wheat flour. Steaming duration also varied among samples, influencing their sensory characteristics.

The equipment used included sample plates, sample labels, tasting booths, toothpicks, questionnaires, pens, and XLSTAT software for statistical analysis. Sensory evaluation involved 10 semi-trained panellists (5 male and 5 female) in a Focus Group Discussion (FGD) to determine sensory attributes, followed by sensory testing with 100 untrained panellists. Evaluated attributes included aroma, color, taste, and texture. The RATA method was used to identify relevant attributes and assess their intensity using a 6-point scale, followed by a hedonic test using a 5-point preference scale. Samples were presented using random three-digit codes.

Data were analyzed using the Kruskal–Wallis test followed by Dunn's post hoc test to identify significant differences among samples. PCA was used to visualize relationships between attributes and samples, while preference mapping displayed panelists' preference levels through contour plots with color gradients from red (80–100% liking) to dark blue (0–20% liking).].

3. RESULT AND DISCUSSION

3.1. Focus Group Discussion (FGD)

The FGD panelists consisted of 10 selected individuals who met the established criteria. Each panelist was given the opportunity to add or remove attributes from the table provided in the questionnaire. The FGD was conducted in three sessions. The first session involved the 10 selected panelists tasting the bonggolan samples to familiarize themselves with the product. This familiarization allowed panelists in subsequent sessions to better perceive and evaluate the sensory attributes of the bonggolan products. The FGD results identified 17 sensory attributes, presented in Table 1, which were subsequently used in the RATA testing. These sensory attributes were grouped into four parameters: aroma (umami, fishy, smoky, starchy, leafy), color (brown, bright, white, grey, green), taste (umami, salty, sweet, fishy), and texture (hardness, gritty, chewiness).

These attributes represent the sensory characteristics perceived by the FGD panellists in the fish bonggolan samples. Through direct observation and discussion, 17 attributes were identified as the most representative of the product. These attributes were subsequently used as references in the RATA testing..

Table 1. Sensory attributes identified from Focus Group Discussion (FGD)

No	Attribute	Description
1	Umami Aroma	Savory aroma derived from the addition of flavor enhancers and naturally occurring amino acids/glutamic acid in fish
2	Fishy Aroma	Aroma associated with raw marine fish with a strong fishy note
3	Smoky Aroma	Aroma related to smoke resulting from the heating process
4	Starchy Aroma	Aroma associated with heated starch
5	Leafy Aroma	Aroma associated with heated banana leaves
6	Brown Color	Sample appears brownish, associated with the Maillard reaction between sugar and protein
7	Bright Color	Sample appears bright, associated with the use of fish and tapioca flour
8	White Color	Sample appears white, associated with the use of fish and tapioca flour
9	Grey Color	Sample appears greyish as a result of the steaming process
10	Green Color	Sample appears greenish, associated with the color of banana leaf wrapping
11	Umami Taste	Taste derived from glutamic acid in fish protein and the addition of flavor enhancers
12	Salty Taste	Salty taste associated with the addition of salt
13	Sweet Taste	Taste stimulated by sucrose
14	Fishy Taste	Characteristic fish taste with a slight fishy note
15	Hardness	Sample has a hard and compact texture associated with the use of flour as a filler
16	Gritty	Sample has a coarse texture due to the presence of fish bones
17	Chewiness	Sample has a chewy texture due to the proportion of fish raw material

3.2. Sensory Attribute Profiling of Fish Bonggolan Using RATA Method

The FGD resulted in agreement on 17 sensory attributes to serve as sensory attribute parameters in the RATA method. The RATA test data were subsequently analyzed using several statistical methods, including the Kruskal-Wallis test, Principal Component Analysis (PCA), and preference mapping. These analyses aimed to determine differences among samples and to explain the overall sensory characteristics and consumer preferences for each product. The Kruskal-Wallis test was conducted to identify sensory attributes exhibited by each sample. The analysis results showed p-values for each observed sensory attribute, as presented in **Table 2.** These values were used to determine whether significant differences existed among samples for each attribute. The results indicated that most samples showed significant differences in sensory attributes, as indicated by p-values < 0.05.

