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The meat chemical quality of lamb's longissimus dorsi muscles with addition of saponified animal and vegetable oil in the ration

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Abstract. The meat quality characteristics were influenced by the chemical quality of the meat. This study aimed to observe the effect of saponified animal oil (lemuru fish oil: LFO) and vegetable oil (palm oil: PO) addition in the ration on the chemical quality of lamb meat on Longissimus dorsi. Twelve male local lamb were randomly divided into 3 ration treatments; P0: control ration (40% king grass: 60% concentrate), P1: 40% king grass + 57% concentrated + 3% saponified LFO and P2: 40% grass king + 57% concentrate + 3% saponified PO. Each treatment consisted of 3 replications. The observed variables were the chemical quality of meat (moisture, fat, protein and cholesterol). The data obtained were analyzed by analysis of variance and real difference test between treatments. The results showed that the use of LFO and PO has no significant effect ($P > 0.05$) on the chemical quality of meat (moisture, fat, protein and cholesterol). It can be concluded that the use of saponified animal and vegetable oil cannot improve the chemical quality of lamb meat.

1. Introduction

Meat is one of the livestock products that are consumed by many people and contains the high nutritional value. Meat is all animal tissues and all its associated products which are feasible to eat and do not cause health problems [1]. The protein content in meat varies from 25 to 80% (dry weight basis) depending on the level of fat [2]. Fatty meat tendon is fat which determines tenderness, taste, fragrance, and attractiveness of meat [3]. Meat contains several nutrients, namely protein, fat, ash, minerals, vitamins, and water that are needed by the human body. However, meat also contains cholesterol which lately tends to be avoided by society. Meat is one of the most important foods in the world and in some countries, it is considered an essential product with very high consumption rates [4]. In fact, meat provides valuable amounts of protein, fatty acids, vitamins, minerals, and other bioactive compounds.

The quality of feed consumed by livestock can affect the quality of meat produced by an animal. The fat consumed by lamb will be degraded by microorganisms in the rumen to produce free fatty acids and glycerol. Furthermore, the microorganisms in the rumen will modify poly unsaturated fatty acid (PUFA), which process is called hydrogenase. The population of rumen microorganisms is not tolerant of fat at high levels. Normally fat supply ranges from 5-7% of the total ration; giving higher than this amount will cause fermentation to be abnormal [5]. To obtain post rumen PUFA, efforts are needed to provide protection so that PUFA can escape dehydrogenase in the rumen. An alternative is to protect it using saponification treatment on palm oil and sardine (*lemuru*) fish oil.



The meat quality characteristics is largely determined by the content of water, protein, fat, ash, cholesterol, and collagen. The level of meat safety as a food ingredient is also determined by high and low cholesterol levels. Therefore, it is necessary to look for alternative feeds that can increase the nutritional value of meat so that the quality of meat is getting better. Feed polyunsaturated fatty acid (PUFA) sources which are widely available and can be used as local feed ingredients are animal oils such as lemuru fish oil and vegetable oils such as palm oil. The results of a study reported that carcass quantitative characteristics decreased with the use of palm kernel cake [6]. While the use of CPO protected with formaldehyde can increase feed conversion rates [7].

Triglyceride content was significantly affected by the addition of lemuru and Niacin fish oil; the combination of 2% lemuru fish oil treatment and 400 ppm Niacin was able to reduce blood serum triglyceride levels [8]. The addition of 1.5% of protected lemuru fish oil could increase the extract ether digestibility of female local lamb ration [9]. The addition of molasses protected palm kernel meal can affect nutrient consumption, nutrient digestibility, daily weight gain, and feed efficiency [10].

This study aims to observe the effect of saponification of Lemuru Fish Oil (LFO) and Palm Oil (PO) in rations on the chemical quality of lamb meat in Longissimus dorsi muscle in terms of moisture, fat, protein, and cholesterol.

2. Methods

2.1. Time and place of research

This research was conducted at the Jatikuwung Experiment Farm, Department of Animal Husbandry, Faculty of Agriculture, Universitas Sebelas Maret, for 3 (three) months. Proximate analysis of experimental material was carried out at the Laboratory of Animal Nutrition and Food Science, Department of Animal Husbandry, Faculty of Agriculture, Universitas Sebelas Maret, Laboratory of Nutrition Biochemistry, Faculty of Animal Sciences, Universitas Gadjah Mada, Laboratory of Food Technology and Agricultural Products, Faculty of Agricultural Technology, Universitas Gadjah Mada.

