The effect of carbohydrate and protein protection in additional feed on carcass, non carcass and physical quality on Bligon goat meat

E Suryanto, Z Bachruddin, N Anggraini and R Ma'arifani

The Faculty of Animal Husbandry, Gadjah Mada University, Yogyakarta, 55281

Abstract. This study aimed to determine the effect of additional food with carbohydrates and protein protection on carcass, non carcass and physical quality of Bligon goat meat. The eight Bligon goats Livestock with an average age of 1.5 years were used and divided into two treatment groups. The first treatment was additional feeding without heating (control feed), the second treatment was additional feeding with heating (additional protection feed). Three of the four goats in each treatment were cut and observed their carcass and non carcass quality. Variables observed in the carcass quality included weight and percentage of carcass, rib eye area, weight and percentage of heart, pelvic or kidney fat. The variables observed in non carcasses were blood, head, feet, skin, heart, lungs, liver, clean digestive tract and spleen. The physical quality of the Bligon goat meat observed included meat color, fat color, marbling score, water binding capacity, pH, cooking decrease,and tenderness. The carcass and non carcass quality data were analyzed using the independent sample T-test, using SPSS 16. The physical quality data obtained from Bligon meat were analyzed using variance analysis with a complete design of 2x2 factorial patterns, if there were significant differences continued by Duncan's New Multiple Range Test (DMRT). The Additional protection feed did not affect carcass and non carcass quality, but it affected significantly the physical properties of Bligon goat meat such as color, fat color, marbling score, water binding capacity, pH, cooking decrease, and tenderness ($P<0.05$). The carcass percentage of the control and the feed carcass protection were 34.4±0.60% and 45.57±1.73%. The non-carcass percentage of the control feed were 25.78±0.73% and the non-carcass percentage of additional feed was 28.7% ± 0.36%. Additional protection feed affected the liver percentage ($P<0.05$). The liver percentage of the additional protection was 2.04 ± 0.14%. The color of meat with feed without heating and heating were 5.27 and 4.94. The color of fat with feed without heating and heating were 4.56 and 3.61. The marbling score with feed without heating and heating were 2.22 and 2.78. The binding capacity of water with feed without heating and heating were 28.01% and 23.17%. pH with feed without heating and heating is 6.56 and 6.36. Cooking loss with feed without heating and heating were 25.84% and 18.09%. Tenderness with feed without heating and heating were 5.42 kg/cm2 and 4.68 kg/cm2. The conclusions of the study were the additional feed protection could improve the physical properties of the Bligon goat meat, but not the carcass and non carcass quality of the Bligon goats.

1. Introduction

The roles of goat livestock in Indonesia as a meat producer in support of providing national meat needs. In the year 2016 the population of goats in indonesia as much as 19,608,181 and goat populations in the special region of Yogyakarta are 403,701 [1]. The low contribution of the goat meat supply as a national meat a low and a slow population increasement are caused by the maintenance system which is still simple, goat ownership by breeder, and also its feeding management.

Breeders keep the Bligon goat with the aim of their saving. Bligon goats will be sold at a time when ranchers have sudden needs and usually in old age. The Bligon goat has a low growth rate with a small body size, although the actual diversity of reproduction is quite good with the alleged presence of genetic potential is quite high in the number of children once birth. the Bligon goat potentially to be developed because of its reproduction rate and its productivity of a good parent. One of the efforts in order to improve Bligon goats growth rate is applying technology in feed rations for livestock. Protection to the carbohydrates and protein feed can be an alternative glucose supply aside from propionate which is appropriate for the carcass formation.

The feed is one of the factors which determine the quality of the meat. Management of feeding and nutritional content of the feed is a supporting factor to obtain the result of livestock production. The availability of the feed materials in a livestock business until today still play an important role. Increased productivity of goats meat is supported by the quantity and quality of feed consumed. The feed material which is appropriate, balanced, easily obtainable, cheap and good quality also does not compete with human needs is important to be aware of.

Food substances utilized for livestock growth especially for the bone growth, then for the formation of muscle tissue and also for the fat formation. Therefore, the energy levels of the ration is a major consideration for animal meat. The energy source becomes a primary source in the formation of the carcass. Which obtained from the feed contains carbohydrates, protein, and fat.

Carbohydrate fermentation process occurs in the rumen will produce the main energy source of ruminants in the form of volatile fatty acids (VFA) or fly fatty acids. VFA consists of acetic, propionic and butyric. Which is absorbed directly through the wall of the rumen. Propionate as a source of glucose that is used for the tissue. Normally, only 10% or 3 to 8 grams/day of carbohydrates that escape from rumen fermentation process. Carbohydrates that escape will get an enzymatic process to produce glucose to be absorbed. The amount of carbohydrates which will be digested in the abomasum can be increased by adding starch level, corn as an example. VFA is absorbed through the rumen wall and is transported in the blood to the liver which will be converted into another energy source. the energy produced is used for various functions such as milk production, basic life, pregnancy and growth. carbohydrate in the form of glucose that is absorbed in the digestive tract is very small, therefore most of the glucose needs are supplied from the gluconeogenesis process of non-carbohydrate sources[2]. One of the non-carbohydrate sources is protein.

