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Organoleptic and Physical Qualities of Sapudi Lamb Meat from Different Muscle Parts

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Abstract

Sapudi sheep has been widely developed in the East Java Province. Data on organoleptic tests and the physical quality of different muscle parts of the Sapudi lamb meat are still limited and need to be explored to provide information about the meat quality from local Indonesian livestock. This study aimed to analyze the organoleptic and physical qualities of the Sapudi lamb's meat from different muscle parts. This study used Completely Randomized Design (CRD) with three different muscle parts as treatments: the *longissimus dorsi* (LD) muscle, the *biceps femoris* (BF), and the *triceps brachii* (TB). Observed variables were hedonic and hedonic qualities in the organoleptic test, including texture, color, aroma, meat tenderness, and physical quality (pH, cooking loss, and tenderness). The results showed that the BF muscles' hedonic quality tests for aroma, texture and tenderness had higher scores than the TB and LD muscles. The TB muscles had higher texture values than the BF and LD muscles. The muscle part didn't affect the panelists' preference level, pH values of 4 and 6 hours. LD muscle has the highest cooking loss.
Keywords: Sapudi sheep, Meat quality, Meat preference

Kualitas Organoleptik dan Fisik Daging Domba Sapudi dari Berbagai Bagian Otot

Abstrak

Domba Sapudi telah banyak dikembangkan di Provinsi Jawa Timur. Data uji organoleptik dan kualitas fisik berbagai bagian otot daging domba Sapudi masih terbatas dan perlu digali untuk memberikan informasi tentang kualitas daging dari ternak lokal Indonesia. Penelitian ini bertujuan untuk menganalisis karakteristik organoleptik dan kualitas fisik daging domba Sapudi dari berbagai bagian otot. Penelitian ini menggunakan Rancangan Acak Lengkap (RAL) dengan tiga bagian otot yang berbeda sebagai perlakuan yaitu otot longissimus dorsi (LD), otot biceps femoris (BF), dan otot triceps brachii (TB). Variabel yang diamati adalah hedonik dan kualitas hedonik pada uji organoleptik yang meliputi tekstur, warna, aroma, keempukan daging, dan kualitas fisik (pH 4 jam, pH 6 jam dan susut masak,). Hasil penelitian menunjukkan bahwa uji kualitas hedonik otot BF terhadap aroma, tekstur dan keempukan memiliki skor lebih tinggi dibandingkan otot TB dan LD. Otot TB memiliki nilai tekstur yang lebih tinggi daripada otot BF dan LD. Bagian otot tidak mempengaruhi tingkat kesukaan panelis, nilai pH 4 dan 6 jam. Otot LD memiliki susut masak tertinggi.
Kata Kunci: Domba Sapudi, Kualitas daging, Preferensi daging

Introduction

Sheep is one of the ruminant livestock often kept by many Indonesian people. This preference is caused by sheep's potential to be developed and its relatively easy maintenance (Mulyaman, 2017). The East Java Province has the highest sheep population sheep in Indonesia. Data from the Indonesian Central Bureau of Statistics show that in 2016, East Java owned 1,370,878 sheep, 1,362,062 sheep in 2017, 1,374,742 sheep in 2018, 1,382,418 sheep in 2019, and 1,416,969 sheep in 2020 (Statistic Indonesia, 2022).

The type of sheep that people widely keep is local sheep because they can adapt better in the local environment, have immunity to various endemic diseases, and can reproduce throughout the year (Wijaya, 2016). One of the local sheep that has long been used and cultivated as a production livestock meat (type cut) is the fat-tailed sheep. Sapudi sheep is one of the fat-tailed sheep that spreads in Madura Island and East Java Province, as corresponds with the Minister of Agriculture Decree Number 2389/Kpts/LB.430/8/2012. Sapudi sheep meat contains 11 fatty acids, 25.06% of total protein content, and 2.20% of total fat content (Khasanah *et al*., 2022). Sapudi sheep have been cultivated for generations and have become Indonesia's local livestock genetic resources that need to be preserved and protected (Ministry of Agriculture, 2012). This potential has been accompanied by increasing demand for lamb meat in recent years, 54,188.48 tons of meat was requested in 2020, and it was increased to 55,863.16 tons in 2021 (Statistic Indonesia, 2022).