Based on the overall attribute analysis, two attributes did not show significant differences among samples, namely leafy aroma (p-value = 0.237) and umami taste (p-value = 0.346). Variations in significant differences were influenced by the intensity of attributes perceived by the panelists for each sample. These differences may be attributed to variations in ingredient composition and/or product processing conditions.

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Table 2. Overall p-values of Sensory Attributes of Fish Bonggolan

No	Sensory Attribute	p-value
1	Umami Aroma	**0,000**
2	Fishy Aroma	**< 0,0001**
3	Smoky Aroma	**< 0,0001**
4	Starchy Aroma	**< 0,0001**
5	Leafy Aroma	0,237
6	Brown Color	**< 0,0001**
7	Bright Color	**< 0,0001**
8	White Color	**< 0,0001**
9	Grey Color	**< 0,0001**
10	Green Color	**< 0,0001**
11	Umami Taste	0,346
12	Salty Taste	**0,017**
13	Sweet Taste	**< 0,0001**
14	Fishy Taste	**< 0,0001**
15	Hardness	**< 0,0001**
16	Gritty	**< 0,0001**
17	Chewiness	**< 0,0001**

Note: Values shown in bold in the original table indicate significant differences among bonggolan samples for each attribute at α = 5%..

3.2.1. Panelists' Responses to Sensory Attributes

Significant differences in sensory attributes were analysed using the Kruskal–Wallis test in XLSTAT; the results are presented in Table 4. Attributes with p-values < 0.05 were considered statistically significant. Dunn's post hoc test at a 5% significance level was subsequently performed to identify specific differences among samples.

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Panellists observed significant differences in aroma intensity among the fish bonggolan samples. Sample P1 exhibited the highest umami aroma, which was attributed to the proportion of fish used. Umami aroma in fish-based products arises from glutamic amino acids naturally present in fish [13]. The highest fishy aroma was observed in sample P2, likely due to the longer cooking time. Trimethylamine (TMA) is the primary compound responsible for fishy aroma in fish and is characterized by its distinctive fish-like odor [14]. In fish muscle, bacterial activity reduces trimethylamine oxide (TMAO) to trimethylamine (TMA), dimethylamine, and formaldehyde through enzymatic reactions, a process accelerated at high temperatures [15].

Table 3. Intensity of Sensory Attributes of Fish Bonggolan

Sensory Attribute	Sample					
	P1	**P2**	**P3**	**P4**	**P5**	**P6**
Umami Aroma	2.95^{b}	2.67^{ab}	2.76^{ab}	2.35^{a}	2.22^{a}	2.25^{a}
Fishy Aroma	3.42^{b}	4.15^{c}	3.42^{b}	2.64^{a}	3.11^{ab}	2.93^{ab}
Smoky Aroma	2.66^{b}	1.46^{a}	1.64^{a}	1.26^{a}	3^{b}	1.79^{a}
Starchy Aroma	1.45^{a}	1.46^{ab}	1.87^{abc}	2.32^{c}	1.53^{ab}	2.08^{bc}
Leafy Aroma	1.54^{a}	1.24^{a}	1.61^{a}	1.58^{a}	1.39^{a}	1.68^{a}
Brown Color	3.7^{c}	1.2^{a}	0.98^{a}	0.69^{a}	1.26^{a}	2.24^{b}
Bright Color	0.99^{a}	2.62^{b}	3.43^{c}	1.55^{a}	2.58^{b}	1.57^{a}
White Color	0.47^{a}	2.22^{de}	2.86^{e}	1.45^{bc}	2.06^{cd}	1.07^{b}
Grey Color	1.47^{a}	2.85^{b}	2.08^{a}	3.92^{c}	2.88^{b}	2.94^{b}
Green Color	1.07^{b}	1.06^{b}	0.61^{a}	1.51^{b}	0.62^{a}	1.08^{b}
Umami Taste	2.95^{a}	3.01^{a}	3.11^{a}	3.11^{a}	2.83^{a}	2.87^{a}
Salty Taste	2.37^{ab}	2.32^{a}	2.45^{ab}	2.78^{b}	2.37^{ab}	2.6^{ab}
Sweet Taste	1.77^{ab}	2.69^{d}	2.41^{cd}	2.32^{bcd}	1.7^{a}	1.91^{abc}
Fishy Taste	3.82^{bc}	4.03^{c}	3.27^{ab}	2.87^{a}	2.99^{a}	3.08^{a}
Hardness	1.87^{a}	2.78^{c}	3.42^{d}	2.62^{bc}	2.1^{ab}	3.01^{cd}
Gritty	2.49^{b}	2.88^{b}	1.43^{a}	1.26^{a}	1.67^{a}	1.59^{a}
Chewiness	3.88^{b}	3.12^{a}	2.93^{a}	3.62^{b}	3.93^{b}	2.97^{a}

