

The effect of giving fermented gamal leaf extract (*Gliricidia sepium*) through drinking water on the organoleptic quality of male bali duck meat

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Abstract

Duck meat is less favored due to its tough texture and fishy aroma. The study aim was to determine the effect of fermented gamal leaf extract on organoleptic quality of male bali duck meat, using 25 panelists. The experimental design uses was a completely randomized design (CRD) consisting of 4 treatments of fermented gamal leaf extract in drinking water, namely: P0 (0%), P1 (2%), P2 (4%) and P3 (6%). The research results show that the administration of fermented gamal leaf extract has a significant effect ($P < 0.05$) on the preference levels of the panelists regarding the color, aroma, taste, texture, and overall acceptance of male bali duck meat, with the highest score at the 6% level being 3.80 (tends to really like). The hedonic quality test show that the male bali duck meat has criteria of slightly dark red color, non-fishy aroma, soft texture, and savory taste. Based on the results of this study, it can be concluded that the administration of fermented gamal leaf extract can improve the organoleptic quality of male bali duck meat, with the highest overall acceptance at the 6% administration level, with criteria: meat color is slightly dark red, non-fishy aroma, soft texture, and savory taste.

Keywords: Gamal Leaves Extract; Male Bali Duck; Meat; Organoleptic

1. Introduction

Bali duck is one of the types of local ducks that thrive in Bali, which is a dual-purpose type, meaning it can be utilized for both meat and eggs. Generally, the male bali ducks are used for meat production because they grow faster, the price of their chicks is relatively cheaper, and they have stronger immune systems. However, duck farming still has its drawbacks, such as tough meat, dark red meat color, and a fishy smell. This is what causes duck meat to be less favored by the community.

According to [18], the texture of meat is determined by the amount of connective tissue (collagen) that makes up a muscle. A higher amount of connective tissue results in meat that is tougher than that with less connective tissue. The fishy smell in duck meat is caused by the oxidation of unsaturated fatty acids [1]. Bali ducks have a high fat content, especially in the subcutaneous area, which causes the fishy smell. Duck meat contains about 60% unsaturated fatty acids of the total fat, which makes the oxidation process easier, thus producing volatile compounds that contribute to the intensity of the meat's odor [25]. In addition to lipid oxidation, the fishy aroma in duck meat is also caused by skatole found in the intestines as a result of microbial activity breaking down amino acids. The formation of skatole can be inhibited by the administration of probiotics. One effort that can be made to improve the organoleptic quality of duck meat is by administering fermented gamal leaf extract because it contains phytochemical compounds that can function as antioxidants and lactic acid bacteria that have the potential to be probiotics.

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Yohanes [24] stated that the addition of herbal formulations up to 15 ml in drinking water causes the color of broiler meat to become white, the aroma of the meat to become less fishy, the taste of the meat to become delicious, and the texture of the meat to become smooth. The research by [12] found that providing papaya leaf extract in drinking water at a concentration of 30 ml can improve the color and reduce the fishy aroma of joper chicken meat. Furthermore, [21] reported that the provision of fermented maja fruit herbal medicine (makarens herbal medicine) containing phytochemical compounds and lactic acid bacteria through feed can improve the organoleptic quality of pork with criteria of light pink color, non-fishy aroma, smooth and tender texture, as well as savory taste.

Based on this information, this research needs to be conducted to determine the effect of giving fermented gamal leaf extract through drinking water on the organoleptic quality of male bali duck meat.

2. Materials and Methods

2.1. Material

This study was conducted at the Farm of the Faculty of Animal Husbandry, Udayana University, using 60 heads of male day old duck (DOD). The ducks were kept in 20 colony battery cages made of wood and bamboo. The diet provided was commercial feed CP 511 B, and drinking water was supplemented with fermented gamal leaf extract according to the treatment. The meat samples used for the organoleptic test consisted of 300 g of the breast part for each treatment.