Lamb meat has a distinctive smell that has positive and negative impacts. For lamb lovers and satay consumers, the typical mutton flavor becomes the interesting feature that grabs the consumer's attention. On the other hand, many consumers refuse to consume sheep meat due to its mutton flavor. This mutton flavor is usually found in lambs and ewes (Suryadi *et al*., 2016). Consumers' preference in choosing lamb meat is influenced by the meat's cleanliness, color, point of purchase, scent, storage methods, fattening, and carcass handling (Hilmi *et al*., 2015). The fresh meat's physical properties influence the determination of the lamb meat's quality and attractiveness because the quality of the meat can be interpreted as a measurement for desired and rated meat traits by potential consumers.

Meat's physical properties include softness, color, shrink cooking, tenderness, pH value, and water-holding capacity (Sianturi, 2015). Color can be used to assess meat quality at first sight (Sianturi, 2015). Several factors affect the quantity and quality of meat, including the *antemortem handling* (sheep's breed, birth, meat type, sex, feed, and age) and the *post-mortem* (lamb meat's heating method, withering method, acidity level, additives such as tenderizer enzyme, fat content, and storage method (Sianturi, 2015). Different muscle parts are known to produce different qualities and are affected by the location and type of muscle meat (Dewi *et al*., 2016). Different muscle parts affect consumer preference for lamb meat due to the changes in meat's metabolic characteristics, structures, and functions between muscles, resulting in different protein content in each muscle part (Dewi *et al*., 2016). Therefore, this study aimed to analyze the organoleptic test and physical quality of Sapudi lamb meat from several muscle parts.

Material and Method

Sapudi Sheep

A total of four female Sapudi sheep aged 12 months were kept for two months in the same cage condition, feeding system, and treatments. Feed (GMF DB-1) was given to as much as 3 % of sheep's body weight using ingredients: Distillers Dried Grains with Soluble (DDGS), Corn Gluten Feed (CGF), copra meal, copra palm, pollard, bran, dried kangkong, and minerals. The nutrient content of the feed is shown in Table 1.

Sheep's Slaughter and Sampling Method

After two months, four sheep (14 months old) were slaughtered at UPT Kaliwates Slaughterhouse (RPH), Jember. Halal butchers from the slaughterhouse slaughtered the sheep through their three vital channels (throat, esophagus, and jugular veins). The killed sheep were then skinned to separate the skin from the meat to ease the sample-taking process. Each sample from different muscles; *longissimus dorsi* (LD), *biceps femoris* (BF), and *triceps brachii* (TB), was collected for further testing.

Organoleptic Test

The organoleptic test was carried out by a survey method using a questionnaire with 20 untrained panelists and each panelist was assessed 3 different boiled muscle parts with 2 pieces for each part. The boiling method was performed by cutting the meat around 2 cm and packed in vacuum plastic then boiled for 30 minutes at 80°C. Before filling out the questionnaire, the panelists were given directions or instructions on how to evaluate the sample for the organoleptic test. The panelists were free to give a score according to sensory attributes without having to look at the options in the organoleptic test or compare the samples. Four criteria were tested: aroma, texture, color, tenderness and the criteria for each attribute shown in Table 2. In the hedonic test, the panelists were free to give a value or score according to what they liked without having to look at the options on the organoleptic test or compare between samples, using scores: 1 (very disliked), 2 (disliked), 3 (quite liked), 4 (liked) and 5 (liked very much).