Microorganisms in the reticulo-rumen hydrolyze proteins into amino acids and synthesize them into microbial proteins. In part of amino acids can pass through the abomasum and are absorbed in the intestine. Absorption of amino acids from the small intestine can be obtained by reducing the protein degradation in the rumen without reducing the production of microbial proteins. The amount of feed protein utilized for digestion and absorption in the intestine can be achieved by means of protection. Protein protection methods against degradation in the rumen include feed formulations from ingredients containing naturally protected proteins, processing treatment such as milling and making pellets, heat treatment and chemical treatment of proteins using chemical agents such as tannins, aldehydes in formaldehyde, and volatile fatty acids.

Protection by heating is a popular since this method is quite easy protection. Heating in protein source feed ingredients can reduce the occurrence of proteolysis by inhibiting the performance of enzymes from proteolytic microbes, so as to reduce the level of degradation in the rumen. Heating protection methods can be obtained by several methods, including heating ovens, grills, and autoclaves. The existence heating in the protein will cause a reaction between the aldehide group of carbohydrates and the amine group from protein. The bonds formed are complex bonds reduce which able to the digestibility. However, heating can cause Maillard reactions to proteins which effect in proteins not degraded in the rumen. The maillard reaction occurs between the amine groups of proteins that bind to the carboxyl group of carbohydrates in the heating process. Heating protection can change the color of food into brown, therefore, to avoid browning reaction, carbohydrate and protein protection methods are carried out with the addition of hot water temperature ranging from 90°C to 100°C in corn flour and soybean cake. The protection process as an additional feed on Bligon goats is expected to improve carcass and non-carcass quality better.

2. Materials and methods

2.1. Material

2.1.1. Trial technique. Experimental livestocks used in this study were 8 Bligon goats with an average weight range of 20.63 ± 0.8 to 21.51 ± 1.38 kg with age 1.5 years were divided into two treatments. Each treatment consisted of 4 goats.

2.1.1.1. Pen. An individual pen measuring 50 x 75 cm equipped with a place to eat and drink was used in this experiment.

2.1.1.2. Equipment. The equipments used in this study were 3 kg of electric scales capacity with a sensitivity of 0.1 g to weigh meat samples, livestock scales that had a capacity of 100 kg and sensitivity of 0,01 kg, drying oven 55°C, and a set of tools for proximate analysis for nutrient content analysis.

2.1.1.3. Feed. The feed given to livestock during the study was peanut straw (*rendeng*) as a basal feed, fermented concentrate as an energy source, additional protected feed containing carbohydrates and protein. Additional protection feed consisted of a mixture of 70% corn flour and 30% soybean meal added with water at a temperature of 90°C - 100°C with a comparison of 1: 2. Additional feed without protection consisted of a mixture of 70% corn flour and 30% soybean meal added with water at a temperature of 28°C - 29°C with a comparison of 1: 2.

2.2. Method

2.2.1. Adaptation stage. The adaptation stage was carried out on the Bligon goat for two weeks. The adaptation period is necessary for the livestock. Feed was given gradually until the experimental livestock consumption level was in a stable condition to consume the feed given.

2.2.2. Research stage. The study activity was started with the provision of additional protected feed ingredients. Additional feed is protected as a source of carbohydrates and the protein escapes rumen degradation use basic ingredients of corn flour and soybean meal mixed with water temperature of 90 ^{O}C - 100 ^{O}C. The treatment of protection additional feeding was compared to additional feed without protection. Additional feed without protection uses basic ingredients of corn flour and soybean meal mixed with room temperature water. Each treatment was mixed for 10 minutes to produce a homogeneous mixture.

The rations given to livestock were divided into two groups, the first group of rations for the treatment of additional feed without protection was peanut straw, concentrated fermented energy sources and protein concentrates without protection (control feed). The second group provided additional protected feed that had peanut straw, concentrated fermented energy sources and concentrated protected protein sources. The chemical composition of feed ingredients for ration can be seen in Table 1. The rations given were in accordance with the needs of the goat livestock according to [3], goats weighing 30 kg with average daily gain (ADG) 50g/day, requiring consumption of dry matter (DM) 690 g, crude protein (CP) 65 g, and metabolized energy (ME) 2,030 kcal/goats/day.

Feed was given in the morning at 6.00 AM and in the afternoon at 4.00 PM. The feed to be given was weighed formerly first, and the remaining feed was weighed the next day. Drinking water was given in *ad Libitum*. Weighing livestock was carried out done once a week, in the morning before the livestock were fed.

Table 1. Chemical composition of feed ingredients (100% DM)

Feed ingredients	DM (%)	Nutrient content				
		CP	CFr	CF	ETN	TDN*
Peanut Straw 1)	23.48	17.79	4.38	28.43	39.22	51.97
Concentrate fermented energy sources2)	75.83	16.73	1.36	31.00	50.91	70.99
Concentrate protected protein sources	87.24	22.04	3.07	3.11	42.77	62.38
Concentrated protein sources without protection	85.57	21.01	2.71	3.05	41.56	60.32

Note: DM=dry matter, CP=crude protein, CFr=crude fiber, CF=crude fat, EMN=extractable materials non nitrogen, TDN= total digestible nutrient
1)[4]
2) [5]
*) Calculation based on the chemical composition [6]

Table 2. Ingredient composition and nutrient content of feed (100% DM)

Parameters	Treatment	
	Control feed	Additional protection feed
Feed ingredient composition (100% DM)		
Peanut Straw	55.56	55.56
Concentrate on energy sources fermented	37.04	37.04
Concentrate on protein sources protected	-	7.4
Concentrate protein sources without protection	7.4	-
Total	100	100
Nutrient content of ration (%)		
Dry matter (DM)	45.1	47.6
Crude protein (CP)	16.4	17.6
Crude fat (CF)	3.04	3.16
Crude fiber (CFr)	26.85	27.51
Extractable materials non nitrogen (EMN)	42.69	43.82
Total digestible nutrient (TDN)	56.64	59.78

The concentrated fermented energy sources consisted of tofu waste, fine bran, pollard, soybean meal, "kleci", molasses, mineral premix, vitamin premix and lactic acid bacteria starter. The concentrate of protected protein sources consisted of corn flour, soybean meal, hot water (100°C). The concentrated protein sources without protection consisted of corn flour, soybean meal and cold water.

