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The nutritional quality of chuck and shank meat of thin-tailed sheep supplemented with protected aldehyde in the rations

J. Riyanto*, Sudibya, S D Widyawati, A Fatmasari and A A Tyastuti

Department of Animal Science, Faculty of Agriculture, Sebelas Maret University, Surakarta, Central Java, Indonesia

*Email: jokoriyanto@staff.uns.ac.id

Abstract. The purpose of this study was to determine the effect of aldehyde supplementation, protected and without protection on the nutritional quality of chuck and shank meat of thin-tailed sheep. Thin tailed sheep were fattened for 3 months with 30% forage and 70% concentrate. The chuck and shank meat were obtained via carcass preparation by AMLC method. Meat samples taken from the right carcass pieces and tested for nutritional quality including moisture content, protein content, fat content and cholesterol. Feed treatments were P0 = 30% elephant grass + 70% basal concentrate; P1 = 30% elephant grass + 60% basal concentrate + 10% soybean groats without formaldehyde protected; and P2 = 30% elephant grass + 60% basal concentrate + 10% soybean groats without formaldehyde unprotected. The difference in feed treatment significantly affected the cholesterol levels of chuck and shank meat (P <0.05) and protein content of chuck meat (P <0.05). The conclusion was that chuck and shank meat of thin-tailed sheep contained lower cholesterol in thin-tailed sheep which was given protected and non-protective supplement than control. The thin-tailed sheep which were supplemented with protected and without protection containing higher protein than control.

1. Introduction
The main product of male local sheep is meat. The acceptability and usability of the meat are determined by the characteristic appearance of the sheep’s body muscles. Anatomical differences between the muscle’s location and function affect the quality of the meat. Muscles that are often used as an indicator of the quality of meat are the ones with clear muscle fibers and a contained a large proportion of Biceps femoris (BF) and Triceps brachii (TB) [1]. Chuck meat is obtained from BF muscle and shank meat from TB muscles. Each muscle location has a different function, in active organs, the muscles contained less fat and water than passive ones [1]. TB muscle is a large muscle in the triangular region of the ventral end of the scapula to the posterior end of the humerus. TB muscle is more active because it is located at the base of the livestock movement. BF is a muscle group of sheep body which is often used as a sample for determining the quality of meat and is in great demand by consumers [4]. The quality of meat can differ based on changes in its chemical components such as water, protein, cholesterol and fat levels [1].

Commonly, meat consumers assume that sheep meat is high in cholesterol, thereby reducing the interest in consuming sheep meat. Meat consumers want sheep meat that is low in fat and cholesterol but high in protein. One step to accelerate the improvement of sheep meat quality is through the utilization of potential protein and fat content from local feed ingredients.
Soybean meal is one source of local feed ingredients rich in protein and fat [5]. Because proteins are degraded during the fermentation process in the rumen, protection needs to be done [6]. The protection was performed by coating the fat and protein with aldehyde, thus the fatty acids and protein became insoluble without undergoing any chemical changes [7]. Aldehyde protection is intended so that fatty acids and proteins can escape hydrogenation processes. Later in the rumen the fat-proteins bypassing to the abomasum and are absorbed in the small intestine and act as a precursor to the formation of meat proteins and omega-3 and -6 fatty acids in meat [2, 5, 8]. Protection is needed to avoid too much protein degraded [6, 9]. Protein protection in various local feed ingredients has been found using aldehyde [5]. Local feed ingredients such as soybeans have been shown to have rumen fermentation kinetic which provide nutrients for microbe in-vitro for 24 hours [5]. The soybean contained protein around 43-48% [2, 3]. Soybeans are also protected with formaldehyde [9, 8]. Aldehydes of 37% have been used with a dose 2% of dry weight of protected soybean meal flour that can escape protein from rumen degradation in vivo [10, 11]. The results of the research invitro showed that the omega-6 fatty acid concentrate product is able to produce beef with 19-22% protein content and cholesterol 45-55 mg / 100 g [10]. There are not many data obtained from the research results of supplementation of omega-3 and -6 fatty acid concentrates from local feed ingredients as feed fattening supplement Sheep. For this reason, it is necessary to conduct applied research on concentrates to produce Sheep meat which is high in protein and low in cholesterol.

