

Effect of An Additional Amount of Fish and Fermentation Time on The Sensory Properties of The Lemea

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ABSTRACT (10PT)

Lemea, a traditional fermented food of the Rejang people in Bengkulu, is made from young bamboo and fish. The fish commonly used in the making Lemea is Mozambique tilapia or Mujair (*Oreochromis mossambicus*). The fermentation process typically lasts between 3 to 7 days. This study aimed to assess the sensory characteristics, including taste, color, texture, and aroma, of Lemea, based on the preferences of panelists. The variations examined were fermentation duration, and the amount of Mujair fish added. The research followed a completely randomized design, incorporating three fermentation durations (24, 96, and 144 hours) and three fish quantities (250 grams, 500 grams, and 750 grams). Sensory evaluations were conducted on the fermented samples, encompassing taste, aroma, texture, and color. The data revealed that the most favored taste and texture of Lemea were achieved with 500 grams of fish and a fermentation duration of 144 hours (J2W3). Likewise, the preferred aroma and color were observed in the sample with 750 grams of fish and 24 hours of fermentation (J3W1). The data analysis indicated that the sample with 500 grams of fish and a fermentation duration of 144 hours (J2W3) exhibited the most favorable sensory characteristics (taste, aroma, texture, and color). Thus, the quantity of fish added and the duration of fermentation influenced the sensory attributes of Lemea.

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1. Introduction

Traditional foods are eaten by members of particular ethnic groups and geographic areas (Reddy and van Dam et al., 2020). It is prepared utilizing local ingredients and catering to the taste preferences of the local community. One such traditional food in Bengkulu Province is Lemea, a fish-based fermented food unique to the Rejang tribe (Liyoni et al., 2020). Lemea is a fermented food that combines diced young bamboo and fish. Its distinct aroma arises from fermentation when fish is mixed with young bamboo shoots. The primary types of bamboo used in Lemea preparation are Betung (*Dendrocalamus asper*) and Mayan (*Gigantochloa robusta*) (Nuryani et al., 2012). *Oreochromis mossambicus*, commonly known as Mozambique tilapia or Mujair, is the favored fish species utilized in the preparation of Lemea. This freshwater species is abundantly found in Rejang Lebong. As a result, the Rejang community has convenient access to Mujair fish for their consumption needs. According to Oktariato et al. (2018), Lemea is prepared by utilizing 500 grams

of fish and 1 kilogram of diced bamboo shoots. These components undergo a fermentation process lasting for three days under anaerobic conditions.

Lemea, as a fermented product, acquires a unique and intense flavor and aroma due to the chemical breakdown of its raw materials. The exact processes and raw materials required for producing high-quality Lemea remain uncertain. Adjustments are necessary to achieve desirable Lemea quality using traditional methods to lessen the distinctive taste and aroma, making it more appealing to a broader audience. Historically, Lemea fermentation has been conducted spontaneously or traditionally without precise ingredient measurements, relying solely on the maker's preferences. Consequently, this approach has led to inconsistencies and variations in the resulting Lemea products. This study aims to assess the panelists' preference for the aroma, taste, texture, and color of Lemea by examining the effects of different fermentation durations and varying amounts of Mujair fish that are added.

2. Methods

Preparation of the material

Nine kilograms of bamboo shoots were divided into 5×0.5 cm segments. Afterward, the bamboo stalks were washed extensively using fresh water. Moreover, 4.5 kilograms of Mujair fish (*Oreochromis mossambicus*) were acquired and appropriately prepared. The fish was sliced into pieces approximately 5-7 cm long and boiled for approximately 15 minutes.

Preparation of Lemea

One kilogram of sliced bamboo shoots was taken and combined with varying quantities of Mujair fish: 250 grams (J1), 500 grams (J2), and 750 grams (J3). The mixture was supplemented with 200 milliliters of water to support fermentation. The fermentation was conducted under anaerobic conditions for durations of 48 hours (W1), 96 hours (W2), and 144 hours (W3). Subsequently, the fermented bamboo shoots and fish were retrieved and placed in a pan. In the same pan, the fermented mixture was blended with finely ground ingredients, which included 100 grams of chili, 3 grams of garlic, 5 grams of shallots, 10 grams of salt, and 5 grams of lemongrass. The resulting mixture, Lemea, was cooked at approximately 100 °C for 15 minutes until it thickened.