2.2.3. Method of slaughtering. The number of livestock cut each treatment were 3 from 4 goats which have been maintained for 8 weeks. Before cutting the goat, they were fasting for about 12 hours, then cut the neck, precisely at the back of the angle of the jaw so that it cuts the trachea, carotid artery and jugular vein. Goat head from the body between the bone atlas occipitalis condylus and cervical vertebrae. The leg were separated also start tarsus and carpus to down. The goat was hung by the position of the hind legs located above then carried out the skinning by making incisions on the skin of the neck, chest and abdomen, while the front legs were made incisions from the right and left chest of each front forehead to the end of the carpus section. The front foot was made an incision from the back of the navel with the direction to the left and right of each back leg to the tip of the tarsus. The skinning stage that has been completed was continued with the evisceration of the abdominal and chest cavities except the kidneys [7].

2.3. Variables measured
The variables measured in this study were cut weight; weight and percentage of carcass; rib eye area; heart fat; pelvis and kidney; and the weight and percentage of non carcasses.

2.3.1. Slaughter weight. Slaughter weight was obtained by weighing the goat Bligon before cutting.

2.3.2. Carcass weight and carcass percentage. Carcass was weighed to find out the carcass weight. The results obtained were then calculated to get the value percentage of the carcass. The formula for calculating carcass percentage was:

$$\text{Carcass percentage formula} = \frac{\text{Carcass Weight}}{\text{Slaughter Weight}}\, x\, 100\%$$

2.3.3. Rib eye area (REA). Measuring rib eye area, by way of the carcass was split into two symmetrically. The right side carcass was sliced transversely between the 12th rib and the 13th rib was then measured by stick the plastic and drawing it with markers on the REA surface, then the area was calculated using millimeter block paper.

2.3.4. Weight and percentage of kidney, pelvic and heart fat (KPH fat). KPH fat weight was obtained by weighing fat which covers the kidneys, pelvic and heart. The KPH fat percentage was calculated by KPH fat weight divided by slaughter weight and multiplied 100%.

2.3.5. Non carcass weight and its percentage. The weight of external non carcass and its percentage were blood, head, feet and skin. The weight of internal non carcass internal and its percentage were heart, lungs, liver, clean digestive tract and spleen. All weights were obtained by weighing each part. The percentage was obtained by calculating weight obtained divided by the slaughter weigth , multiplied by 100%, with the following formula

$$\text{Non carcass percentage formula} = \frac{\text{Non carcass weight}}{\text{slaughter weight}}\, x\, 100\%$$

2.3.6. Evaluation of the physical quality of meat

2.3.6.1. Determination of meat colour. The colour of meat was determined by using a colour scale of meat. Meat with the highest colour score had a darker colour and vice versa.

2.3.6.2. Determination of fat colour. Fat colour was compared using the fat colour scale. Meat with the highest fat colour score had a more yellowish colour and vice versa.

2.3.6.3. Determination of marbling score. The marbling score in meat was compared using the beef marbling score scale. Meat with the highest marbling score has a lot number of marbling and vice versa.

2.3.6.4. Determination of meat pH. The determination of meat pH was carried out using the method of Bouton *et al*. (1971). Ten g samples of meat was chopped and added with aquadest 10 ml (mixture). The pH value was measured using a digital pH meter by dipping the electrode in the mixture. The electrode was calibrated first using a buffer solution. The measurements were carried out three times.

2.3.6.5. Determination of water holding capacity of meat. The water holding capacity (WHC) of meat was determined by [8] method cited by [7]. Sample of meat amounting to 0.3 g was placed on a filter paper and between two glass plates, they were then pressed with 35 kg for 5 minutes. The area enclosed on the suppressed meat sample which has become thin, and the wet area around it on filter paper along with marked sample was measured. The wet area was obtained by subtracted the area enclosed by meat from the total area which includes the wet area on the filter paper. The total water content was determined by putting 1 g of sample into an oven with a temperature of 105 °C for 12 hours or until the sample weight is stable. Water holding capacity was calculated using the following formula:

$$\mathrm{MgH_2O} = \frac{\text{wet area (cm}^2\text{)}}{0{,}0948} - 8{,}0$$

$$\text{Free water area } = \frac{\mathrm{MgH_2O}}{300\ \text{(mg)}} \text{ x } 100\%$$

$$\text{Total Water holding} = \frac{(x+y)-z}{x} \text{ x } 100\%$$

Water holding capacity = Total Water holding – Free water area
X = weight before cooking
Y = weight after cooking
Z = sample weight

2.3.6.6. Cooking loss determination. Cooking loss of the meat was determined by the method of [9] was meat samples which were weighed as initial weight and put into polyethylene plastic bags, then vacuumed. Plastic bags containing meat was boiled in a waterbath at 80°C for 30 minutes. Then cooled in running water until the temperature is 35°C to restore the condition of the meat sample as before. The meat liquid was separated and the meat sample is wiped with infiltration paper (tissue) then weighed. The cooking loss value was calculated by the formula:

$$\text{Cooking loss (\%)} = \frac{\text{weight before cooking} - \text{weight after cooking}}{\text{weight before cooking}}\ x\ 100\%$$

2.3.6.7. Tenderness. Meat samples were cut with Warner Bratzler shear force machine according to the [10] method, by cutting meat (cutting meat fibers) which had been formed square with a width of 1.5 cm and 0.67 cm thick. Measurement was carried out in 3 times, then the results were averaged. The results of the Warner Bratzler Shear Force Machine test were the magnitude of the force needed to cut meat fibers as wide as 1 cm^2.