2. Materials and methods
The equipment used to measure water, protein and fat content is "foods can" (Type 78810 foss electric A / S 69 DK Slangerupgade Denmark). Equipment for analyzing Thermo Scientific brand cholesterol spectrophotometers. Meat samples used for chemical quality testing are sheep shank and chucks. The initial weight of the sheep is 20.81 ± 1.40 kg. The ration arrangement and the nutrient content of the treatment ration in Table 1.

| Feed ingredients   | P0  | P1  | P2  |
|--------------------|-----|-----|-----|
| Protein (%)        | 9.93| 11.98| 12.01|
| Fat (%)            | 4.81| 5.78| 5.74|
| Fibre (%)          | 25.44| 23.72| 23.92|
| Ash (%)            | 12.10| 11.96| 12.02|
| BETN (%)           | 47.72| 46.56| 46.31|
| Organic matter (%) | 87.90| 88.04| 87.98|
| TDN (%)            | 58.37| 61.51| 61.19|
| NDF (%)            | 71.10| 67.75| 68.05|
| ADF (%)            | 48.91| 47.74| 47.94|

This research was carried out experimentally using Factorial Completely Randomized Design (CRD) (3x2). The first factor is the difference in the type of ration (P0, P1, P2). The second factor is the type of meat, namely the meat of the shank and chucks. Each treatment consisted of 3 sheep as replications. The treatment of feed given is as follows:

Factors of different types of rations:
P0 = 30% elephant grass + 70% basal concentrate
P1 = 30% elephant grass + 60% basal concentrate + 10% Soybean groats protected
P2 = 30% elephant grass + 60% basal concentrate + 10% Soybean groats unprotected

Muscle difference factor:
PD = Chuck meat
PB = Shank meat
The ration used consisted of 30% elephant grass, basal concentrate consisted of 30% bran, 25% pollard, 17% coffee skin, 22% palm oil cake, 1% mineral mix and 5% molasses, and protected soybeans groats and soybean groats without protection [3]. Protected supplement was made by adding 1% of formaldehyde (37%) relative to the dried ingredients by spraying it on soybean meal flour [2, 11].

Feeding experiment was carried out for 90 days and the amount of feed given was 4% DM from body weight [3]. The collection phase of meat samples was taken from a sample of 9 sheep or 3 sheep per treatment from meat on the shank and chucks. The sheep were rested for 12 hours before slaughter. Sheep were slaughtered by cutting through three channels, namely the esophagus, respiratory tract and blood vessel channels. After the slaughtering process, the removal of internal organs was removed, and carcass was processed [1].

The whole carcass is split into two parts along the spine into two halves, namely the left and right hemispheric carcasses. The shank meat sample was taken from the TB muscle and chucks from the BF muscle [12]. Sample preparation using the method [1]. Meat samples were separated from the fat and used as samples to test nutrition quality [1].

The research data was obtained from sample analysis by measuring water content, fat content and protein content. The analysis method uses Near Infrared Reflectance Spectroscopy (NIRS) [13] developed by [14] and applied to a scan using infrared light with a certain wavelength (800-2500 nm). Test using foods can [14], Cholesterol Level Test using Lieberman Burchard method. [15]

Data obtained from this study were analyzed using Analysis of Variance. If the results showed significant differences, DMRT test was conducted.

3. Results and discussions

The nutritional content of sheep in the shank and chucks after being fattened with a variety of feed treatments can be seen in Table 2.

| Meat Nutrient Content | Sheep Meat | Feeding | P0 | P1 | P2 |
|-----------------------|------------|---------|----|----|----|
|                       |            |         | 72.73±0.23 | 74.47±0.33 | 2.97±0.51 | 4.55±0.57 | 72.14±0.66 | 72.84±0.27 | 3.30±0.14 | 3.22±0.62 | 3.10±0.28 | 3.71±0.19 |
| Water (%)             | Chuck Meat |          | 7.14±0.66  | 7.84±0.27  | 3.10±0.28 | 3.71±0.19 |            |            |            |            |            |            |
|                       | Shank Meat |          | 72.27±0.81 | 73.30±0.24 | 3.10±0.28 | 3.71±0.19 |            |            |            |            |            |            |
| Fat (%)               | Chuck Meat |          | 2.97±0.51  | 3.30±0.14  | 3.10±0.28 | 3.71±0.19 |            |            |            |            |            |            |
|                       | Shank Meat |          | 74.47±0.33 | 72.84±0.27 | 3.30±0.14 | 3.22±0.62 | 3.10±0.28 | 3.71±0.19 |            |            |            |            |
| Protein (%)           | Chuck Meat |          | 20.40±0.94 | 20.67±0.28 | 20.52±0.77 |            |            |            |            |            |            |            |
|                       | Shank Meat |          | 19.31±0.31 | 19.84±0.34 | 19.85±0.49 | 19.31±0.31 | 19.84±0.34 | 19.85±0.49 |            |            |            |            |
| Cholesterol (mg/100g) | Chuck Meat |          | 49.87±7.60 | 42.11±7.10 | 45.77±1.24 | 49.87±7.60 | 42.11±7.10 | 45.77±1.24 | 49.87±7.60 | 42.11±7.10 | 45.77±1.24 |            |
|                       | Shank Meat |          | 45.37±7.66 | 44.84±7.95 | 39.96±6.54 | 45.37±7.66 | 44.84±7.95 | 39.96±6.54 | 45.37±7.66 | 44.84±7.95 | 39.96±6.54 |            |
| P value               |            |          | <0.05      | <0.05      | <0.05      |            |            |            |            |            |            |            |

<sup>a,b</sup> different superscripts on the same row showed significant differences (P <0.05) α = 0.05; NS = Non Significant, * = Significant.

