Physical Meat Quality of Kacang Goat and Garut Sheep Fed Sorghum Based Concentrate

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Abstract

Physical characteristics of goat and sheep meat (lamb) become an important criteria for consumers in ruminants meat products purchasing. The quality of meat depend on meat colours, tenderness, water holding capacity and cooking loss, it is also influenced by the type of feed and feeding factors. This study designed to evaluate local goat meat and lamb quality based on physical characteristics. Goats and sheeps were given sorghum based concentrate which contain high protein and carbohydrate. Six local Kacang goats and five Garut sheeps were fed concentrate with 20% sorghum and raised for 100 days. Measured physical characteristics were pH, water holding capacity, tenderness, cooking loss and meat colours. Data analized using ANOVA and t-test. There were significant differences ($p<0.05$) in pH 6.03 ± 0.10^a and 5.794 ± 0.085^b, tenderness 2.733 ± 0.33^a and 1.860 ± 0.23^b respectively between goat meat and lamb. Other parameters of goat meat and sheep meat were similar. Sorghum in goat and sheep feeding resulting good meat quality of both goat and sheep.
Keywords : goat meat , physical characteristics, sheep meat, sorghum

Introduction

One effort to meet people's needs for animal protein is by breeding and raising different kinds of livestock, including goats and sheep. Indonesian local livestock such as Kacang goats and Garut sheep has a huge potential to be developed since these animals have several advantages compared with other kinds of livestock, for example, they breed rapidly and adjust to the environment easily.

In general, nutritionists consider meat an important part of a well-balanced diet because it provides protein, vitamins, minerals and fat necessary which are necessary for good health and growth. Meat protein contains essential amino acids needed to build and maintain body tissue. Meat is rich in iron, which is needed to build and maintain red blood cells and muscle growth. Red meat (meat of cattle, pigs, goats, sheep, etc.) is an excellent source of the vitamin B complex groups (B1, B2, B6, and B12).

All kinds of meat sold in traditional markets and supermarkets have to meet government health standard. That is why meat is graded according to its quality. Higher grades of meat are tenderer, juicy, and flavorful than lower grades. Grading is based on such quality factors as genetic, species, breed, sex, age, and diet (before slaughter), and withering method and meat pH (after slaughter) (Lambe, 2008).

The physical quality of meat, which consists of color, tenderness, water holding capacity, and cooking loss, is a consumer reference in buying meat. Water holding capacity greatly affects the appearance of the meat before cooking, its properties during cooking, and its juiciness when chewed (Lawrie, 2003). The quality of meat will increase as the water binding ability of the meat increases, lowering the cooking loss and lessening the loss of nutrients. The quality of the meat which is the end result of the fattening of local goats and sheep cannot be separated from the quality of the feed given. Feed is one of the factors that determine the quality of the meat. Feed management and nutrient content are contributing factors to obtain the good results of livestock production.

Sorghum (*Sorghum bicolor* L.) is one type of cereal crops that has great potential to be developed in Indonesia in view of its wide area of adaptability. Sorghum plants are tolerant to drought and water puddle, relatively resistant to pests / diseases, and can produce on marginal land. Sorghum is a carbohydrate source with a metabolic energy content of 3,212 kcal kg^{-1} (NRC 1994). In addition, sorghum has high protein content (12.99%) and low fat (2.34%) compared to corn. Sorghum grains are potential to be used as feed concentrates. Therefore, this study was conducted to determine the quality of meat produced by local goats and sheep which were reared intensively fed sorghum-based concentrates. The objective of this study was to determine and evaluate the meat quality values of Kacang goat and Garut sheep which were fed sorghum-based concentrate in an intensive rearing.