2.2. Research materials and methods

This study uses 12 lamb divided into 3 feed treatments, namely:

P0: Basal feed (Forage and Concentrate) as control

P1: Basal feed + Protected LFO

P2: Basal feed + Protected PO

Basal ration as control consists of king grass and concentrates with a ratio of 40: 60 (base of dry matter). LFO and PO supplementation was 3% of dry matter (DM) ration. The PO and LFO protection were carried out using the saponification method referring to [11] in the following manner: to avoid the process of biohydrogenation of PUFA in experimental feed ingredients, Palm oil is protected through saponification with KOH which is then transformed into Ca salt using CaCl_2 . The feeding frequency was twice per day, each for concentrate and forage. Experiment begun with an adaptation period of 2 weeks. Lamb were weighed every 2 weeks. Lamb were sampled and slaughtered for the meat chemical quality tests. Meat samples preparation were done by homogenizing the condition of the meat with freezer storage. The part of meat taken in the longissimus dorsi (LD).

2.3. Research variables

The variables observed in the study were the chemical quality of lamb meat which was moisture, fat, protein and cholesterol.

2.4. Data analysis

The data obtained were analyzed statistically using one-way analysis of variance following Completely Randomized Design (CRD). In case of significant difference ($\alpha = 5\%$); the difference was tested with Duncan's New Multiple Range test (DMRT) [12], with the help of Statistical Product and Service Solution (SPSS) personal computer software version 15.0.

Table 1. Nutrient content of research feed ingredients (% DM)

Feed ingredients	Dry matter	Crude protein	Extract ether	Crude fibre	Ash	NFE ³
King grass	87.09	14.28	1.23	22.23	6.88	55.38
Concentrate	85.93	14.59	6.48	7.31	9.39	62.23
LFO ¹	91.19	3.70	70.40	0.75	8.54	17.63
PO ²	93.32	1.48	60.41	0.19	9.53	30.84

¹LFO: Lemuru Fish Oil; ²PO: Palm Oil; ³NFE: Nitrogen Free Extract

Table 2. Composition and nutrient content of the treatment ration

Feed ingredients	P0	P1- LFO	P2-PO
King grass	40	40	40
Concentrate	60	57	57
Lemuru fish oil (LFO)	0	3	0
Palm Oil (PO)	0	0	3
Total	100	100	100
Nutrient content of the treatment ration (% DM)			
Crude Protein (CP)	14.47	14.15	14.08
Extract Ether (EE)	4.38	6.62	6.35
Crude Fibre (CF)	13.28	13.30	13.28
Ash	8.39	8.66	8.70
Nitrogen Free Extract (NFE)	59.49	60.02	60.41

3. Results and discussion

Data obtained from the meat chemical quality with the addition of saponified LFO and PO in feed during the experiment can be seen in Table 3 below.

Table 3. Effect of LFO and PO saponification in ration on the chemical quality of lamb meat

Meat Chemical	P0	P1-LFO	P2-PO
Moisture (%) ^{ns}	71.18	70.47	71.58
Fat (%) ^{ns}	5.23	8.03	4.48
Protein (%) ^{ns}	20.84	19.20	19.88
Cholesterol (mg/100g) ^{ns}	26.24	37.67	35.14

^{ns}: non-significant

3.1. Moisture

The results of statistical analysis showed that the addition of saponified LFO and PO in feed gave no significant effect ($P > 0.05$) on the moisture content of lamb meat. Lamb's moisture contents were 69.08% for P0, P1-LFO was 69.89% and P2-PO was 72.28%. Based on Table 3, it can be seen that the highest moisture content of lamb meat in P2-PO treatment (72.28%) compared to the moisture content in other treatments (69.08% and 69.89%). This indicates that the addition of LFO and PO saponification cannot increase or decrease the fat content of lamb.

Water is one component in meat that will affect the appearance, texture, taste and also determine the attraction of meat or acceptability of meat, the level of freshness and endurance (shelf-life) of meat [13, 14]. Moisture in muscles has a high correlation with meat protein because muscle protein has hydrophilic nature, which is as a binder of water molecules in meat [15]. Muscles contain about 75% of water with a range of 68-80%. If the water content of the meat exceeds the normal value (75%) it can reduce the quality of the meat [1].

The results of this study are different from [16] study that supplementation of calcium peanut oil, iodine peanut oil and copper proteinate zinc in the ration had a positive effect on ration dry matter

consumption, body weight gain and feed conversion, water content and body fat, while the protein and mineral levels of the sheep's body were not affected.