Table 1. Content nutrition sir GMF DB-1

Water content	Ash	Crude protein	Crude fat	Calcium	Phosphor	TDN
13%	8%	13%	7%	0.30 – 0.80%	0.20%	65%

Table 2. Sensory attribute and score for hedonic quality assessment

Aroma	Texture	Color	Tenderness	Score
Not mutton flavor	Very fine	Pink	Hard	5
Slightly mutton flavor	fine	Light Red	Slightly tender	4
Moderately mutton flavor	Moderately Fine	Red	Moderately tender	3
Mutton flavor	Rough	Brownish Red	Slightly soft	2
Extremely mutton flavor	Very rough	Dark red	Soft	1

Meat Physical Quality Test

Physical tests of the fresh meat included pH 4 hours, pH 6 hours, and cooking loss. The pH test was carried out using 5 g of finely chopped meat sample, put into 25 mL beaker glass, homogenized, then measured using a pH meter calibrated using a pH 7 buffer (Sulistiarto, 2012). The cooking loss test was carried out by cutting the meat and weighing it for ±25 g. Then it was vacuum packed into polyethylene plastic bag and cooked at 80°C for 30 min. The weight loss during cooking was measured, and the cooking loss was calculated according to Behan *et al.,* (2021) with modification in boiled time used for this study only 30 min.

Data Analysis

Observational data were collected and tabulated. All the data did not distribute normally and were not homogenous. Therefore, analysis of variance was not performed. The Kruskal-Wallis test was then performed for analyzing the data (organoleptic and physical qualities) using SPSS formula by comparing median across group.

Results and Discussion

Organoleptic characteristics

Table 3. Results of organoleptic and hedonic tests of Sapudi lamb meat

Variable	Muscle part	Mean±standard deviation	
		Hedonic quality	Hedonic
Aroma	*Longissimus dorsi*	3.14±0.85[a]	2.81±0.85
	Triceps brachii	3.10±1.00[a]	2.8 ±9.82
	Bicep femoris	3.65±0.98[b]	2.50±0.96
Texture	*Longissimus dorsi*	3.48±0.77[a]	2.91±0.97
	Triceps brachii	3.56±0.80[a]	2.81±1.02
	Bicep femoris	3.14±0.89[b]	2.65±0.92
Color	*Longissimus dorsi*	3.26±0.83	3.00±0.87
	Triceps brachii	3.24±0.95	2.93±0.99
	Bicep femoris	3.30±0.81	2.81±0.85
Tenderness	*Longissimus dorsi*	2.66±0.85[a]	2.83±0.99
	Triceps brachii	2.81±0.98[a]	2.75±1.00
	Bicep femoris	3.23±1.05[b]	2.85±1.08

Note: Different superscripts show significant data at the p-value level <0.05.

Aroma

The aroma in food affects the delicacy of said food or ingredient. In sensory testing, the aroma is more difficult and complex than the taste test, where the aroma can be enjoyed with the stimulus received by the nasal cavity (Wati *et al*., 2018). The average hedonic and organoleptic scores of the panelists testing for the percentage of the different parts of the lamb meat muscle's aroma can be seen in Table 3. The results of the hedonic quality test for BF muscle aroma had a higher score (3.65) than LD (3.14) and TC muscles (3,10). The presence of mutton flavor influences the aroma of lamb meat, and according to Suryadi *et al.* (2016), the mutton flavor is caused by pheromones produced by the sheep's body, especially in rams. Moreover, Watkins *et al.* (2021) stated that mutton flavor in lamb meat is influenced by intrinsic factors (age, sex, age and sex interactions, and carcass location) and extrinsic factor such as feed. The flavor in meat or adipose tissue are dominated by the deposition of 8-10 carbon long chain fatty acids and 4-methyl branch chain fatty acids (BCFAs) especially 4-Me-8:0 and 4-Me-9:0 (Wong *et al.*, 1975). The highest concentration of BCFAs was found in subcutaneous fat in the brisket area when compared to intramuscular fat, perinephric fat and omental/caul fat and lean muscle from brisket, rump and shoulder found having low BCFAs (Watkins *et al.*, 2021).