Note: Mean values followed by different letters indicate significant differences ($p \leq 0.05$). Scale criteria: 1 (low), 2 (somewhat low), 3 (moderate), 4 (somewhat high), 5 (high).

The highest smoky aroma was detected in sample P5, which was attributed to the use of firewood during processing, unlike the other samples. The use of firewood results in uncontrolled temperature fluctuations and smoke that can be absorbed into the product [16]. The highest starchy aroma was observed in sample P4, which contained wheat flour as a filler. Starch from cereals such as corn and wheat may retain a cereal-like flavour, contributing to the development of starchy aroma in food products [17]. A leafy aroma emerged from using banana leaves as product wrapping. Banana leaves contain polyphenols that generate a distinctive "traditional" aroma when heated [18].

The highest brown color intensity was found in sample P1, which had a higher proportion of fish. Protein and amino acid content in fish influence product colour; higher fish proportions result in a more dominant brown colour [19]. The highest brightness and whiteness intensities were observed in sample P3, which used fish with a higher yield of white flesh. Fish with higher white flesh yield produce brighter and whiter product coloration [20]. The highest grey color intensity was detected in sample P4 due to the addition of wheat flour as a filler. The use of wheat flour can result in a greyer and duller product appearance [21]. The highest green colour intensity was also observed in sample P4, likely due to the banana leaf wrapping and the duration of heating. Chlorophyll content decreases during heating, as organic acids released from plant tissues promote the formation of pheophytin, a reaction that converts chlorophyll from green to brown [22].

Umami taste did not differ significantly among samples, which was likely due to the similarity of the raw materials used. Fish meat, as the main raw material in all samples, contributed high levels of umami-forming compounds. Umami taste operates through a strong synergistic effect between amino acids and nucleotides (such as IMP and GMP) that bind to the T1R1 and T1R3 taste receptors on the human tongue. Because all samples used fish, the concentration of umami compounds likely exceeded the detection threshold and reached sensory saturation [23]. The highest salty taste intensity was observed in sample P6, likely due to a higher proportion of added salt. The perceived intensity of the salty taste of food products is directly related to the level of salt added [24]. The highest sweet taste intensity was observed in sample P2, which may be attributed to the added sugar. The addition of glucose, sucrose, starch, and other carbohydrates can enhance flavor, with sucrose specifically contributing sweetness [25]. The highest fishy taste intensity was also observed in sample P2, possibly due to longer steaming duration. Prolonged steaming can induce lipid oxidation, leading to fatty acid degradation. Lipid oxidation is closely associated with changes in aroma and taste in fishery products [15].

The highest hardness texture was observed in sample P3, likely due to starch retrogradation under prolonged cold conditions. Retrogradation leads to increased starch crystallinity, gel hardness, and water release from the system (syneresis) during storage, resulting in a harder product texture [26]. The highest gritty texture was observed in sample P2, likely due to processing conditions. Improper separation of fish meat from bones can result in bone fragments remaining in the bonggolan dough, leading to a coarse texture [27]. The chewiness texture was influenced by the proportions of the raw fish material and tapioca flour filler. Higher flour proportions tend to reduce chewiness. Chewiness increases with a higher fish-to-tapioca ratio, as fish proteins bind water and form gel networks through hydrogen and disulfide bonds, resulting in a more elastic texture [28].