From anova results it appears that the differences in sheep fattening ration affects the cholesterol content of the thigh and back of the sheep and the protein content of chucks (P0.05). Shank and chucks contain protein and water content which are not significantly different (P> 0.05) in control sheep and those given protected and unprotected soybean supplementation. The DMRT test results showed that the protection of unprotected and unprotected soybean meal containing different cholesterol levels was not significant but both were lower than cholesterol in sheep fed control both in shank and chucks (P> 0.05). The fat content of chucks contains higher fat in sheep fed control than those fed both protected and aldehyde-protected soybean supplementation (P> 0.05).
Both the chuck and shank meat content were not significantly different in all the different ration treatments. This is thought to be due to differences in muscle activity and location which do not cause different levels of water content in the meat. The difference in muscle function and muscle activity does not cause differences in the content of water content in meat [1]. Meat water content can be influenced by the fat content. There is a negative relationship between fat content and water content [10, 11, 4]. The high water content of sheep is closely related to the low-fat content in this study [16].

Addition of soybean meal which is a high protein source of feed that can increase the crude protein in the ration but has not been able to increase the protein content in meat. This is because livestock does not have the ability to reflect protein in meat in response to high levels of protein in feed [1]. The excess of protein in the feed is not transferred as a body protein [10] but is used as an energy source for the synthesis of body fat or disposed in the urine [1]. There are differences in meat structure and muscle activity when livestock are still alive which can lead to differences in myofibril protein content and the amount of connective tissue so that the protein content is also different [10, 11, 16].

Fat content is not different in this study because sheep were kept in a limited space so that motion in the thigh muscle is limited and fat tends to be deposited. Fat in meat is produced through carbohydrate metabolism [10]. The difference in carbohydrate metabolism is thought to cause no different levels of fat from different types of muscle. Sheep fat levels in each type of muscle can be different [16]. Differences muscle types of shank and chuck meat in sheep were not significantly different (P < 0.05). This is presumably due to differences in muscle structure and activity [1] there is a positive correlation between the levels of protein and the water content in the meat. Increasing water content will increase the level of meat protein due to water being able to bind proteins in meat tissue. The treatment of addition of soybean meal in the protection ration was significantly different (P < 0.01) with the addition of soybean groats without protection. This is presumably because the treatment of feed is able to protect fat from the influence of rumen degradation. The addition of formaldehyde in soybeans will react with protein so that this protein complex will protect the fat [10, 11]. Fat content of chuck and shank meat shows no significant difference (P > 0.05). This is presumably because there are differences in metabolic activity in the muscles [16]. TB muscle performs more movement activity than the TB muscle. This causes the TB muscle to require a lot of energy for the process of glycolysis in muscle fibers so that the fat content of the meat is lower in the TB muscle [1]. Muscles that are more active, especially in the thighs, contain lower glycogen [4, 5, 10, 16] and contains more fat as an energy source for metabolism [1].

The results of the anova of meat cholesterol level data showed significant differences (P < 0.05). This is presumably because there are two types of cholesterol in the body namely exogenous cholesterol which is cholesterol contained in the feed and absorbed slowly from the digestive tract into the intestinal lymph channels. In addition, there is also cholesterol synthesized in the body's cells and called endogenous cholesterol [17, 10]. Animals that are in their infancy are in desperate need of cholesterol as a builder of the hormonal system and the brain so that the production of endogenous cholesterol in livestock is more abundant [18, 10, 11]. High and low cholesterol levels are influenced by differences in muscle activity associated with metabolic activity [18, 1]. This is presumably because the age of livestock kept is relatively young and still in the growth phase [1]. In this phase the fat deposited is not maximal because at that phase it is still concentrated in cell formation for muscle and bone development [1]. The results of the analysis of cholesterol level variance in femur and TB muscle showed no significant difference (P > 0.05) [17]. High and low cholesterol levels are influenced by differences in muscle activity associated with metabolic activity [1, 20, 21]. The results of this study are thought to be caused by the age of relatively young sheep and still in the growth phase. In the growth phase of fat, the deposited body is not maximal because in that phase it is still concentrated in cell formation for muscle and bone development. Growth has a fast and slow stage [19]. The rapid stage occurs before genital maturity and the slow stage occurs in the initial phase and as adults grow it has been achieved [1, 10, 11, 18].
4. Conclusions
The conclusion was that chuck and shank meat contained lower cholesterol in thin-tailed sheep which was given protected and non-protected supplement than control. The thin-tailed sheep which were supplemented with protected and without protection containing higher protein than control.

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