Sensory analysis of Lemea

The quality of the Lemea was assessed through sensory evaluation. A group of 15 individuals was selected as testers and provided nine Lemea samples to evaluate. Each sample was rated on a scale ranging from 1 (intensely disliked) to 9 (strongly liked). The Lemea was considered liked by panelists who scored ≥ 5 , while those who gave a ≤ 5 disliked it. During this process, the taste, aroma, texture, and color of the Lemea were analyzed and evaluated.

Statistical analysis of data

The data displayed represents the mean values. Statistical analysis was conducted using SPSS Software to assess the sensory scores of the fermented Lemea and determine whether there were any significant variations among the tested samples.

3. Results and Discussion

Following the fermentation process, the panelists identified several aromas in Lemea, including a sour aroma, a fishy aroma, and a fermented bamboo shoot aroma. The sour aroma is a result of bacterial activity. According to Darna et al. (2018), changes in aroma and taste can be attributed to the activity of bacteria or microorganisms. The duration of fermentation influences the changes in Lemea's aroma. After the processing stage, the sourness of Lemea's aroma diminishes, and the intensity of the fishy aroma decreases. This alteration occurs due to the cooking process and adding various kitchen spices like chili, salt, and others, transforming the aroma profile. The outcomes of Lemea processing are depicted in Figure 1.

The preference data were subjected to statistical analysis. The normality test using the Shapiro-Wilk test revealed that the collected data does not follow a normal distribution, primarily due to the limited sample size, with a significance level of 5% ($p < 0.050$). The sensory evaluation, specifically for the

aroma, was assessed using the Kruskal-Wallis test, which indicated a significant distinction among the different samples. Pairwise comparisons were employed to determine the significant differences between the samples at a significance level of 5% ($p < 0.050$).

The preference levels based on aroma, as determined by 15 panelists, demonstrate that treatment J3W1 obtained the highest total score of 117 (Like). Conversely, treatment J1W1 received the lowest evaluation score of 61 (Slightly like), as shown in Figure 2. Panelists preferred treatment J3W1 due to its pronounced fishy aroma and distinctive fermented bamboo shoot aroma, distinguishing it from treatment J1W1. The defining characteristics of Lemea sambal's aroma are its sourness and fishiness. Treatment J1W1 garnered the lowest preference score since it lacked the sour and fishy aroma, thus making it less preferred (Slightly like) among the panelists.

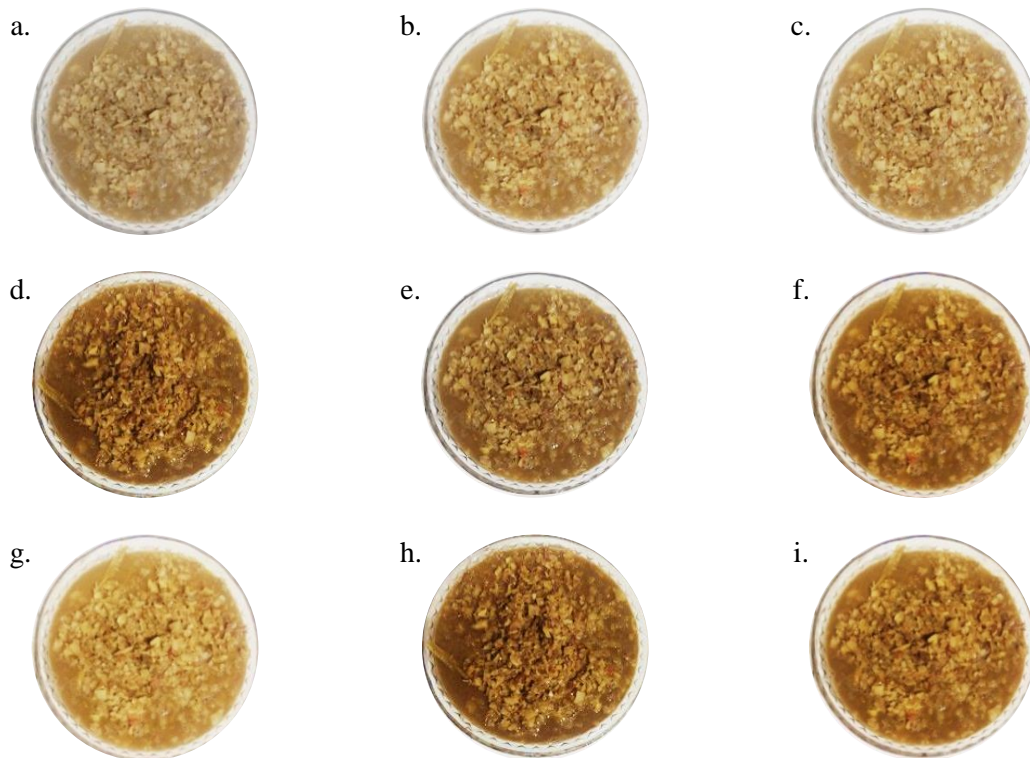


Figure 1. Lemea sample (a.) J1W1, (b.) J1W2, (c.) J1W3, (d.) J2W1, (e.) J2W2, (f.) J2W3, (g.) J3W1, (h.) J3W2 and (i.) J3W3