3.2.2 Panelists, Response to Bonggolan Samples

Each sample exhibited sensory attributes that differed from those of the other samples. Likewise, panelists' responses varied across samples. Differences in sensory attributes among samples led to variations in panellists' responses to the sensory characteristics of fish bonggolan. The sensory attributes of the six fish bonggolan samples are illustrated in the spider chart shown in **Figure 1**.'

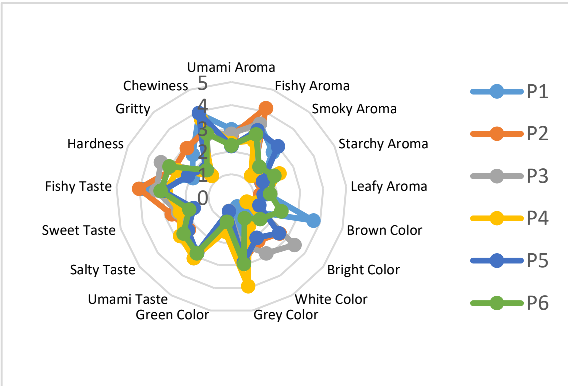

Figure 1 Spider chart fish bonggolan

Based on Figure 1, the attributes with the highest and lowest intensity values for each sensory parameter can be identified. The highest intensity values among the sensory parameters were observed for fishy aroma, grey color, fishy taste, and chewiness. In contrast, the lowest intensity values were found for leafy aroma, green color, sweet taste, and gritty texture.

3.3. Principal Component Analisys (PCA)

Principal Component Analysis (PCA) was employed to identify and visualise differences in perception and interactions among sensory attributes in greater depth using biplot graphs [12]. The biplot provides valuable information for understanding product positioning relative to an ideal product, which can serve as a basis for product reformulation to better align with consumer preferences [29].

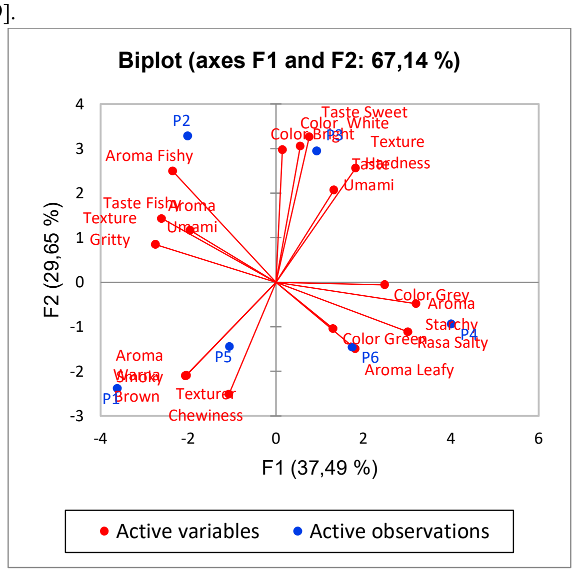

Figure 2. PCA Biplot of Fish Bonggolan

Based on **Figure 2,** sample P3 was characterised by a sweet taste, a white colour, a bright colour, an umami taste, and hardness. The sweet taste was attributed to the addition [25]. The type of fish influenced the use of white and bright colours [30]. Umami taste resulted from glutamic amino acids present in the fish raw material [31]. At the same time, the hardness texture was associated with starch retrogradation in the product [3].

Sample P2 exhibited sensory characteristics, including a fishy taste, umami aroma, and a gritty texture. The fishy taste and aroma were caused by trimethylamine (TMA) formed during prolonged cooking [15]. Umami aroma increased due to elevated levels of free amino acids during heating [31]. The gritty texture was attributed to insufficient fine removal of fish bones during processing [27].