2.2. Methods

2.2.1. Experimental design

This study was carried out for 8 weeks using a completely randomized design (CRD) consisting of 4 treatments and 5 replications, with each replication consisting of 3 head male bali ducks. The treatments were: P0 (drinking water without fermented gamal leaf extract), P1 (drinking water + 2% fermented gamal leaf extract), P2 (drinking water + 4% fermented gamal leaf extract), and P3 (drinking water + 6% fermented gamal leaf extract).

2.2.2. The process of making fermented gamal leaf extract

As much as 1 kg of wilted gamal leaves is mixed with 1 L of water and then blended until smooth. After blending, it is filtered to separate the pulp. The gamal leaf extract is placed in a closed container (anaerobic) and then fermented using effective microorganism-4 (EM-4) at a rate of 5% of the material's weight, for 5 days. After the fermentation is complete, the fermented gamal leaf extract is ready to be mixed with drinking water and given to male bali ducks according to the treatment.

2.2.3. Provision of feed and drinking water

The rations and drinking water were provided ad libitum (always available). The provision of drinking water in treatment P0 was without the fermented gamal leaf extract, while in treatments P1, P2, and P3, 2%, 4%, and 6% were given respectively. For treatment P1 (980 ml water + 20 ml fermented gamal leaf extract), treatment P2 (960 ml water + 40 ml fermented gamal leaf extract), and treatment P3 (940 ml water and 60 ml fermented gamal leaf extract).

2.2.4. Organoleptic test procedure

The organoleptic test consists of two tests: hedonic testing and hedonic quality testing, conducted by filling out a test format by 25 semi-trained panelists. The hedonic test is designed to measure the level of preference of panelists for the tested product with scores ranging from 1-5 (1 = very disliked, 2 = disliked, 3 = liked, 4 = very liked, 5 = extremely liked), while the hedonic quality test aims to characterize the product based on the criteria present in the test format. Filling out the hedonic and hedonic quality test formats is done by marking (√) the answer according to the panelists. The assessment is made on color, aroma, flavor, texture, and overall acceptance. Before testing, the meat sample to be tested is cut into cubes (2x2 cm) and given a three-digit code for each treatment. The testing of the color and aroma of male bali duck meat is done on the raw meat, while texture and flavor testing is done using cooked meat (boiled).

2.2.5. Observed Variables

The variables observed in this study include: color, aroma, flavor, texture, and overall acceptance, conducted as follows:

Color

The color assessment is conducted visually through direct observation with the eyes on the uncooked flesh of male bali ducks. For the hedonic test, panelists are asked to rate based on their level of preference (1=very dislike, 2=dislike, 3 = like, 4 = very like, 5 = extremely like), while for the hedonic quality test, panelists are asked to tick one of the meat colors with the criteria: pale red, slightly pale red, red, slightly dark red, and dark red.

Aroma

Aroma evaluation is conducted using the sense of smell, namely the nose, where the assessment of meat aroma can be done without considering its appearance. The aroma assessment is conducted on raw male bali duck meat. For the hedonic test, panelists are asked to rate based on their level of preference (1=very dislike, 2=dislike, 3 = like, 4 = very like, 5 = extremely like), while for the hedonic quality test, panelists are asked to rate the aroma of the duck meat using the criteria: very fishy, fishy, slightly fishy, not fishy, and very not fishy.

Texture

The assessment of texture can be done in two ways, namely by using the hands through touch and pressure, as well as by using the teeth and mouth through biting and chewing. The texture assessment is conducted on boiled bali duck meat. For the hedonic test, panelists are asked to rate based on their level of preference (1=very dislike, 2=dislike, 3 = like, 4 = very like, 5 = extremely like), while for the hedonic quality test, panelists are asked to evaluate the texture of the duck meat using the criteria: very coarse/hard, somewhat coarse/hard, slightly soft, soft, and very soft.

Flavor

The flavor in organoleptic testing is a testing method that uses human senses, particularly the sense of taste, to assess and measure the taste characteristics of a food product. For the hedonic test, panelists are asked to rate based on their level of preference (1=very dislike, 2=dislike, 3 = like, 4 = very like, 5 = extremely like), while for the hedonic quality test, panelists are asked to evaluate the texture of male bali duck using the criteria: very bland, bland, slightly savory, savory, very savory.