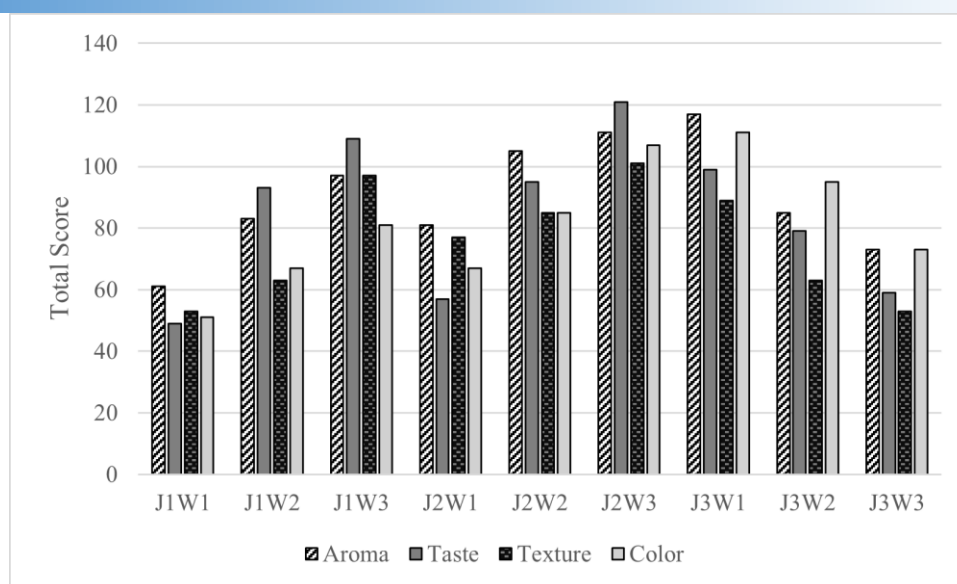


Figure 2. Sensory evaluation test results

Table 1. Sensory evaluation test results

No	Sample	Aroma	Taste	Texture	Color
1	J1W1	61 ^a	49 ^a	53 ^a	51 ^a
2	J1W2	83 ^{abcd}	93 ^{abcd}	63 ^{ab}	67 ^{ab}
3	J1W3	97 ^{bcde}	109 ^d	97 ^c	81 ^{abcd}
4	J2W1	81 ^{abc}	57 ^{ab}	77 ^{ab}	67 ^{abc}
5	J2W2	105 ^{cde}	95 ^{bcd}	85 ^b	85 ^{bcd}
6	J2W3	111 ^{de}	121 ^e	101 ^c	107 ^d
7	J3W1	117 ^e	99 ^{cd}	89 ^b	111 ^e
8	J3W2	85 ^{abcde}	79 ^{abcd}	63 ^{ab}	95 ^d
9	J3W3	73 ^{ab}	59 ^{abc}	53 ^a	73 ^{abcd}

Note: Different capital letters indicate significant differences (P<0.05)

The organoleptic taste test of J1W1, J2W1, and J3W1 after fermentation indicated the presence of a sour taste and a bamboo shoot taste. Similarly, the panelists perceived treatments J1W2, J1W3, J2W2, J2W3, J3W2, and J3W3 as having a sour taste, bamboo shoot taste, and a fishy taste. Among these treatments, the panelists preferred taste in treatment J2W3, scoring it at 121 (Very like). The taste formulation of Lemea sambal in treatment J2W3 achieved a satisfactory level of fishiness, while the 144-hour fermentation process resulted in an appropriately sour taste. Consequently, treatment J2W3 was favored by the panelists. On the other hand, treatment J1W1 received the lowest evaluation score of 49 (Slightly like). The panelists showed less enthusiasm for treatment J1W1 due to its failure to exhibit the distinctive taste characteristic of Lemea sambal.