Materials and Methods

Five male Garut sheep and six male Kacang goats less than one year of age were intensively reared for 100 days in an individual stall. The feed was in the form of sorghum-based concentrate (20% sorghum grain) mixed molasses and forage of Brachiaria humidicola (RBH) grass. The feeding consisted of 60% concentrate and 40% forage. Concentrate feed was given in the morning as much as 500 g / head, mixed with molasses 250 g / head. Forage was given in the afternoon 1kg / head and in the late afternoon 1 kg/head. A carcass part called *M. Longissimus dorsii* would be analyzed to test the physical quality, the observed variables such as pH test of meat, DMA, cooking loss, meat tenderness and color. The value of meat pH was measured by using a pH meter, and the water holding power was determined by using Hamm Formula (1972). The meat tenderness was measured objectively by using a tool called Warner-Bratzler shear. The meat color was tested objectively using Chromameter with hunter notation, that is, L *, a * b *. The data obtained were analyzed using t-test.

Results and Discussion

The meat quality of Kacang goat and Garut sheep intensively fed sorghum-based feed for 100 days based on their physical properties included pH value, DMA, tenderness, cooking loss and meat color, as can be seen in Table 1.

Table 1. Mean of physical quality of the meat of Kacang goat and Garut sheep fed sorghum-based feed

Type of Livestock	pH	DMA (%)	Cooking Loss(%)	Tenderness (kg/cm^2)	Meat Color		
					L*	a*	b*
Kacang goat	6.03^{a}±0.10	52.12±10.54	39.160±3.54	2.733^{a} ±0.33	45.77	13.96	5.243
Garut sheep	5.79^{b}±0.08	44.80± 3.78	37.744±4.79	1.860^{b}±0.23	43.78	12.23	5.164

^{a,b}Different letters in the same column show a significant difference (P<0.05)

pH Value

There was a significant difference (P> 0.05) between the pH value of Kacang goat meat and Garut sheep meat fed sorghum-based feed. The mean of pH value of each animal was 6.03 ± 0.10^{a} and 5794 ± 0.085^{b}, respectively. The measurement of pH value was done 24 hours after slaughter to determine the final pH which was achieved when the glycogen content of the meat was really exhausted. The decrease in meat pH during slaughter is influenced by lactic acid. The process of change from muscle into meat requires glycogen as an energy source and will produce lactic acid. This process causes glycogen to convert to lactic acid until the pH reaches a point when the breaker enzymes become inactive. The breaker enzymes (glycolytic) on specific mammalian meat will stop at a pH of 5.4 - 5.5 and in this condition glycogen cannot be found anymore in meat (Lawrie, 2003). The more lactic acid is available, the greater the decline of the meat pH of during slaughter and the lower the final meat pH. That the final pH value of Kacang goat meat will be higher than that of Garut sheep meat is due to the different glycogen content between the cattle. The glycogen content in Garut sheep meat is higher than in Kacang goat meat.

The goat or sheep that is quiet during slaughter has enough glycogen reserves for rigormortis process, while the stressed one is likely to produce higher ultimate meat pH because the muscle of glycogen reserves gets exhausted quickly. The treatment of cattle before slaughter greatly affects them in order not to experience high stress during slaughter. To lower the stress level in cattle, before slaughter is conducted, the animal should be avoided doing a lot of activities. Good cattle handling before the slaughtering process will also contribute to the calmness of the cattle during slaughter.

Water Holding Capacity (DMA)

The result showed that in the meat section of *longissimus dorsi* there was no significant difference in the DMA value of Kacang goat meat and Garut sheep meat. However, the DMA value of each animal was relatively high, that is, 52.120± 10.54% and 44.806 ± 3.78% respectively, so that the quality of both meat based on the value of their DMA was in the category of good. One of the factors that cause the high DMA value was that the cattle were relatively young, less than one year. The high water binding power of meat protein increases the tenderness and juiciness of the meat and decreases its cooking loss, lowering the loss of nutrients. DMA in meat is influenced by differences in muscle, species, breed, age, muscle fungtion, sex,

intramuscular fat and storage temperatures (Soeparno, 1994). The percentage of the water that comes out of the meat can be used as an indicator to determine the value of DMA. The smaller the percentage of water that comes out of the meat, the higher the DMA value. The decrease in the DMA of beef and mutton is due to the formation of aktomiosin and the depletion of ATP at the time of rigor. A third of the DMA reduction in meat is caused by a decrease in pH. DMA is closely related to the cooking loss of the meat.

