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COMMERCIAL CARCASS FAT AND NON-CARCASS FAT DEPOSITS IN THE SUPPLEMENTATION OF MINERALS (ZN) AND AMINO ACIDS (METHIONINE, LYSINE, AND L-CARNITINE) TO LAMB

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Abstract

The increasing demand for meat must be accompanied by increased production of fattening sheep. One of the local breeds used for meat production is the Priangan sheep. Consumers demand not only higher quantities of meat but also higer quality particularly meat with low fat. This research aims to test the effects of minerals (Zink) and amino acids (Methionine, Lysine, and L-Carnitine) supplementation on commercial carcass and non-carcass fat in Priangan sheep. The livestock used were 7-month-old Priangan sheep with an average weight of 14.66 kg. The trial lasted for 67 days, consisting of 7 days adaption and 60 days of treatment. The statistical analysis used was a completely randomized design (CRD) of 4 treatments with 5 replications. If the statistical results show an effect of treatment (P<0.05), then a further test is carried out using the Duncan Test. The treatments observed were (P1): No Treatment, (P2): Zn (60 mg) supplementation, (P3): Zn (60 mg) + Methionine (3 g) + Lysine (5 g), supplementation and (P4): Zn (60 mg) + Methionine (3 g) + Lysine (5 g) + L-Carnitine (200 ppm) supplementation. The results of the study showed that the P2 treatment (addition of 60 mg Zn) had an effect on reducing carcass fat (back fat, stomach, right waist, and neck), while the non-carcass fat components did not experience any significant decrease.
Keywords: sheep, amino acids, carcass, non-carcass, zinc, methionine, lysine, l-carnitine

DEPOSIT LEMAK KARKAS KOMERSIAL DAN LEMAK NON-KARKAS DALAM PEMBERIAN MINERAL (ZN) DAN ASAM AMINO (METIONIN, LISIN, DAN L-KARNITIN) PADA DAGING DOMBA

Abstrak

Meningkatnya kebutuhan daging harus diiringi dengan dengan meningkatkannnya produksi domba penggemukan. Salah satu yang domba lokal yang dimanfaatkan dagingnya ialah domba Priangan. Permintaan konsumen bukan hanya pada kuantitas daging saja namun juga kualitas daging, terutama daging dengan lemak yang rendah. Penelitian ini bertujuan menguji pengaruh pemberian mineral (Zink) dan asam amino (Metionin, Lysin, L-Karnitin) terhadap lemak karkas komersial dan lemak non karkas. Ternak yang digunakan ialah domba Priangan berusia 7 bulan sebanyak 20 ekor dengan bobot rata-rata 14,66 kg. Pemeliharaan dilakukan selama 67 hari dengan 7 hari adaptasi dan 60 hari diberi perlakuan. Analisis statistik yang digunakan ialah Rancangan Acak Lengkap (RAL) 4 perlakuan dengan 5 ulangan. Apabila hasil statistik menunjukan adanya pengaruh perlakuan (P<0,05) maka dilakukan uji lanjut dengan Uji Duncan. Perlakuan yang diamati ialah ialah (P1) : Tanpa Perlakuan, (P2) : Pemberian Zn (60 mg), (P3): Pemberian Zn (60 mg) + Metionin (3 g) + Lysin (5 g), (P4): Pemberian Zn (60 mg)+ Metionin (3 g) + Lysin (5 g) + L-Karnitin (200 ppm). Hasil penelitian menunjukan penambahan Zn (60 mg) berpengaruh terhadap perlemakan karkas (lemak punggung, perut, rusuk kanan dan leher) sedangkan pada komponen lemak non karkas tidak berpengaruh.
Kata Kunci: domba, asam amino, karkas, non karkas, zinc, metionin, lisin, l- karnitin

INTRODUCTION

Consumer awareness of the need for animal protein in Indonesia increases every year, including lamb. Lamb meat production has increased from 2021–2023, reaching 52,998.8 tons (Central Statistics Agency, 2024). West Java Province had the highest lamb meat production, reaching 33,494.5 tons. One of the local sheep used for fattening is the Priangan sheep, which is often found in West Java.