2.4. Data analysis

Data of carcass and non-carcass physical quality were analysed using a T-Test design was used consisting of 2 treatments and 3 replications. The data obtained was processed using independent sample T-test with the help of personal computer software Statistical Product and Service Solution (SPSS) series 16.

The data processing of this research uses the calculation of variance analysis of Complete Random Design (CRD) factorial pattern. If there were differences in the variables observed because of the treatment then the DMRT test (Duncan's New Multiple Range Test) is continued.

3. Results and discussion

3.1. Slaughter weight

Slaughter weight of Bligon goat with control feed and additional protection feed were presented at Table 3.

Table 3. Slaughter weight, carcass weight and carcass percentage of Bligon goat

Variable	Type of feed	
	Control feed	Additional protection feed
Slaughter weight (kg) ^{ns}	22.92 ±0.39	24.04±1.62
Carcass weight (kg) ^{ns}	7.90±0.03	10.87±0.35
Carcass percentage (%)^{ns}	34.46±0.60	45.57±1.73

Note: ^{ns} = non significant

The slaughter weight of Bligon goats given control feed and additional protection feed were 22.92 ± 0.39 kg and 24.04 ± 1.62 kg respectively. There were not any different in the slaughter weight of the Bligon goat (P>0.05) (Table 3). The initial weight of Bligon goats with control feed was 20.63 ± 0.80 kg, so that during maintenance the weight had increased by approximately 2.29 ± 0.87 kg, while the initial weight of Bligon goat with additional protection feed was 21.58 ± 1.38 kg and the increase in body weight was 2.38 ± 0.17 kg. Based on Risnansyah's study (2014) regarding the weight of Bligon goats kept with complete fermented feed, which amounted to 15.20 ± 1.94 kg and the initial weight was 13.86 ± 0.20 kg, so that it is known the increase during maintenance was approximately 1.34 kg. This showed that the provision of control feed and additional protection feed showed higher weight additions compared to [11]. The quality of carcasses of goat maintained and fed with dry grass feed and added tofu dregs that feeds with protein-enhanced feed and energy levels in livestock rations could increase slaughter weight [12].

Rations that have high nutritional value and good levels of palatability can quickly increase animal weight gain during the maintenance period. The provision of high-quality feed in sufficient quantities will increase live weight gain resulting in a high slaughter weight, furthermore they yield high carcass weight [13]. Additional feed given, has not experienced optimum protection. This was viewed from the research of [14] regarding the digestibility of corn flour and soybean meal protected with hot water temperatures of 90°C up to 100°C by 44.31%. This is higher than [15] study regarding protein digestibility in hempseed cake (grains in the form of pellets) which is heated at 130°C for 30 minutes which can increase the rumen by-pass protein by 62.9%. These results confirm that the glucose source does not add to the growth of the Bligon goat.

3.2. Carcass weight and carcass percentage

The results of statistical analysis of the weight and percentage carcass of Bligon goats fed control and additional protection feed showed no significant difference (P>0.05). Each carcass weight were 7.90 ± 0.03 kg and 10.87 ± 0.35 kg. Results obtained at the percentage of carcasses of goat Bligon fed with control feed and additional protection feed were 34.46 ± 0.60% and 45.57 ± 1.73% which can be seen in Table 3. Although the results obtained were not significantly different, but the weight and percentage carcass of Bligon goat which was given additional protective feed had higher carcass weight than the control feed (Table 3).

The average percentage of carcass obtained was 44.09%. The results of the percentage of feed carcass protection were higher than previous study [16]. The percentage of carcass fed additional feed protection in this study falls into the range of carcass percentage according to [17], which was between 40 and 50% for goats (sheep) in the tropics. One factor that affects the percentage is not used for muscle growth tissue. Carbohydrates and protected proteins will be able to provide glucose supply, amino acids and glucogenic amino acids in the body of livestock, but this study has not provided optimal effect.

Data of rib eye area, weight and its percentage of kidney, pelvic and heart fat were presented at Table 4.

Table 4. Rib eye area, weight and percentage of kidney, pelvic, and heart fat

Variable	Type of feed	
	Control feed	Additional protection feed
Rib eye area (cm^2) ^{ns}	5.01 ±0.19	6.30±0.37
KPH fat weight (kg)^{ns}	0.97±0.13	1.08±0.24
KPH fat percentage (%)^{ns}	4.25±0.55	4.67±1.28

Note: ^{ns} = non significant; KPH= kidney, pelvic and heart

3.3. Rib eye area

The results obtained were not significant because the energy content given to the protection food was significantly at the rib eye area (REA) value in the Bligon goat (P>0.05). But the REA of Bligon goats feed with additional protection feed were higher than the value of the rib eye area of control feed. This situation is in accordance with increased the magnitude in the amount of slaughter weight and carcass percentage. The data obtained is in line with [12], which stated that the different cutting weights would produce different REAs. With the difference in high slice weight, possibility occurrence increase feed consumption which ultimately causes more body conformation so that REA is produced more widely. However, REA tends to be wider in goats who are fed with additional protection feed than control feed.