Overall acceptance

Overall acceptance is one aspect of the sensory parameters of meat that includes the level of consumer acceptance of all sensory characteristics, such as color, aroma, texture, and taste of male bali duck meat. Panelists were asked to assess overall acceptance based on the criteria: (1) really dislike, (2) dislike, (3) like, (4) really like, (5) really like very much.

3. Results and discussion

The results of the non-parametric statistical analysis of the Kruskal-Wallis test on the organoleptic quality of male bali duck meat that was given fermented gamal leaf extract through drinking water are presented in Table 1.

Table 1 The hedonic test score of the panelists' preference for male bali duck meat added with fermented gamal leaf extract

Variable	Treatment ¹⁾				SEM ⁴⁾
	P0	P1	P2	P3	
Color	2.84 ^{a(2)}	3.24 ^b	3.60 ^c	3.76 ^c	0.07
Aroma	2.92 ^a	3.16 ^{ab}	3.36 ^{bc}	3.68 ^c	0.08
Flavor	3.08 ^a	3.44 ^{ab}	3.56 ^b	3.72 ^b	0.08
Texture	3.00 ^a	3.16 ^a	3.64 ^b	3.76 ^b	0.07
Overall acceptance ³⁾	3.04 ^a	3.34 ^a	3.72 ^b	3.80 ^b	0.07

Note: Treatment: P0: Ducks that are given drinking water without fermented gamal leaf extract; P1: Ducks given drinking water + 2% fermented gamal leaf extract; P2: Ducks given drinking water + 4% fermented gamal leaf extract; P3: Ducks given drinking water + 6% fermented gamal leaf extract; Values with different letters on the same line indicate

significant differences ($P < 0.05$); Level of preference: 1=Really dislike; 2=dislike ; 3=like; 4= Really like; 5=Really like very much ; SEM: *Standart Error of the Treatment Means*

3.1. Meat color

Color is one of the parameters that can be used as an indicator for meat selection, even though it does not affect meat quality and serves as the first impression for consumers to taste the meat [2]. The color of poultry meat is influenced by several factors such as genetics, age, sex, husbandry, and slaughter [7], as well as livestock activities [19]]. The results of the non-parametric Kruskal Wallis test showed that administering 2-6% fermented gamal leaf extract through drinking water significantly ($P < 0.05$) increased the preference score of panelists toward meat color, with the highest value in treatment P3 at 3.76 (leaning towards very liked), followed by P2 at 3.60 (leaning towards very liked), P1 at 3.24 (leaning towards liked), and P0 at 2.84 (leaning towards liked). The results reflect that the higher the level of fermented gamal leaf extract given, the more preferred the resulting duck meat is by the panelists. The results of the hedonic quality test (Figure 1) show that the color of bali duck meat in treatment P3 has the highest frequency value (50%) for a slightly dark red color. Therefore, the reason the duck meat in treatment P3 is the most preferred by the panelists is because of its slightly dark red color.