The fattening period increases production by maximizing the nutrient requirements of livestock. The production parameters used to determine the quality of livestock are the carcass and the fat contained in carcasses and non-carcasses. Carcass is a part that has high economic (commercial) value because meat composition is the main parameter (Elvannudin et al., 2016). Non-carcass has edible and non-edible parts; this part is still used in Indonesia (Elvannudin et al., 2016). Consumer demands low-fat lamb carcass, as shown by the increased preference for lean meat (Kashan et al., 2005).

Apart from being a source of animal protein, lamb has higher saturated fat than other livestock (Setyaningrum et al., 2015). The increase in body fat in sheep occurs due to energy deposition, so that it is stored in the form of fat as an energy reserve under the skin of the stomach or abdomen. High fat in the ration will cause negative effects on livestock; it can reduce fiber digestibility due to disruption of the activity of cellulolytic bacteria in the rumen. Apart from fat, which can affect body weight, it can also affect meat quality (Abqoriyah, 2013). In addition, high fat can affect carcass value. The fat in the carcass develops as the sheep grows. The fat proportion in the carcass increases with increasing body weight (Schereurs and Kenyor, 2017). Fat is found in the internal, intermuscular, and subcutaneous parts, so it is distributed throughout the carcass and non-carcass.

Fat growth is influenced by internal factors, including race, birth weight, and gender. Meanwhile, external factors influencing fat growth are the maintenance system (environment) and feed. During the fattening period, it is maintained intensively by providing feed that can increase production. The intensive fattening system in sheep stores less intramuscular fat (IMF) and more subcutaneous fat (Maya et al., 2019). Thus, the nutrients in the feed influence the formation of fat. Feeding during the fattening period is dominated by energy sources, resulting in excess accumulation.

The provision of Zn minerals to sheep has not been maximized where its use is still half of the Zn requirement of 40 mg/kg in rations. There needs to be Zn mineral supplementation that can increase livestock production, play a role in the acid-base balance in the rumen, increase appetite, maintain muscle contraction, carbohydrate, and protein metabolism. The role of zinc (Zn), an important component in the metabolism of carbohydrates, lipids, proteins, and nucleic acids in ruminants (Vierboom et al., 2003). Apart from minerals, protein function can influence energy use and muscle formation. Methionine is an amino acid that is able to maximize livestock production and is free from rumen degradation. Methionine can be maximized by administering lysine, which plays a role in the development of microorganisms in the rumen (El-Tahawy et al., 2015). Another amino acid that acts as an additive is L-carnitine, which can streamline the utilization of energy and protein to ensure normal activity in metabolic processes (Chen et al., 2009; Ríosrincón et al., 2014).

Supplemented L-Carnitine can have a positive effect in effectively eliminating fat deposits (Liu et al, 2020). Biologically active L-Carnitine is synthesized from the amino acids, methionine and lysine in the liver. This is to transport fatty acids from the cytosol to the mitochondria during fat breakdown to produce metabolic energy (Miahra et al, 2016). L-Carnitine is able to synergize with methionine in controlling fat accumulation in carcasses (De Antonio et al., 2017). Therefore, research looked at fattening sheep on commercial carcass fat and non-carcass fat with mineral and amino acid supplementation.

MATERIAL AND METHOD

Animal and Feed

This study used twenty 7-months-old Priangan sheep with an average initial weight of 14.66 kg. They were subjected to four treatments and five replications. They were kept in individual cages measuring 1 x 0.5 meters, with individual feeders and drinkers.

The sheep were provided concentrate and complete feed (Table 1) with a concentrate percentage of 70% and 30% silage as their main feed. The concentrate was composed of soybean meal, copra meal, palm kernel meal, CGF, molasses, cassava, and bran. The compound feed used was a combination of 70% corn kernels and 30% concentrate. Calculation of the feed requirements of sheep each day was based on the amount consumed the previous day. Feed was given five times a day, including at 07.00, 09.00, 11.30, 14.00, and 16.00. Drinks were provided ad libitum using a tap.

Table 1. Concentrate and Diet Nutrition Content

Parameter	Concentrate	Diet
TDN (%)	71.45	56.12
Gross Energy (Kkal/Kg)	4139	3531
BETN (%)	46.65	49.07
Fat (%)	10.25	3.26
Crude Fiber (%)	16.78	22.66
Ash (%)	10.94	12.53
Protein (%)	15.38	12.48
Water Content (%)	8.76	62.43

Source: Ruminant Animal Nutrition and Animal Food Chemistry Laboratory Test Results, Padjadjaran University (2024).