A brown colour, a smoky aroma, and a chewy texture characterised samples P1 and P5. The brown color was influenced by the fish raw material used [20], the smoky aroma was associated with longer cooking time [32], and the chewy texture was influenced by the proportion of fish raw material and tapioca flour as a filler [28]. Samples P4 and P6 exhibited sensory characteristics, including leafy and starchy aromas, green and grey colours, and a salty taste. The leafy aroma and green color were associated with the use of banana leaves as packaging material [22]. The starchy aroma was influenced by the use of filler ingredients [17], the grey color resulted from the filler material used [21], and the salty taste was associated with salt addition [33].

3.4. Preference Mapping of Fish Bonggolan Panelist

Preference mapping is a widely used technique for helping researchers understand the sensory attributes preferred by consumers [34]. Variations in consumer preferences are visually represented in contour plots that use different colors to indicate varying levels of liking. The color gradients in the plots illustrate differences in preference among samples.

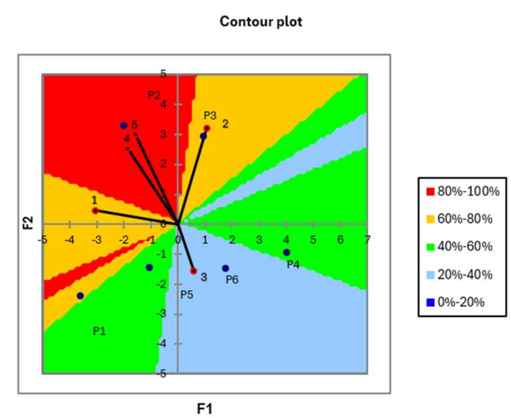

Figure 3. Contour Plot of Consumer Preference for Fish Bonggolan

The contour plot in Figure 3 from the preference mapping analysis shows that sample P2 is located in the red area, indicating a liking score of 80–100% above the average. Sample P3 is positioned in the yellow area, corresponding to a liking score of 60–80% above the average. Sample P1 lies between the yellow and green areas, indicating a liking level ranging from 40–80% above the average. Samples P4 and P5 are located in the green area, representing liking scores of 40–60% above the average. In contrast, sample P6 is located in a different region, namely the light blue area, indicating a relatively low liking score of 20–40% above the average. These findings indicate that sample P2 has a higher potential for consumer acceptance compared to the other samples and may serve as a reference for product development.

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4. CONCLUSION

This study successfully identified the sensory profiles of traditional fish bonggolan from Gresik. The analysis revealed four distinct sensory profiles, with significant variations in aroma, color, taste, and texture among the samples. A brown colour, a smoky aroma, and a chewy texture characterised sample P1. A fishy taste, umami aroma, and a gritty texture characterised sample P2. Sample P3 exhibited sweet taste, white color, bright color, umami taste, and hard texture.

Meanwhile, samples P4 and P6 were characterised by leafy aroma, starchy aroma, green colour, grey colour, and a salty taste. Sample P2 achieved the highest liking score (80–100%), indicating that consumers preferred this sensory profile most. In contrast, sample P6 had the lowest liking score (20–40%) and was identified as the sample with the least preferred sensory characteristics by the panellists.

REFERENCE

[1] Nabillah, R. S., Ismawati, R., Handajani, S., & Astuti, N. (2021). Studi Kesukaan Panelis Terhadap Nasi Krawu Makanan Khas Gresik. Jurnal Tata Boga, 10(2), 373-379.Saputri, G. A. R., & Febriyanti, F. (2019). Penetapan Kadar Protein Udang Air Tawar dan Udang Air Laut dengan Metode Kjedahl. *Jurnal Farmasi Malahayati*, *2*(2), 137-144.

[2] Pharwati, S., & Sasmita, I. R. A. (2023). Pengaruh Penambahan Daging Ikan Kembung (Rastrelliger kanagurta) terhadap Karakteristik Sifat Fisik dan Sensori Bonggolan. In NaCIA (National Conference on Innovative Agriculture) (pp. 12-21).

[3] Amaliyah, N. A., Rosida, R., & Priyanto, A. D. (2024). Physicochemical and Organoleptic Properties of Milkfish Bonggolan (Study Proportion of Fish Meat: Sago Flour and Addition of Sodium tripolyposphate). Journal of Tropical Agricultural Engineering and Biosystems-Jurnal Keteknikan Pertanian Tropis dan Biosistem, 12(2), 94-104.