The rib eye area in sheep fed dry grass with plus tofu waste has values ranging from 4.22 ± 0.94 cm^2 to 7.69 ± 0.78 cm^2 [12]. REA obtained in this study was in the normal range based on the study of [12]. At the same slice weight and in different nations rib eye muscle rib area was not different [18].

Rib eye area (REA) is often used to measure or predict carcass production in livestock. REA Bligon goats which were given Control feed were 5.01 ± 0.19 cm^2, while the area of ribs in the Bligon goats given Additional protection feed were 6,30±0,37 cm^2.

3.4. Weight and fat percentage of kidney, pelvis and heart,

The weight and percentage of kidney, pelvic and heart fat of goat Bligon fed control feed and additional protection feed did not show significant differences (P>0.05), with the average value of goat Bligon fat weight KPH with control feed namely 0.97 ± 0.13 kg with additional protection feed which is 1.08 ± 0.024 kg. while the fat percentage in the goat Bligon with the Control feed was 4.25 ± 0.05% and the additional feed protection was 4.67 ± 1.28% (Table.4).

Using bean goats obtained fat of heart, plevic, and kidney weight of 0.48 kg and a percentage of 2.75% [19]. The results of the additional control feed and additional protection feed were higher when compared to [19] study. Livestock with good nutritional status, getting feed with high energy content will produce the carcass more fatty than low energy feed. The deposition sequence of carcass fat components begins in the deposition of kidney fat and pelvic, then followed by intermuscular fat and subcutaneous fat [20]. Thus, the results obtained show that high energy-containing feed experiences high heart, pelvic and kidney fat deposition. This can be seen after the Bligon goat has been cut.

3.5. Non carcass weight and its percentage

The total weight and percentage of external non carcass of Bligon goat with control feed and additional protection feed were presented in Table 5.

Table 5. External non carcass weight and its percentage of the Bligon goat

Variable	Type of feed	
	Control feed	Additional protection feed
Blood		
Weight (kg) ^{ns}	1.14±0.17	1.38±0.17
Percentage (%)^{ns}	4.99±0.69	5.70±0.43
Head		
Weight (kg) ^{ns}	1.47±0.08	1.63±0.07
Percentage (%)^{ns}	6.46±0.37	6.77±0.22
Feet[1]		
Weight (kg) ^{ns}	0.69±0.04	0.76±0.07
Percentage (%)^{ns}	3.03±0.15	3.14±0.06
Skin		
Weight (kg) ^{ns}	1.46±0.12	1.63±0.08
Percentage (%)^{ns}	6.38±0.53	6.78±0.39

Note: percentage based on cut weight
^{ns} : non significant

ns : four feet, metatarsus and metacarpus down

Based on the statistical analysis there were no the differences between the treatment (P>0.05). The total weight and percentage of external non carcass of Bligon goat with control feed were 5.94 ± 0.14 kg and 25.78 ± 0.73%. Nutritional treatment of livestock had no effect on external non carcass, especially the weight of the head, legs and skin [7]. The results of this study when compared with [11] study that the weight and percentage of Bligon goat blood can be maintained with complete fermented feed was 0.84kg and 5.57% by weight and the percentage of heads were 1.18 kg and 7.81%, while the weight and the percentage of legs were 0.47kg and 3.11% and the weight skin was 5.74kg. Based on that studies the weight and percentage of Bligon goat blood results of this study were higher than [11]. The percentage of goat heads 7.83% and skin 0.84% [21]. The results of the study obtained results close to the [21] this was due to maintenance management and environmental conditions during the maintenance of the Bligon goat.

The weight and percentage of internal non-carcass of the Bligon goat with control feed and additional protection feed can be seen in Table 6.

Table 6. Internal non carcass weight and its percentage of Bligon goat

Variable	Type of feed	
	Control feed	Additional protection feed
Heart		
Weight (kg) ns	0.09±0.01	0.11±0.02
Percentage (%)ns	0.38±0.02	0.46±0.04
Lungs		
Weight (kg) ns	0.18±0.04	0.26±0.06
Percentage (%)ns	0.77±0.19	1.06±0.18
Liver		
Weight (kg) ns	0.28±0.01	0.49±0.04
Percentage (%)ns	1.23±0.06	2.04±0.14
Clean digestive tract		
Weight (kg) ns	0.57±0.01	0.64±0.08
Percentage (%)ns	2.48±0.06	2.67±0.24
Spleen		
Weight (kg) ns	0.06±0.01	0.08±0.01
Percentage (%)ns	0.26±0.04	0.33±0.02