The results of the hedonic aroma test showed that the LD (2.81) and TC (2.81) muscles scored higher than the BF muscles (2.50), although not significantly. Panelists tend to dislike meat with strong mutton flavor. This result is reinforced by Hastuti & Suparman's (2018) opinion that the lack of food products from lamb, such as sausages and meatballs is due to the mutton-flavor smell on the lambs that is less desirable by some layers of society. The musty smell itself comes from the capric acid, caprylic acid, and caproic acid content found in meat (Hastuti & Suparman, 2018).

Texture

Assessing the texture of muscle meat can be done by looking at the smoothness or hardness of the surface of the meat parts. The average hedonic and hedonic quality scores of the panelists' test on the percentage of the texture of the lamb's meat from different parts of the muscle can be seen in Table 2. The results of the hedonic quality test for the texture of the TC (3.56) and LD (3.48) muscles were the same, while the BF muscles (3,14) were lower than LD and TC muscles, which means that LD and TC muscles have a smoother texture than BF muscles. The sheep's age affects the meat's texture, where young sheep have a finer meat texture than older sheep (Setiawan *et al*., 2017), while the hedonic texture test results show a score that is not significantly different. In general, male livestock have a rough texture compared to female livestock. Breed also affects the texture of the meat. Texture can vary between livestock breeds within the same species, carcass cut, species, and the same muscle (Merthayasa *et al*., 2015).

Color

The results of the hedonic quality test for BF muscle color (3.30) had a higher value compared to LD (3.26) and TC (3.24) muscles (Table 2). Age is a factor that affects the color of the meat. Where the older the sheep, the darker or red the color will be (Rahayu *et al*., 2015). The color hedonic test results did not show a significant difference, but descriptively the LD muscle (3.00) was higher than the TC (2.93) and BF (2.81) muscles. Color has an important role in food and is the first sensory tool that can be seen directly by the panelists. Color is the total impression seen by the eye and can be influenced by the conditions of the scene (Murliana *et al*., 2018). Consumers often associate the color of meat with the freshness of livestock meat which is said to a past study, which stated that fresh meat has a bright red color (Merthayasa *et al*., 2015), as well as Monteschio *et al*., (2018) which revealed that color confirms that a younger animal's flesh shows a brighter color and stronger saturation. In his research, Monteschio *et al*., (2018) revealed that age is an indicator that can be used to determine the color of meat. Younger animals have a brighter meat color, which is associated with the spacing of the filaments in the muscles, the dimensions of the collagen fibers and intramuscular fat.

Tenderness

The organoleptic test results for the value of BF muscle tenderness (3.23) had the highest value compared to LD (2.66) and TC (2.81) muscles. Tenderness is an important factor in luring consumers to buy meat. The acceptability of meat tenderness is influenced by taste, tenderness, and juiciness. Tenderness is one of the main factors and indicators for consumers to choose and determine good quality meat (Burnier, 2021).

According to Suryadi *et al.* (2016), muscle tissue affects the tenderness of lamb meat the more muscle tissue the meat will be tougher, the front carcass contains more connective tissue than the back carcass because the BF muscle is a muscle that is at the back and is a more inactive muscle compared to the TC and LD muscles, so it is not wrong if the BF muscles have higher tenderness than the LD and TC muscles. The results of the hedonic test for tenderness showed that the panelists quite liked the BF muscles (2.85), LD muscles (2.83), and TC muscles (2.75). Anaduaka *et al*. (2023) explained that the level of the tenderness of meat affects the consumer's preference value. Consumers prefer tender meat because this makes it easier for consumers to chew. The amount of intramuscular fat or marbling plays a role in determining the quality of the meat and is a sensory property of taste, meat juices, and meat tenderness (Azizah *et al*., 2020). Genetic factors/livestock genotypes also affect the quality of meat (Khasanah *et al*., 2016). Tenderness also has a close relationship with water holding capacity and meat pH where the higher the pH and water holding capacity of a meat, the meat will have higher tenderness compared to meat which has a low water holding capacity and pH value (Hambakodu, 2019).