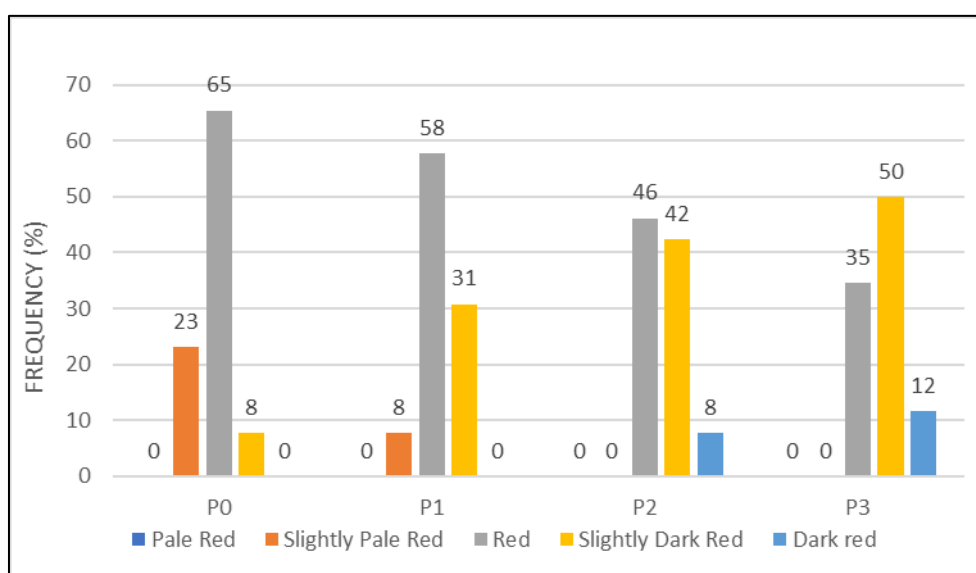


Figure 1 The results of the hedonic quality test on the color of bali duck meat given fermented gamal leaf extract through drinking water (P0=0%; P1=2%; P2=4%; P3=6%)

The reason the panelists chose a slightly dark red color is that pale-colored meat is often considered less fresh and usually indicates that the meat has been stored for a long time or has undergone improper storage processes. The slightly dark red color in meat indicates better freshness because pale meat may have experienced a decline in quality due to oxidation or pH changes, thereby reducing consumer appeal and confidence in its freshness.

The slightly dark red color in duck meat is caused by beta-carotene and phytochemical compounds in gamal leaves that can enhance the color of male bali duck meat. This opinion is in accordance with [17] and [11], who stated that beta-carotene compounds can influence the active color in meat. Furthermore, [9] states that a 6% moringa leaf extract can improve the meat color due to the content of beta-carotene and phytochemicals, thus affecting the myoglobin levels. The content of beta-carotene in gamal leaves is 368.5 mg/kg of dry matter [13]. The content of beta-carotene in plants as a coloring agent can increase the color score of male bali duck meat along with increased levels of administration and has a significant effect on the control treatment.

In addition to beta carotene, the color of the meat is also influenced by polyphenol compounds (such as flavonoids and tannins) which can affect the color of the meat to become darker or dull due to oxidation reactions. This aligns with the research by [8] which states that myoglobin can undergo shape changes due to various chemical reactions. When exposed to air, myoglobin pigment oxidizes into oxymyoglobin, resulting in a bright red color. Further oxidation of oxymyoglobin will produce the brown-colored metmyoglobin pigment. [14] state that tannins can enhance the red color in meat and tend to increase the formation of metmyoglobin during refrigeration storage.

3.2. Aroma

Aroma is a determining factor of the deliciousness of a food ingredient. The aroma in meat is caused by the presence of a volatile fraction in the form of inosin-5-monophosphate (a conversion product of adenosine-5-trisphosphate in animal muscle tissue during its lifetime) that contains hydrogen sulfide and methyl mercaptan [22]. The results of the non-parametric Kruskal-Wallis test show that the application of fermented water extract from gamal leaves can increase the preference of panelists for the aroma of male bali duck meat at concentrations of 4-6%. The acceptance of panelists towards the aroma of male bali duck meat treated with fermented water extract from gamal leaves increases along with the increase in treatment levels, with the highest score at treatment P3, which is 3.68, indicating a tendency toward very liking (Table 1). Based on the results of the hedonic quality test (Figure 2), it was found that the duck meat aroma in treatment P3 had the highest frequency (48%) for non-fishy aroma. Therefore, the reason why the duck meat aroma in treatment P3 is most favored by the panelists is because it has a non-fishy aroma. This is due to the phytochemical compounds contained in fermented gamal leaf extract such as flavonoids, saponins, alkaloids, and phenolics, which act as antioxidants that can inhibit the formation of free radicals in lipid oxidation reactions [15].