[4] Adawiyah, I. D. R., Dase Hunaefi, S. T. P., St, M. F., & Nurtama, I. B. (2024). Evaluasi Sensori Produk Pangan. Bumi Aksara.

[5] Syari, R. M., Sarofa, U., & Pratiwi, Y. S. (2025). Analisis Profil Atribut Sensori Bandeng Asap Produksi UMKM Kabupaten Sidoarjo dengan Metode RATA (Rate-All-That-Apply). BUANA SAINS, 25(1), 1-10.

[6] Adawiyah, I. D. R., Dase Hunaefi, S. T. P., St, M. F., & Nurtama, I. B. (2024). Evaluasi Sensori Produk Pangan. Bumi Aksara.

[7] Atikoh, I. (2025). Kajian Etnolinguistik Pada Kuliner Khas Kabupaten Gresik Sebagai Representasi Identitas Budaya Lokal.

[8] David, W., & David, F. (2020). Analisis Sensori Lanjut Untuk Industri Pangan dengan R: Preference mapping dan survival analysis.

[9] Agustina, R., Hartuti, S., & Rubawan, P. I. (2023). Penilaian sensori pliek-u yang difermentasikan secara alami. Jurnal Ilmiah Mahasiswa Pertanian, 8(2), 385-391.

[10] Winarti, S., & Adawiyah, I. (2024). Pengaruh Penambahan Prebiotik Inulin Terhadap Profil Sensoris Kaldu Bubuk Rasa Sapi "HALAWA". Jurnal Teknologi Pangan, 18(2).

[11] Mahdi, S., Astawan, M., Wulandari, N., & Muhandri, T. (2023). Sensory profiling of Tempe functional drink powder using rate-all-that-apply method. Food Res, 7, 19-26.

[12] Nurlaela, R. S., Pertiwi, S. R. R., & Maulidi, M. R. (2025). Profil Sensori Marshmallow dengan Penambahan Sari Buah Kecombrang (Etlingera elatior) Menggunakan Metode RATA. Jurnal Ilmiah Pangan Halal, 7(1), 117-127.

[13] Mouritsen, O. G., Duelandb, L., Calleja, G., and Frøst, M. B. (2017) 'Flavour of fermented fish, insect, game, and pea sauces: Garum revisited', International Journal of Gastronomy and Food Science, 9, pp. 16−28

[14] Noviana, A., Palupi, E., Giriwono, P. E., & Rimbawan, R. (2024). Decreasing fishy odour from catfish (Clarias sp.) flour as a food ingredient by using various soaking solutions. Food Res., 8(1), 349-358.

[15] Liu, L., Zhao, Y., Zeng, M., & Xu, X. (2024). Research progress of fishy odor in aquatic products: From substance identification, formation mechanism, to elimination pathway. Food Research International, 178, 113914.

[16] Głuchowski, A., Czarniecka-Skubina, E., Wasiak-Zys, G., & Nowak, D. 2019. Effect of various cooking methods on technological and sensory quality of Atlantic Salmon (Salmo salar). Foods, 8(8), 323.

[17] Nasir, A., Dasir, D., & Patimah, S. (2021). Nlai Sensoris Aroma dan Rasa Pempek Dari Jenis Olahan Daging Ikan Patin (Pangasius pangasius) dan Perbandingan Tepung Tapoka. Edible: Jurnal Penelitian Ilmu-ilmu Teknologi Pangan, 8(1), 1-11.

[18] Verma, A. C. (2015). Chemical Composition and Applications of the Banana Tree. Naveen Shadh Sansar (An nternatonal Refereed/Peer Revew Multdsciplinary Research Journal), 45(4), 1390-1393.

[19] Shabrina, Z.U dan Susanto, W.H. 2017. Pengaruh suhu dan lama pengeringan dengan metode cabinet dryer terhadap karakteristik manisan kering apel varietas anna (Malus domestica Borkh). Jurnal Pangan dan Argoindustri, 9(4), 57-63.