Physical Qualities Observation

The physical properties of meat play an important role in the processing because they determine the quality and type of processed meat that will be made. The results of the physical test of sweeper lamb meat from several different muscle parts are shown in Table 4.

pH Value

The pH value is an indicator of meat quality because pH is related to taste, tenderness, color, binding capacity and shelf life (Murliana *et al*., 2018). ANOVA results at 4 hours pH and 6 hours pH showed no significant difference ($p>0.05$) with the meat pH range between 5.8 – 6.3. A decrease in the pH value during *rigor mortis* occurs due to the addition of lactic acid which causes the pH to decrease, the pH value of meat that is healthy and handled properly will experience a gradual decrease in pH from a pH value of around 7.0 - 7.2 then it will decrease gradually from pH to 7 to 5.6 -5.7 within 6-8 hours postmortem and will reach a final pH value of 5.5 - 5.6 (Setiawan *et al.*, 2017). The process before slaughter and during slaughter affects glycogen levels in the muscles, stress in livestock also affects the availability of glycogen in the muscles and the high and low pH values after death (Kuntoro *et al*., 2013). The pH value affects the water holding capacity, the closer to the isoelectric point value, the smaller or lower the water holding capacity and vice versa (Haq *et al.*, 2015).

Cooking Loss

Cooking loss is the amount of weight lost during the cooking process. The purpose of calculating cooking loss is to find out the amount of weight loss of a product during cooking (Murliana *et al*., 2018). Cooking loss is an indicator related to the level of meat juice, namely the amount of water bound between and in the meat in meat muscle fibers (Haq *et al*., 2015). Table 4 shows the percentage of cooking loss in LD muscle (40.67%), TC muscle (38.23%), and BF muscle (30.25%). The LD muscle has a higher average value of cooking losses than the TC and BF muscles. The data on cooking losses for the three muscles shows that the average value of cooking losses is in the normal range, namely 30 %-40 % (Haq *et al*., 2015). According to Soeparno *et al.*, (2011) factors that affect cooking loss include (1) length of muscle fiber sarcomeres, (2) meat pH, (3) myofibril contraction status, (4) length of muscle fiber pieces, (5) cross-section Meat cross-section, the greater the cooking losses, the smaller or shorter the meat cross-section, (6) sample size and weight, (7) nation, (8) age, (9) feed, and (10) heating. The pH value can affect the amount of cooking shrinkage of meat, which if the pH value is low, the greater the value of cooking loss (Ardiansyah *et al*., 2021).

Table 4. Physical Test Results of Sapudi Lamb Meat from Different Muscle Parts

Variable	Muscle part	Means
pH 4 hours	*Longissimus Dorsi*	5.97 ±0.05
	Triceps Brachii	6.33 ±0.58
	Bicep Femoris	6.20 ±0.30
pH 6 hours	*Longissimus Dorsi*	5.80 ±0.10
	Triceps Brachii	5.97 ±0.58
	Bicep Femoris	6.07 ±0.20
Cooking loss (%)	*Longissimus Dorsi*	40.67 ±3.39[b]
	Triceps Brachii	38.23 ±0.88[b]
	Bicep Femoris	30.25 ±2.90[a]

Note: Different superscripts show significant data at the p-value level <0.05.

Conclusion

The hedonic and physical qualities of Sapudi's meat were influenced by muscle parts. The aroma of *bicep femoris* almost has a slightly mutton flavor and was the most tender than others, and the texture of *longissimus dorsi* and *triceps brachii* was finer than *bicep femoris.* The cooking loss of the *bicep femoris* was better than other parts.

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