While evaluating sambal Lemea, the panelists assessed the texture following the fermentation phase, and they observed that the bamboo shoot components retained their firmness. In contrast, the fish surface displayed a tender consistency. According to Faridah (2019), the fermentation technique can also influence the texture of a food product. Treatment J2W3 received the highest preference level for texture, as indicated by the panelists, with a score of 101 (Like). The formulation of Lemea sambal in treatment J2W3 resulted in a moderately tender texture for the bamboo shoot parts and a very tender texture for the fish. As a result, the panelists favored treatment J2W3. Conversely, treatment J1W1 received the lowest evaluation score of 53 (Slightly like). The panelists were less inclined towards treatments J1W1 and J3W3 due to the relatively firm texture of the bamboo shoot parts after the fermentation process. This led to a decreased preference for J1W1 and J3W3 among the panelists.

In the organoleptic assessment of sambal Lemea's color, the panelists observed that treatments J1W1, J2W1, and J3W1 had a whitish-yellow color after fermentation, while treatments J2W2, J2W3, J3W2, and J3W3 had a whitish-gray color. These color variations can be attributed to differences in the amount of fish used and the duration of fermentation. After the cooking process, sambal Lemea took on a reddish hue due to adding chili during the preparation of sambal Lemea. The panelists' preference ratings indicated that the most preferred color was observed in treatment J3W1 with a 111 (Like) score. After fermentation, this treatment exhibited a whitish-gray color and transitioned to a reddish color after cooking, which can be attributed to adding chili. The lowest evaluation score was obtained in treatment J1W1 with a 51 (Slightly like) score. The shorter fermentation time resulted in a whitish-yellow color, leading to lower satisfaction among the panelists regarding this treatment.

Microbial activity and growth conditions are integral factors in the fermentation process of Lemea, as highlighted by Oktariato (2017). In the study by Okfrianti (2018), it is elucidated that Lemea, a traditional Rejang food, harbors two species of lactic acid bacteria (LAB), specifically *Lactobacillus plantarum* and the genus *Pediococcus*. LAB, which are Gram-positive bacteria exhibiting spherical or rod-shaped morphology, lack spore-forming capability (Mokoena, 2017). Notably, Jagadesswari and Vidya (2010) expound on producing bacteriocins by LAB, which comprises antimicrobial peptides or protein compounds with extracellular localization. LAB are commonly found in fermented food products such as yogurt, pickled items, vegetables, fruits, and other similar goods (Wang et al., 2021).

Fresh bamboo shoots comprise water, carbohydrates, protein, fiber, fat, vitamins A and B, riboflavin, calcium, phosphorus, and potassium (Nongdam & Tikendra, 2014). In contrast, Mujair fish exhibits nutritional attributes encompassing protein, fat, vitamin B3, and other constituents (Jamioł-Milc et al, 2021). The process of compound degradation involving carbohydrates, glucose, proteins, and analogous compounds, is facilitated by microorganisms, specifically lactic acid bacteria. The nutrients sourced from bamboo shoots and fish are employed as substrates for bacterial growth and undergo decomposition into simpler compounds. Enzymatic activity, facilitated by microorganisms within a controlled environment, orchestrates the conversion of fish proteins into simplified compounds.

The fermentation process of Lemea can be influenced by the quantity of fish used, specifically at weights of 250, 500, and 750 grams. This influence stems from higher protein and carbohydrate levels in a product facilitating microorganisms' rapid and optimal growth under controlled conditions. The duration of Lemea fermentation plays a role in determining the acidity level, whereby prolonged fermentation results in a decrease in pH, indicating microbial activity. The development of a sour taste in Lemea can be attributed to producing organic acids during fermentation. Lactic acid bacteria primarily reduce pH (Zapaśnik et al., 2022). Overly prolonged fermentation can lead to a sour aroma and a decline in bacterial population due to nutrient depletion and the accumulation of toxic metabolites, such as ethanol, produced by heterofermentative lactic acid bacteria (Sharma et al., 2020). Oktariato et al. (2018) emphasize the critical role of microbial activity and growth conditions in the fermentation process of Lemea. Notably, the texture of bamboo shoots remains unchanged during the fermentation process as they possess a firm texture, and no significant alterations are observed.

4. Conclusion

In the research findings, it was observed that panelists preferred the aroma and color of Lemea in treatment J3W1 (using 750 grams of fish and fermenting for 48 hours), while in terms of taste and texture, treatment J2W3 (using 500 grams of fish and fermenting for 144 hours) was favored. Therefore, the quantity of fish and fermentation duration influence the sensory attributes of taste, aroma, texture, and color in Lemea, as assessed by the panelists.

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