Procedures

The research procedure was carried out in several stages as follows: (1). It begins with cage preparation, by making skates for 20 individual experimental cage units. (2). Preparing feed according to estimated needs during maintenance, by making silage for 67 days of maintenance to be used as complete feed and concentrate. (3). The arrival of the livestock, by weighing the initial weight, giving vitamins, and adapting for 7 days by giving forage before giving concentrate and comfed. (4). After the adaptation period, fattening sheep were shaved to avoid fungus on the sheep's skin. (5). The maintenance period was carried out for 60 days with 4 treatments and 5 repetitions. (6). The calculation of feed requirements was based on the remaining feed each day and observations on days 0, 20, 40, and 60. (7). After maintenance, 20 livestock was slaughtered, which process took 2 days.

Slaughtering process

The slaughtering process was carried out over 2 days for accuracy in the measurement and data collection stages. Slaughter was carried out in an Islamic manner according to Indonesian national standards (SNI). The process was carried out according to standards to meet animal welfare and produce products that are *halal* and *thayyib*. The slaughtering was carried out at the Asian Brother's Agritech (ABA) farm slaughterhouse. The slaughtering stage was carried out on harvest day, with an average final weight of 18.57–23.26 kg. Before the slaughter, livestock were fasted first in order to minimize the remaining food in the digestive system during the cleaning and measuring process. Slaughter began by cutting the neck until the jugular vein, oesophagus, and trachea are cut (near the lower jawbone) and until the blood comes out completely (Purbowati et al., 2006).

Fat Measurement Process

After the slaughtering process was completed, the separation was carried out, starting with weighing the collected blood. After that, the carcass parts were separated, which included the head, skin, blood, internal organs, and feet (Santoso et al., 2012), and the non-carcass parts were separated. The carcass parts were cut based on commercial cuts, consisting of the thigh, loin, rib, shoulder, neck, foreshank, breast, and flank (Soeparno, 2005). However, commercial carcass fat includes the loin, ribs, shoulder, neck, back, and flank. The weight of non-carcass and commercial carcass parts was weighed, and then the fat thickness was measured. The thickness of commercial carcass fat was measured using an electronic caliper (Kasler et al., 2002) on each part observed. Measurement of non-carcass fat using analytical scales after separating the fat.

Statistical Analysis

The study incorporated a Completely Randomized Design (CRD) using experimental methods. The data were analyzed using analysis of variance, and if the results of the variance analysis showed a significant effect ($P<0.05$), then a Duncan's multiple range test was carried out to determine the effect between treatments. Data were analyzed using the SmartStat program (https://www.smartstat.info/produk.html). The treatments use the topping method to provide minerals and amino acids in each treatment. The treatments observed were (P1): No Treatment, (P2): Giving Zn (60 mg), (P3):

Giving Zn (60 mg) + Methionine (3 g) + Lysine (5 g), and (P4): Giving Zn (60 mg) + Methionine (3 g) + Lysine (5 g) + L-Carnitine (200 ppm).

RESULT AND DISCUSSION

Commercial Carcass Fat

The supplementation of Zn minerals, amino acids (Methionine, Lysine, L-Carnitine) to commercial carcass fat, as presented in Table 2, showed a significant difference from commercial carcass fat. The results of the study showed significant differences in back fat, abdominal fat, and right rib fat, but no significant effect was found on the loin fat and left rib fat.