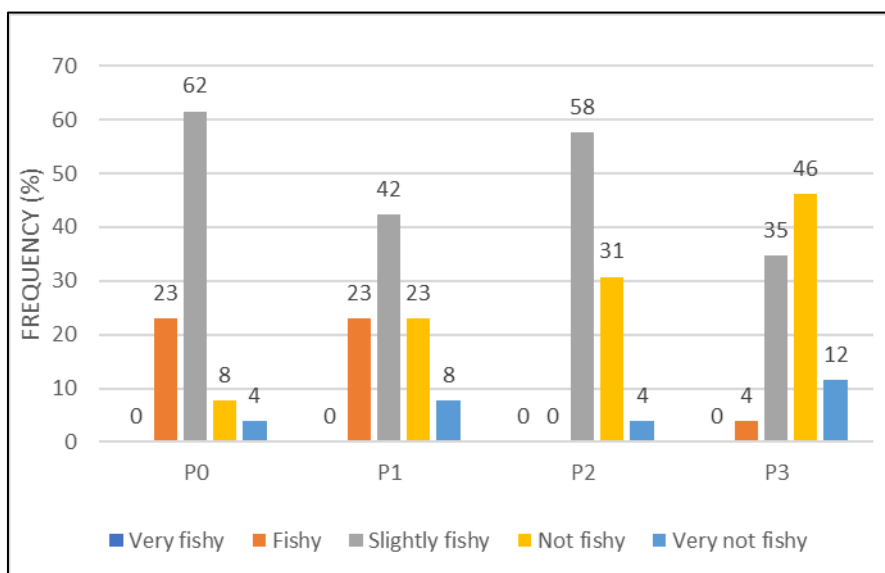


Figure 2 The results of the hedonic quality test on the aroma of bali duck meat treated with fermented gamal leaf extract through drinking water (P0=0%; P1=2%; P2=4%; P3=6%)

The results of this study are consistent with [6], who stated that the administration of mangosteen peel extract can enhance the panelists' response to the aroma of meat because mangosteen peel contains antioxidants (flavonoids and xanthenes) that can inhibit fat oxidation, suppress meat spoilage, thus reducing the fishy aroma in male bali duck meat.

Apart from being caused by lipid oxidation, the fishy aroma in duck meat is caused by skatole found in the intestines. Skatole is formed in the duck's digestive tract as a result of microbial activity that breaks down amino acids (such as tryptophan) in protein, particularly in the intestinal part, as a microbial metabolite product during protein fermentation. Therefore, microbial activity in the duck's digestive tract that breaks down protein contributes to the formation of skatole, which is known as a compound responsible for the fishy odor. The formation of skatole can be suppressed by using antimicrobials, one of which is probiotic lactic acid bacteria. The use of LAB probiotics in the feed or drinking water of ducks is known to improve the balance of intestinal microbiota, suppress the growth of skatole-producing bacteria, and enhance overall digestive health [10].

Another factor that influences the enhancement of the aroma of male bali duck meat is the phenolic compounds found in the fermented water extract of gamal leaves, which can provide a distinctive aroma to the meat. This is in line with the research conducted by [4] on the effect of red dragon fruit peel extract on the organoleptic quality of chicken meat, which improves with increasing levels of administration.

3.3. Flavor

The taste in food ingredients is influenced by the interaction between flavor and aroma, creating a unique and appetizing sensation when consumed. The characteristics of taste are largely determined by the formulation used and are usually not significantly affected by the processing of food products [23]. Based on the results of the non-parametric Kruskal

Wallis test, the administration of fermented gamal leaf water extract in drinking water at levels of 2-6% has a significant effect ($P < 0.05$) on the flavor of male bali duck meat. The highest acceptance score from the panelists for the meat flavor was in the 6% (P3) treatment with a score of 3.72, indicating strong preference (Table 1). According to the results of the hedonic quality test (Figure 3), the flavor of bali duck meat in the P3 treatment had the highest frequency for savory taste, at 58%. Therefore, the reason the panelists favored the flavor of the meat in the P3 treatment is because it has a savory taste.