Cooking Loss

Cooking loss during the cooking process is one indicator of the nutritional value of the meat. The higher the cooking loss of the meat, the more nutrients will lose. The analysis result of cooking loss based on t test showed that in the meat part of *Longissimus dorsi* there was no significant difference in the cooking loss values of the meat of Kacang goat and Garut sheep, 39.160 ± 3.54% and 37.744 ± 4.79% respectively. The cooking loss value obtained in this research was not much different from the value obtained by Kusumastuti (2006) when conducting a study of fattened sheep, that is, 37.17%. The high binding power of the water in meat will lower the cooking loss value. The factors that may affect cooking loss are pH, sarcomere length of muscle fibers, long pieces of muscle fibers, myofibril contraction status, size and weight of the meat samples, and a cross section of the meat. Soeparno (2005) stated that many factors could affect the cooking loss of the meat, among others, the cooking loss can increase when the muscle fibers are shorter. When the water holding capacity of the protein is low, the cooking loss will increase and the tenderness of the meat will reduce.

Tenderness

The results showed that there was a significant difference ($p < 0.05$) between the tenderness of Kacang goat and Garut sheep meat (Table 1). Garut sheep meat is more tender than Kacang goat meat. However, both of them are classified into the category of tender meat. This is consistent with the statement of Suryati (2008) that the tenderness criteria based on the trained panelists showed that very tender meat had a WB (Warner Blatzer) breaking of < 3.30 kg / cm^2. One of the factors that influence meat tenderness is the cattle age. In this research, the cattle used were less than one year old, which is still relatively young for goat or sheep. The meat of young cattle have more tender compared old cattle.

The factors that affect meat tenderness are the treatments before slaughter, including an intensive raising in an individual stall, resulting in the less movement of livestock compared with when raised in a colony enclosure, or even raise through a grazing system. High-motion activities will increase muscle contraction, decreasing the tenderness of the meat. Carcass handling after slaughter such as withering will reduce the shear force of Warner-Blatzler (WB), thereby increasing tenderness. The tenderness levels of Kacang goat and Garut sheep in this study were categorized as very tender. The tenderness was influenced by the feed used in this study, that is, sorghum grain-based concentrates that contain high carbohydrate and high protein which is an excellent source of energy for livestock. Parakkasi (1999) explains that feed ingredients that serve as an energy source are very efficient for the formation of fat in the body. Lawrie (2003) stated that intramuscular fat tends to dilute the binding woven element in the tendon where the fat is deposited. Both Kacang goat and Garut sheep experienced an increase in fat content during the fattening process which automatically increased their meat tenderness.

Meat Color

Meat color is influenced by the concentration of myoglobin in the meat. The a value of the meat color of Kacang goat was 13.96 and Garut sheep 12.236. This value indicates a positive value, leading to reddish color. Although not significantly different, based on the mean value of a, Kacang goat had redder meat than Garut sheep meat. The degree of redness in meat is affected by the content of myoglobin. The higher the myoglobin content, the redder the meat, and the myoglobin content of meat is affected by a genetic factor related to livestock activity. Goat is a breed of cattle that is more active and mobile than sheep. The higher the cattle activity, the more active the process of glycolysis (the change of glycogen into energy from lactic acid) as more oxygen is required. The b value of both types of livestock did not differ much. The b values of Kacang goat and Garut sheep were 5,2438 and 5,164 respectively, meaning that the meat color was bluish color. The L values of the animals were respectively 45,772 and 43,784, meaning that the meat color was bluish red meat (dark red). However, the meat color of Garut sheep was slightly darker than that of Kacang goat. Purbowati *et al* (2006) reported that the higher the slaughter weight of local sheep, the darker the color in *Longissimus dorsi*, which is dark red.

Conclusion

The physical quality of the meat of Kacang goat and Garut sheep fed sorghum-based diet have different ($p<0.05$) pH values and tenderness, but both of them are still at normal pH, and the tenderness is classified as very tender. The values of DMA and cooking loss of both meats were not significantly different. The meat color of Kacang goat and Garut sheep was dark red.

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