Note: ns = non significant

The mean weight and percentage of internal non-carcasses such as heart, lungs, clean digestive tract and spleen showed not significant different (P>0.05), but the weight and percentage of liver organs showed significantly different results (P<0.05). The weight and percentage of the heart were 0.08 ± 0.01 kg and 0.52 ± 0.08%, weight and percentage of the lungs which were 0.17 ± 0.05 kg and 1.09 ± 0.18%, weight and percentage of the net digestive tract which is 0.57 ± 0.06 kg and 3.38 ± 0.89% by weight and the percentage of the spleen is 0.05 ± 0.01 and 0.30 ± 0.06%, and the weight and percentage of the liver are 1.04 ± 0.05 kg and 2.69 ± 0.60% [11]. It can be seen that the percentage of heart and liver results of this study was lower than [11] study, but the percentage of lungs, the clean digestive tract and spleen was higher value in this study compared to [11] study. The percentage of goat liver was 2.69% [21] and the percentage of liver in this study the results were close to the range of liver organ percentage from the results of the [21] study. Every livestock will generally produce carcasses with their respective characteristics [22], as well as the proportion of the carcass and non carcass component. If the proportion of one carcass component was higher then the proportion of one of the other carcass components was lower and vice versa. The growth rate of small ruminants livestock is divided as follows, at first who experienced development rapidly are bones, then continued by muscle tissue and the last is the development of fat [7]. It can be seen that rations with high energy levels can increase non-carcass growth well because of the supply of energy from feed [23].

3.6. Physical quality of meat

3.6.1. Meat color. The color score of meat of Bligon goat fed additional protection feed can be seen in Table 7. The average color score of *Longissimus dorsi* (LD) and *Biceps femoris* (BF) were 5.00±0.48 and 5.22±0.42. There was not any significant different in the color of meat of Bligon goat meat fed additional protection feed (P>0.05).

Table 7. Color score of Bligon goat meat fed additional protection feed

Type of muscle	Type of feed		Average ^{ns}
	Control feed	Additional protection feed	
Longisimus dorsi	5.22 ±0.44	4.77±0.44	5.00±0.48
Biceps femoris	5.33±0.50	5.11±0.33	5.22±0.42
Average	5.27±0.46^{a}	4.94±0.41^{b}	

The average color score of the meat of Bligon goat fed control feed and additional protection feed were 5.27 and 4.94. Feeding treatment significantly affected to the color of goat meat (P<0.05). Deficiency of muscle glycogen in the of livestock can cause a postpartum glycolysis process that is limited and slow, so that the meat produced has a high pH with dark red color or known as DFD meat (Dark Firm and Dry) [24].

3.6.2. Fat color. The fat color score of meat of Bligon goat fed additional protection feed can be seen in Table 8.

Table 8. Fat color scores of meat of Bligon goat fed additional protection feed

Type of muscle	Type of feed		Average ^{ns}
	Control feed	Additional protection feed	
Longisimus dorsi	4.67±0.50	3.44±0.44	4.06±0.80
Biceps femoris	4.44±0.52	3.78±0.33	4.11±0.58
Average	4.56±0.51^{a}	3.61±0.50^{b}	

Note: ^{a,b} = different superscripts in the same row showed significant differences (P<0.05)
^{ns} = non significant

The average fat color score of *Longissimus dorsi* and *Biceps femoris* were 4.06±0.80 and 4.11±0.58. Type of muscle (LD and BF) did not have any significant effect (P> 0.05) on the fat color score of meat of Bligon goat. The mean fat color score of meat of Bligon goat fed additional protection feed were 4.56 and 3.61. Feed will affect the color fat of goat meat, fat color score of meat of goat fed ammoniation ration with low quality concentrate (CP 12.3%) was 2.53, fed ammoniation ration plus high quality concentrate (CP 12.6%) was 2.59, fed ammoniation ration plus low quality concentrate (CP 12.3%) and the addition of probiotics, turmeric and javanese ginger was 2.53 [25].

3.6.3. Marbling score. The marbling score of meat of Bligon goat can be seen in Table 9.

Table 9. The marbling score of meat of Bligon goat fed additional protection feed

Type of muscle	Type of feed		Average ^{ns}
	Control feed	Additional protection feed	
Longissimus dorsi	2.33±0.50	2.67±0.50	2.50±0.52
Biceps femoris	2.11±0.33	2.89±0.34	2.50±0.52
Average*	2.22±0.43^{a}	2.78±0.43^{b}	

Note: ^{a,b} = different superscripts in the same row showed significant differences (P<0.05)
^{ns} = non significant

The average marbling of *Longissimus dorsi* and *Biceps femoris* of Bligon goat was both 2.50. The different muscle did not have significant effect (P>0.05) on the marbling score of meat of goat fed control feed or additional protection feed. The mean marbling score of meat of Bligon goat fed with control feed and additional protection feed were 2.22 and 2.78. the percentage of intramuscular fat (marbling) usually tends to increase with the increase of percentage of body fat tissue, including the thickness of back fat [26]. The marbling content is also influenced by the feed (nutritional status) given at the time of life. Score marbling of meat given ammoniation ration with low quality concentrate (CP 12.3%) was 2.39, marbling score of meat given ammoniation ration plus high quality concentrate (CP 12.6%) was 2.46, score of meat marbling given Ammoniation ration plus low quality concentrate (CP 12.3%) and the addition of probiotics, turmeric and javanese ginger are 2.53 [25].

3.6.4. pH. The pH of meat of Bligon goat fed additional protection feed can be seen in Table 10.

Table 10. pH value of Bligon goat meat fed without heating and heating

Type of muscle	Type of feed		Average ^{ns}
	Control feed	Additional protection feed	
Longisimus dorsi	6.53±0.15	6.30±0.19	6.41±0.20
Biceps femoris	6.58±0.09	6.42±0.19	6.41±0.20
Average	6.56±0.12^{a}	6.36±0.19^{b}	

Note: ^{a,b} = different superscripts in the same row showed significant differences (P<0.05)
^{ns} = non significant

The average pH value of *Longissimus dorsi* and *Biceps femoris* of Bligon meat were both similar 6.41. There was not any difference of pH between the muscle of LD and BF (P>0.05). However, the additional protection feed gave a significant effect (P<0.05) on the pH value of goat meat. The average of the pH value of the meat of Bligon goat treated control feed and additional protection feed were 5.56 and 6.36. The pH of meat of goat fed complete feed pellet and undegraded protein was 5.62 [27].