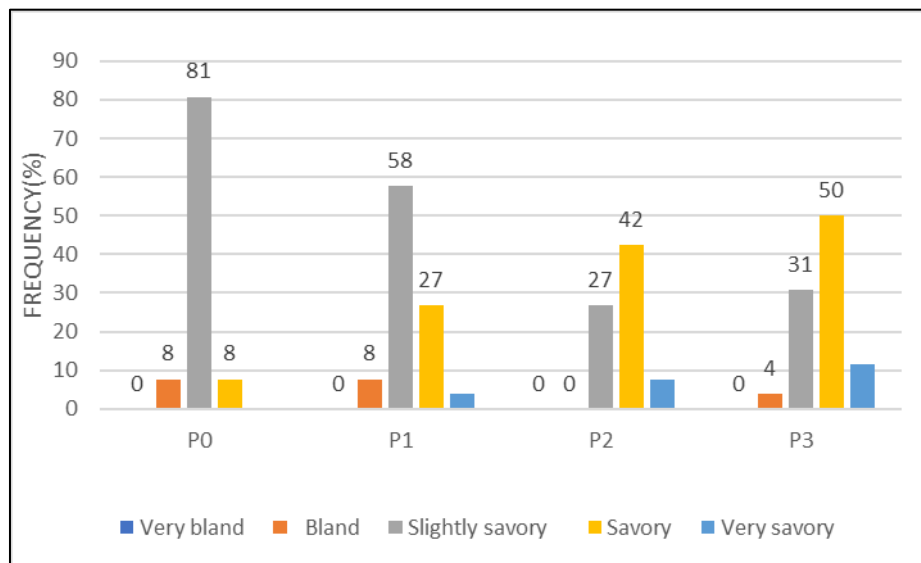


Figure 3 The results of the hedonic quality test on the taste of bali duck meat that was given fermented gamal leaf extract through drinking water (P0=0%; P1=2%; P2=4%; P3=6%)

The savory flavor of bali duck meat in treatment P3 is due to the presence of flavonoids, vitamin C, phenols, tannins, gallic acid, and saponins contained in the fermented gamal leaf extract, which can prevent oxidation that may reduce the rancid taste of the meat and prevent unpleasant odors or flavors. This is in line with [3] that the flavonoid content in fermented grape wine waste extract can counteract the formation of free radicals, thereby reducing rancidity due to the high content of unsaturated fatty acids, leading to an improvement in meat flavor. However, tannins also have astringent properties that impart a bitter and puckering taste to the meat, so if administered in high doses, it can ruin the flavor of the duck meat.

In addition to the presence of phytochemical compounds, the savory taste of the meat is also caused by the tender texture of the meat, making it easier to chew and the absence of a fishy aroma. Tender and non-fishy meat will create a more savory taste when panelists taste the meat samples. The enhancement of the flavor of male bali duck meat is also influenced by the melting of fat during the cooking process. [25] state that duck meat has a high content of unsaturated fatty acids, so heat will cause the fat contained in the meat to melt during the cooking process. Consistent with [20]), the savory flavor of duck meat is influenced by fat melting, leading to an increase in the meat's flavor making it more savory.

3.4. Texture

Texture is a quality closely related to the tenderness of meat [16]. Texture and tenderness are the most important factors in assessing meat quality, as they relate to the flavors that are directly experienced by consumers. The results of the non-parametric Kruskal Wallis test showed that the administration of fermented gamal leaf extract through drinking water at levels of 4-6% had a significant effect ($P < 0.05$) on the texture of male bali duck meat, with the highest average score in the treatment P3 (6%) being 3.76 (Table 1) which indicates a tendency towards 'very liked'. Based on the results of the hedonic quality test (Figure 4), it shows that the majority (68%) of the panelists stated that the texture of the duck meat in treatment P3 felt soft. Therefore, the reason that the panelists really liked the texture of duck meat in treatment P3 is because it has a soft texture.