[20] Fadhallah, E. G., Nurainy, F., & Suroso, E. (2021). Karakteristik sensori, kimia dan fisik pempek dari ikan tenggiri dan ikan kiter pada berbagai formulasi. Jurnal Penelitian Pertanian Terapan, 21(1), 16-23.

[21] Zaidana, N., Bahar, A., Suwardiah, D. K., & Astuti, N. (2022). Pengaruh Penambahan Tepung Terigu dan Puree Wortel (Daucus carota L.) terhadap Sifat Organoleptik Hidangan Pempek Lenjer. Jurnal Tata Boga, 11(3), 82-93.

[22] Puspita, D., Sihombing, M., Juniarto, N., & Wacana, S. (2019). Kandungan Klorofil Pada Sajian Krim Sup dari Caulerpa racemosa. In Prosiding Seminar Nasional Kesehatan "Transformasi Bidang Kesehatan di Era Industri 4.0 (pp. 48-56).

[23] Wang, W., Zhou, X., & Liu, Y. (2020). Characterization and evaluation of umami taste: A review. TrAC Trends in Analytical Chemistry, 127, 115876.

[24] Amal, B. I., Hermanianto, J., & Hunaefi, D. (2023). Optimization of pempek formula with the addition of soy protein isolate paste based on consumer preference.

[25] Widiantara T., Hervelly., dan 'Afiah D., N. (2018). Pengaruh Perbandingan Gula Merah Dengan Sukrosa dan Perbandingan Tepung Jagung, Ubi Jalar Dengan Kacang Hijau Terhadap Karakteristik Jenang. Pasundan Food Technology Journal, Volume 5, No.1

[26] Scott, G., & Awika, J. M. (2023). Effect of protein–starch interactions on starch retrogradation and implications for food product quality. Comprehensive Reviews in Food Science and Food Safety, 22(3), 2081-2111.

[27] Trisnawati, M. R., Wijayanti, I., & Riyadi, P. H. (2024). Characteristics of Nile Tilapia (Oreochromis niloticus) Fish balls with The Addition of Asian Sea Bass (Lates calcarifer) Bones Bio-calcium.

[28] Aminullah, A., Marwiyah, S. W., & Kusumaningrum, I. (2021). Application of Catfish Flour on Texture and Hedonic Profiles of Pempek Lenjer. Agrointek: Jurnal Teknologi Industri Pertanian, 15(2), 441-451.

[29] Fitriyah, R. S. N. (2025). Aplikasi Metode Check-All-That-Apply (CATA) Pada Pengujian Profil Sensori Underrecognized Product Minuman Cokelat Bubuk. Jurnal Sains dan Teknologi Pangan, 10(2).

[30] Cahyani, A. G., Bahar, A., Sulandari, L., & Pangesthi, L. (2025). Pengaruh Jumlah Daging Ikan Kuniran (Upeneus Sulphureus) dan Puree Edamame (Glycine max L. Merril) Terhadap Sifat Organoleptik Kerupuk. RIGGS: Journal of Artificial Intelligence and Digital Business, 4(2), 6687-6697.

[31] Kurihara, K. (2015). Umami the fifth basic taste: history of studies on receptor mechanisms and role as a food flavor. BioMed research international, 2015(1), 189402.

[32] Hustiany, R. (2016). Reaksi maillard pembentuk citarasa dan warna pada produk pangan.

[33] Riswanda, Y. D., Sutiadiningsih, A., Bahar, A., & Romadhoni, I. F. (2024). Inovasi Pembuatan Pempek Lenjer Ikan Bandeng (Chanos chanos), dan Puree Kacang Tunggak dengan Penambahan Jamur Tiram. Edukasi Elita: Jurnal Inovasi Pendidikan, 1(4).

[34] Afrianto, R., Restuhadi, F., & Zalfiatri, Y. (2017). Analisis pemetaan kesukaan konsumen pada produk bolu kemojo di kalangan mahasiswa Fakultas Pertanian Universitas Riau (Doctoral dissertation, Riau University).