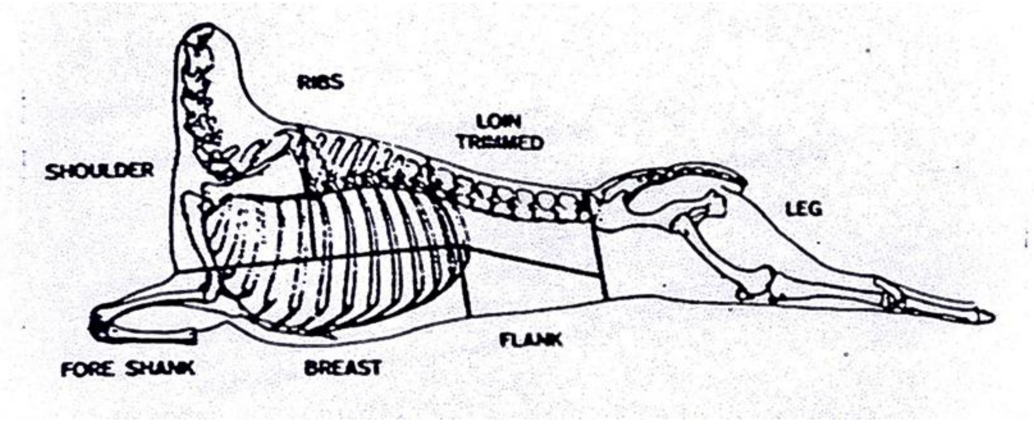
Treatment showed a significant ($P>0.05$) reduction in loin fat, with an average of 0.16 – 0.37 inches. The lowest loin fat was found in sheep treated with single Zn (P2), and the highest loin fat was found in sheep without treatment (P1). Zn affected the fattening of 7-month-old sheep. Zn maximizes muscle, as evidenced by superior body weight gain of 7.32 kg compared to sheep without treatment, which was 5.66 kg. Age also affected fattening in puberty-age sheep. In sheep aged 6-8 months, the proportion of muscle and fat will be smaller than the proportion of bone, while at the time of body maturity, the proportion of muscle almost reaches its optimum, and further growth is only fat deposition (Soeparno, 2005).

Treatments significantly affected back fat ($P<0.05$) with an average of 0.13 – 0.44 inches. Ideal back fat in sheep ranges from 0.05 – 0.5 inches (Boggs & Merkel, 1993). The thickness of fat when supplemented with Zn (P2) and when supplemented with Zn^+ Amino Acids (Methionine, Lysine, L-Carnitine) (P4) showed that the lowest fat on meat, and both had a slight difference. The thickest back fat was obtained from sheep without treatment (P1), which was very significantly different from other treatments, as shown in Table 2. Fattening sheep begin to grow fat but not optimally. The maximum fat growth rate occurred when the sheep reaches maturity (Habil et.al 2015). The provision of Zn + Amino acids and L-carnitine showed the least fat compared to single Zn; this was caused by L-Carnitine's ability to synergize with methionine in controlling fat accumulation in carcasses (De Antonio et al., 2017). While the addition of methionine to the ration P3 (Zn+ methionine+lysine) resulted in high fat deposition in the body, it also resulted in decreased protein and water levels.

Flank fat, according to Table 2, shows significant results between treatments, which reflects that it has a real effect ($P<0.05$) with an average of 0.04 inches to 0.18 inches. The least belly fat was given by adding Zn+ amino acids (methionine, lysine, and L-carnitine) (P4), followed by the supplementation of Zn (P2), with a difference of 0.02 inches. L-Carnitine can significantly reduce abdominal fat percentage (Zhou et al., 2013) by transporting fatty acids from the cytosol to the mitochondria during fat breakdown to produce metabolic energy (Miahra et al., 2016). L-Carnitine is able to synergize with methionine in controlling fat accumulation in carcasses (De Antonio et al., 2017). Based on the results of further research, supplementing L-carnitine to the lamb showed a negative effect on the meat tenderness. Therefore, L-carnitine is able to reduce fat in lamb.

Rib fat was measured at two points: the right side and the left side. Treatments significantly affected the right rib fat ($P<0.05$) with an average of 0.19 inches to 0.37 inches. Left rib fat revealed results that were not significantly different ($P > 0.05$), with an average of 0.20 inches to 0.35 inches. The leanest fat found in the right and left rib is found when supplemented with Zn+ amino acids (methionine, lysine) (P3), and the thickest was found in Zn treatment (P2), according to Table 2. The insignificant results of fat in the ribs is very little because the ribs are dominated by bones. The ribs have a ratio of more bone than muscle, so fat increases should be less (Schereurs and Kenyon, 2017).

Neck fat is located in the shoulder area, which has thicker fat. Neck fat is shaped like jando (cow's milk) fat. The neck is a part of the carcass that has low economic value (Rodriguez et al., 2011). Treatments significantly affected neck fat ($P<0.05$) with an average of 0.24 inches to 0.75 inches. The neck fat in sheep without treatment (P1) had the thickest fat. L-carnitine is able to synergize with methionine in controlling fat accumulation in carcasses (De Antonio et al., 2017).



Gambar 1. Part of Commercial Carcass (Forrest, dkk,1975).