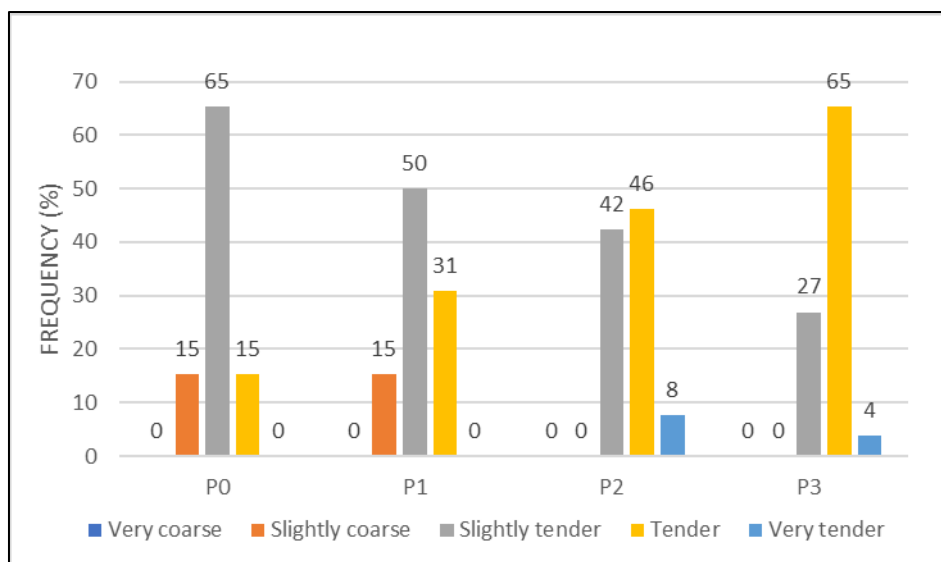


Figure 4 The results of the hedonic quality test on the texture of bali duck meat treated with fermented gamal leaf extract (P0=0%; P1=2%; P2=4%; P3=6%)

The tender meat in treatment P3 is due to the flavonoid compounds contained in the fermented gamal leaf extract, which effectively acts as an antioxidant that can prevent oxidation in duck muscles, maintaining meat quality and enhancing overall muscle health, thereby improving meat texture. This statement is in line with [18], that the texture of meat is determined by the amount of connective tissue (collagen) that composes a muscle. A greater amount of connective tissue results in tougher meat compared to a lesser amount of connective tissue. Muscles that are more active have a coarse texture, while less active muscles have a smooth texture. The texture of meat is also influenced by marbling fat; the higher the marbling fat, the more tender the meat becomes.

3.5. Overall acceptance

The results of the statistical analysis indicate that the overall acceptance scores across the four treatments show significant differences ($P < 0.05$). The average acceptance value of the male bali duck meat given fermented gamal leaf water extract increased with the higher levels of treatment. In this study, 25 semi-trained panelists preferred the 6% treatment with an average score of 3.80, indicating a strong preference. Overall, panelists favored the male duck meat that was slightly dark red in color, non-fishy in aroma, had a soft texture, and a savory flavor. Duck meat treated with 6% can increase its market value due to its good organoleptic quality. According to [5], significant overall acceptance by panelists can enhance consumer appeal. Overall hedonic quality results greatly affect the overall acceptance of the tested duck meat. The active compounds contained in the water extract of gamal leaves, when given to male bali ducks, provide a good response in terms of hedonic aspects and hedonic quality, and do not have a negative impact on the health of the livestock, thus making it safe to use.

4. Conclusion

Based on the results of the research that has been conducted, it can be concluded that the administration of fermented gamal leaves extract through drinking water can improve the organoleptic quality of male bali duck meat, with the highest overall acceptance at a dosing level of 6%, yielding an average score of 3.80 (tends to really like). The 6% dosing level has a positive influence on the color, aroma, texture, flavor, and overall acceptance of male bali duck meat, with criteria: meat color slightly dark red, non-fishy aroma, soft texture, and savory flavor.

Compliance with ethical standards

Disclosure of conflict of interest

We certify that there is no conflict of interest with any financial organization regarding the material discussed in the manuscript.

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