3.6.5. Water holding capacity. Water holding capacity of meat of Bligon goat fed additional protection feed can be seen in Table 11.

Table 11. Water holding capacity of Bligon goat meat fed control and additional protection feed

Type of muscle	Type of feed		Average ^{ns}
	Control feed	Additional feed protection	
Longisimus dorsi	28.09±0.48	22.92±0.43	25.51±2.69
Biceps femoris	27.92±0.45	23.42±0.34	25.67±2.49
Average	28.01±0.46^{a}	23.17±0.46^{b}	

Note: ^{a,b} = different superscripts in the same row showed significant differences (P<0.05)
^{ns} = non significant

The average water holding capacity of LD and BF muscles was not different (P>0.05). However, the treatment of additional protection feed gave significant effect (P<0.05) on the water holding capacity of goat meat. The average yield of the water holding capacity of meat of goat fed with control feed and additional protection feed were 28.01% and 23.17%.

Water holding capacity of meat fed with complete feed pellets plus undegraded protein was 24.92% [27]. The water holding capacity is influenced by differences in species, age, feed, pH, as well as type and function of muscles [7]. Different functions or muscle movements result in differences in the amount of glycogen that determines the amount of lactic acid formation and ultimately produces different WHC [28].

3.6.6. Cooking loss. Cooking loss of meat of Bligon goat fed with control feed and additional protection feed can be seen at Table 12.

Table 12. Cooking loss of Bligon goat meat fed with additional protection feed (%)

Type of muscle	Type of feed		Average^{ns}
	Control feed	Additional protection feed	
Longisimus dorsi	25.68±0.69	18.13±0.46	21.90±3.93
Biceps femoris	26.00±0.52	18.06±0.35	22.03±4.11
Average	25.84±0.62^{a}	18.09±0.39^{b}	

Note: ^{a,b} = different superscripts in the same row showed significant differences (P<0.05)
^{ns} = non significant

Cooking loss of *Longissimus dorsi and Biceps femoris* of Bligon goat were 21.90% and 22.03%. These indicated that the differences of muscle did not have a significant effect (P>0.05) on cooking loss of Bligon goat meat. However, additional protection feed gave significant effect (P<0.05) on the cooking loss goat meat. Cooking loss of meat of control feed and additional protection feed were 25.84% and 18.09%. Cooking loss of meat of Bligon goat given complete feed pellet and undegraded protein was 24.23% [27]. Meat with a lower cooking loss has a relatively better quality meat than higher cooking loss meat, because losing nutrients during cooking will be less. Cooking nutrients losses are related and inversely proportional to the water holding capacity, high cook shrinkage values are followed by low water holding capacity [29].

3.6.7. Tenderness. Tenderness of meat of Bligon goat fed with control feed and additional protection feed can be seen at Table 13.

Table 13. Tenderness scores of Bligon goat meat fed control feed and additional protection feed (kg/cm^2)

Type of muscle	Type of feed		Average^{ns}
	Control feed	Additional protection feed	
Longisimus dorsi	5.34±0.35	4.87±0.66	6.41±0.20
Biceps femoris	5.49±0.26	4.50±0.26	6.51±0.16
Average	5.42±0.46^{a}	4.68±0.46^{b}	

Note: ^{a,b} = different superscripts in the same row showed significant differences (P<0.05)
^{ns} = non significant

Results of analysis statistic indicated that the muscle differences did not have a significant effect (P>0.05) on meat tenderness. Tenderness of *Longissimus dorsi* and *Biceps femoris* were 6.41 kg/cm^2 and 6.51 kg/cm^2. The treatment of additional feed gave a significant effect (P<0.05) on the tenderness of goat meat. The average results of tenderness of meat of control feed and additional protection feed were 5.42 kg/cm^2 and 4.68 kg/cm^2. The tenderness of meat fed with complete feed pellets and undegraded protein was 5.56 kg/cm^2 [27]. The factors that influence the tenderness of meat during cooking, namely the melting of meat fat, changes in collagen to gelatin and broken fiber [30].

Conclusion

The conclusions of the study were the additional protection feed improved the physical quality of the Bligon goat meat. However, it did not affect the quality carcass and non carcass Bligon goat.

Reference

[1] Badan Pusat Statistik 2016 Populasi Kambing menurut Provinsi 2009-2016 Available at: https://www.bps.go.id/linkTableDinamis/view/id/1022

[2] Armstrong DG (1965) Carbohydrate metabolism in ruminants and energy supply In: Douherty RW Allen RS Burroughs W Jacobson NL and McGilliard AD (eds) Physiology of Digestion in the Ruminants Butterworths Washington DC pp. 272-288

[3] NRC 1981 *Nutrient Requirements of Goats: Anggora, Dairy, and Meat Goat in termeprate and tropical countries. Nutrient Requirement of Domestic Animal. No. 15* (Washington DC: National Academy Sci)