3.2. Fat content

The results of statistical analysis showed that the addition of saponified LFO and PO in feed gave no significant effect ($P>0.05$) on the fat content of lamb meat. The fat content of lamb in LD muscle results of the study for treatment P0 were 8.20%, P1-LFO was 6.93% and P2-PO was 4.90%. Based on Table 3 above it can be seen that the highest fat content of lamb in treatment P0 (8.20%) compared to the fat content in other treatments (6.93% and 4.90%). This shows that the addition of LFO and PO saponification cannot increase or decrease the fat content of lamb because the three treatments show unrealistic differences, but for the dietary fat content as shown in Table 2 there is an increase with the addition of both LFO and PO by 3% in rations, respectively 4.38% (P0), 6.62% (P1-LFO) and 6.35% (P2-PO).

Variations in the fat content of meat can be influenced by breed, age, species, the location of muscles, feed, maintenance management [15]. Breed, age, species, the location of muscles and feed are factors that can affect the fat content of meat [1]. Meat fat content has a correlation with protein content and meat water content. The results of this study indicate that the three chemical components of meat such as fat, water and protein provide differences that are not real and are not affected by the treatment of supplementation of LFO and PO. The results of this study are different from those reported by [6], fat thickness decreases linearly ($P<0.05$) as a function of palm kernel inclusion in the diet. The addition of calcium soap from lemuru fish oil in rations can reduced fat content, both of low-density lipoprotein cholesterol (LDL), and high-density lipoprotein cholesterol (HDL) of sheep meat [17].

3.3. Protein content

The results of statistical analysis showed that the addition of saponified LFO and PO in feed gave no significant effect ($P>0.05$) on the protein content of lamb meat. The protein content of lamb in LD muscle results of the study for treatment P0 was 19.96%, P1-LFO was 19.71% and P2-PO was 19.54%. Based on Table 3 it can be seen that the highest protein in the P0 treatment (19.96%) compared to protein levels in the other treatments (19.71% and 19.54%). This shows that the addition of saponified LFO and PO cannot increase or decrease the level of lamb protein because the three treatments showed no significant difference, but for the protein content of rations as shown in Table 2 there was an increase by adding both LFO and PO to about 2% in rations, each at 14.47% (P0), 14.15% (P1-LFO) and 14.08% (P2-PO).

Muscle protein is hydrophilic; which means that it has the ability to bind water, thus meat protein can affect the water content of the meat and both have a highly correlated. In addition, between the water content and protein content is also tightly connected to levels meat fat [13]. The results of the study were the same as that of [18] that the addition of protected lemuru fish oil with different NaOH concentrations in saponification process was not significantly affecting the chemical quality of meat (levels of dry matter, crude protein, extract ether, saturated fatty acids, and unsaturated fatty acids) except for EPA and DHA which increased significantly.

3.4. Cholesterol content

The results of the statistical analysis showed that the addition of saponified LFO and PO in feed gave no significant effect ($P>0.05$) on the cholesterol level of lamb meat. Cholesterol levels of lamb in LD muscle were 28.53 mg / 100 g of fresh meat for P0, 37.28 mg / 100 g of fresh meat for P1-LFO, and 41.47 mg / 100 g of fresh meat for P2-PO. Based on the results, it can be seen that the addition of MIL and MS saponification cannot increase or decrease the cholesterol level of lamb because the three treatments show no differences.

Cholesterol is a steroid main compound synthesized in all body cells which is the result of animal metabolism [19]. Cholesterol functions were forming cell membranes, brain myelin structure, central nervous system and vitamin D [20]. Cholesterol content in meat existed in varying levels, and lamb meat

contains high cholesterol. Ruminant meat, especially lamb, contains high cholesterol and saturated fat [17]. This can lead to health problems, namely atherosclerosis (narrowing of the arteries), which in turn can lead to coronary heart disease.

Fish oil containing polyunsaturated lipids is also contained in the body of fish that live in the deep sea. This type of fish has a double bond in the omega 3 positions. Group oils in omega 3 can indirectly reduce blood cholesterol levels. Lemuru fish oil is very potential to be used as feed ingredients for energy sources to be mixed in rations to produce low cholesterol lamb meat [17]. Vitamin E supplementation contains crude palm oil capsules up to 400 mg / kg dry matter did not affect cattle performance, PUFA content and chemical composition, but tended to reduce meat malondialdehyde (MDA) levels ($P < 0.06$) by 67.52%, increased vitamin E content by 74.80% but was followed by an increase in cholesterol content of meat [21].

4. Conclusion

This study concluded that the addition of LFO and PO could not improve the chemical quality of lamb in LD muscle.

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