Non-Carcass Fat

Non-carcass parts are used for consumption by the Indonesian people. Each treatment has a different non-carcass weight and non-carcass fat. The non-carcass fat measured in the study included the kidney, heart, and liver. The results showed that treatments had a significant effect on the kidney fat (P<0.05), with an average of 336 g – 575.60 g. The highest fat weight was obtained from treatment with the addition of Zn (P2). The addition of Zn has a greater effect on the subcutaneous thickness of the visceral fat of the renal cavity (Malcolm-Callis et al, 2000; Biara et al, 2007).

Heart fat is non-carcass with the least amount of fat. The fat is around the heart and sticks to the surface of the heart. Heart fat had no significant effect (P > 0.05), with an average of 44 g to 65 g. The least heart fat was found in treatment P3 (Zn+Methionine + Lysine + L-Carnitine). This treatment showed positive results, with the addition of methionine and lysine. Subcutaneous fat shows higher levels if Zn-methionine is added (Greene et al., 1998).

Rumen fat is the part that lines the rumen. The size of the rumen is large, as is the fat that lines the rumen, so it has a heavy weight. Rumen fat showed that the results had a significant effect (P<0.05), with an average of 398 g – 694.74 g, with significant results. The smallest weight of heart fat was in treatment P3 (Zn+Methionine+Lysine). The highest fat yield was shown in the single Zn treatment (P2) and treatment (P4) with the addition of L-carnitine.

Tabel 2. Commercial Carcass Fat and Non-Carcass Fat

Component	Treatments			
	P1	P2	P3	P4
Commercial Carcass Fat				
Loin fat (inch)	0,37 ± 0,17[a]	0,16 ± 0,04[a]	0,27 ± 0,15[a]	0,18 ± 0,8[a]
Back Fat (inch)	0,44 ± 0,04[c]	0,14 ±0,03[a]	0,19 ± 0,02[b]	0,13 ± 0,03[a]
Flank Fat (inch)	0,09 ± 0,02[b]	0,06 ± 0,01[a]	0,18 ± 0,01[c]	0,04 ± 0,01[a]
Right Ribs Fat (inch)	0,24 ± 0,01[c]	0,37 ± 0,01[d]	0,19 ± 0,00[a]	0,22 ± 0,00[b]
Left Ribs Fat (inch)	0,32± 0,12[a]	0,35 ± 0,10[a]	0,20 ± 0,10[a]	0,25 ± 0,10[a]
Neck Fat (Shoulder) (inch)	0,75 ± 0,00[c]	0,35 ± 0,06[b]	0,24 ± 0,05[a]	0,34 ± 0,06[b]
Non-Carcass Fat				
Kidney Fat (inch)	336 ± 84,47[a]	556,63 ± 89,92[b]	375,60 ± 99,36[a]	506,60 ±91,90[b]
Heart Fat (inch)	65,60 ± 17,17[a]	52,75 ± 12,48[a]	44,20 ± 17,80[a]	61,60 ± 24,46[a]
Rumen Fat (inch)	472,80 ± 133,21[ab]	694,74 ± 61,55[c]	398,06 ± 65,66[a]	538,60 ± 40,97[b]

Information: (P1): No treatment,
(P2): supplemented with Zn (60 mg),
(P3): supplemented with Zn (60 mg) + Methionine (3 g) + Lysine (5 g),
(P4): supplemented with (60 mg) + Methionine (3 g) + Lysine (5 g) + L-Carnitine (200 ppm).

CONCLUSIONS

Single Zn supplementation (P2) was able to produce the lowest fat content in commercial carcasses (back, stomach, right rib, and neck) and non-carcass fat (kidney and rumen) compared to treatments P3 (addition of methionine + lysine) and P4 (addition of methionine + lysine + L-carnitine). The low carcass fat in treatment P2 (Zn supplementation) showed high fat content in non-carcass parts.

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ETHICAL STATEMENT

The methods in this research have been carefully reviewed through research proposals and using experimental animal subjects by the Padjadjaran University's Research Ethics Committee with number 1346/UN6.KEP/EC/2023. Ir. Diky Ramdani, S.Pt., M.Anim.St., Ph.D., IPM, was responsible for the animal lab, with a personal license for a procedure training program for live animals, including sheep, cattle, and wild birds from animals (Scientific Procedures) ACT 1986 No. PIL60/13262.

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