[4] Ihsani F 2017 *Pengaruh Penambahan $NaHCO_3$ sebagai Buffer pada Pakan Konsentrat fermentasi Bakteri Asal Laktat Berbasis Ampas Tahu terhadap Karakteristik Fermentasi Rumen Kambing Bligon*. Unpublished Undergraduate Thesis (Yogyakarta: Universitas Gadjah Mada)

[5] Fradita Y L 2015 *Pengaruh Penambahan Buffer pada Pakan Konsentrat Berbasis Ampas Tahu terhadap Pola Fermentasi Mikrobia Rumen secara In Vitro* Unpublished Undergraduate Thesis (Yogyakarta: Universitas Gadjah Mada)

[6] Hartadi H, S Reksohadiprodjo and A D Tillman 2005 *Tabel Komposisi Pakan untuk Indonesia. Cetakan ke-5* (Yogyakarta: Gadjah Mada University Press)

[7] Soeparno 2005 *Ilmu dan Teknologi Daging Cetakan VI* (Yogyakarta: Gadjah Mada University Press)

[8] Hamm, R. 1972. Kolloidchemie des Fleisches-das Wasserbindungsvermoegen des Muskeleiweisses in Theorie und Praxis. Berlin: Paul Parey

[9] Bouton E P, P V Harris and W R Shorthose 1971 *J. Food Sci*. **36** 345

[10] Bratzler LJ 1971 Palatability Factors and Evaluation Dalam: Price JF, Schweigert BS (Editor). The Science of meat and meat products. 2nd Edition Freeman WH and Company, San Francisco

[11] Rinansyah M 2014 *Presentase Karkas dan Non Karkas Kambing Bligon Jantan yang Diberi Pakan Komplit Fermentasi* Unpublished Undergraduate Thesis (Yogyakarta: Universitas Gadjah Mada)

[12] Duldjaman M 2005 *J. Trop Anim Agric* **30(2)** 81–7

[13] Lestari C M S, S Dartosukarno and I Puspita 2005 *Edible portion domba lokal jantan yang diberi pakan dedak padi dan rumput gajah* (Semarang: Fakultas Peternakan Universitas Diponegoro)

[14] Bachruddin Z 2016 *Effect of Giving Lactic Acid Bacteria Isolates as Inokulaln on Fermentation Aerobic Resistance Total tofu-based concentrate concentrate* In: Proceedings of the national symposium on research and development on Tropical farms (Yogyakarta: Gadjah Mada University)

[15] Karlsson L Ruiz-Moreno M Stern MD Martinsson K 2012 Effects of temperature during moist heat treatment on ruminal degradability and intestinal digestibility of protein and amino acids in hempseed cake. Asian-Australas. J. Anim. Sci., 25 (11): 1559-1567.Sodiq 2011 *Agripet*. **11(2)** 1–7

[16] Devendra, C and G.B. McLeroy. 1994. Goat and Sheep Production in The Tropic. Longman, New York)

[17] Egan, E. A., Notter, R. H., Kwong, M. S., et al. (1983). Natural and artificial lung surfactant replacement in premature lambs. J. Appl.Physiol., 55, 875-83

[18] Rudiono D 2000 *Pengaruh Hormon Tetosteron dan Umur Terhadap Performans Produksi Kambing Kacang Betina* Dissertation (Bandung: Universitas Padjajaran)

[19] Herman R 2004 *JITAA* **28** 57–64

[20] Koyuncu M, S Duru, S Kara Uzun, S Ozis and E Tuncel 2006 Effect of Castration on Growth and Cascass Traits in Hair Goat Kids Under a Semi-intensive System in the South-Marmara Region of Turkey (Turkey: University of Uludag. Faculty of Agriculture. Departement of Animal Scinece)

[21] Forrest J C, E B Aberle, H B Hedrieck, M D Judge and R A Merkel 1975 *Principle of Meat Science* (San Francisco: W.H. Freeman and Co.)

[22] Venegas G, F Lancien, J Leprince, H Vaudry and J C Le Mevel 2016 *Comp. Biochem. Physiol.C. Toxicol. Pharmacol.* **183-184** 53–60

[23] Aberle E D, J C Forrest, D E Gerrard and E W Mills 2001 *Principles of Meat Science. Fourth Ed.* (America: Hunt Publishing Company)

[24] Wibowo A 2008 *Produktivitas karkas dan kualitas daging sapi Sumba Onggole dengan pakan yang mengandung Probiotik, kunyit dan temulawak* Undergraduate Thesis (Bogor: Program Studi Teknologi Hasil Ternak Fapet IPB)

[25] Soeparno 2015 *Ilmu dan Teknologi Daging Cetakan VI* (Yogyakarta: Gadjah Mada University Press)

[26] Nusi M 2011 *Penggunaan tongkol jagung dalam Complete Feed dan Undergraded Protein terhadap konsumsi nutrien, pertambahan bobot badan dan kualitas daging sapi peranakan Ongole* Thesis (Yogyakarta: Program Pasca Sarjana. Fakultas Peternakan. Universitas Gadjah Mada)

[27] Sianturi S J 2015 *Kualitas Fisik, Kimia dan Histologi Daging Kambing Kacang dan Domba Garut yang Diberikan Pakan Berbasis Sorgum* Thesis (Bogor: Instiut Pertanian Bogor)

[28] Sriyani N L P, A I N Tirta, S A Lindawati and I N S Miwada 2015 *Majalah Ilmiah Peternakan* **18(2)**

[29] Soeparno 2009 *Ilmu dan Teknologi Daging Cetakan V* (Yogyakarta: Gadjah Mada University Press)