

Effect of Undegraded Dietary Protein, Probiotic, and Premixes in Complete Rations on Fat-Tailed Sheep Productivity

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Abstract— Low ration efficiency and Average Daily Gain (ADG) are the key issues that sheep breeders face nowadays. This is because the quality of rations provided is still low, resulting in livestock productivity that is not optimal with its genetic potential. One of the efforts that can be done is by supplementing protected protein (Undegraded Dietary Protein) and probiotics to improve the quality of sheep rations. The aim of this study is to know the effect of administration UDP, Probiotic, and Premix on the fat-tailed sheep productivity. This study used a completely randomized design method (CRD) with 5 treatments, namely R0 (Standard Complete Feed), R1 (Standard Complete Feed with UDP Protein Source), R2 (R1 + Premix), R3 (R1 + Probiotics), and R4 (R1 + Premix + Probiotics). The statistical test used was ANOVA and then it would be followed by Duncan's Multiple Range Test if the results were significant. According to the research, all treatments have no real effect ($P < 0.05$) against the Digestibility of Dry Matter (DDM) and the of Organic Matter (DOM). However, when compared to the control, almost all treatments have a higher value than the control. Whereas in the parameters of body Weight Gain (WG) and Dry Matter (DM) consumption, all treatments had significantly different effects ($P > 0.05$) with P4 (R1 + Premix + Probiotics) providing a value higher than all other treatments. As a result, the provision of rations containing UDP and Probiotics has the potential to increase sheep productivity.

Keywords— UDP; probiotics; premixes; productivity; fat-tailed sheep.

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I. INTRODUCTION

The main issues in sheep breeders nowadays are the Average Daily Gain (ADG) and the low ratio efficiency (Fig. 1). This is due to the low ratio quality, which has prevented it from optimizing livestock productivity following the existing genetic potential. Feeding management is a very decisive thing in sheep farming. The proper feed formulation must be determined to achieve optimal livestock growth.

The adequacy of proteins, energy, and micronutrients (minerals and vitamins) is the determining factor in the success of livestock businesses. Macro and micronutrient balances in rations are necessary to increase sheep productivity. The complete feed contains crude protein 15.14% and TDN 64.15%, resulting in a weight gain of 169.17 grams/head/day to the Padjadjaran Sheep [1]. Feed

protein efficiency is a common issue when feeding ruminants because ruminants have rumen microbes that degrade feed protein into ammonia. The amino acid requirements of ruminants are met partly from microbial protein and partly from feed protein that escapes degradation in the rumen [2]. Microbial protein and feed protein that does not degrade will be digested and then absorbed in the intestines.

The protein content, particularly essential amino acids, which are quite high in feed, such as soybean meal, must be protected from changes inside the rumen so that it can be enzymatically digested in the intestine and utilized by cattle. Protein protection efforts from rumen changes can be carried out in various ways, such as tannins in the ingredients before they are fed to livestock [3]. Tannins will protect soybean meal protein from degradation in the rumen. The utilization of tannins extracted from tea dregs at a concentration of 0.25% gives the best effect on the protein protection of

coconut cake [1]. The success indicator is seen in the decrease in ammonia concentration, and the increase in Undegraded Dietary Protein (UDP) compared to those without tannin extract [4]. Furthermore, the protein protection of jatropa

seed meal with the 0.25% tannin extract decreased the ammonia concentration and increased the proportion of Undegraded Dietary Protein (UDP) compared to those without the use of tannin extract [5].

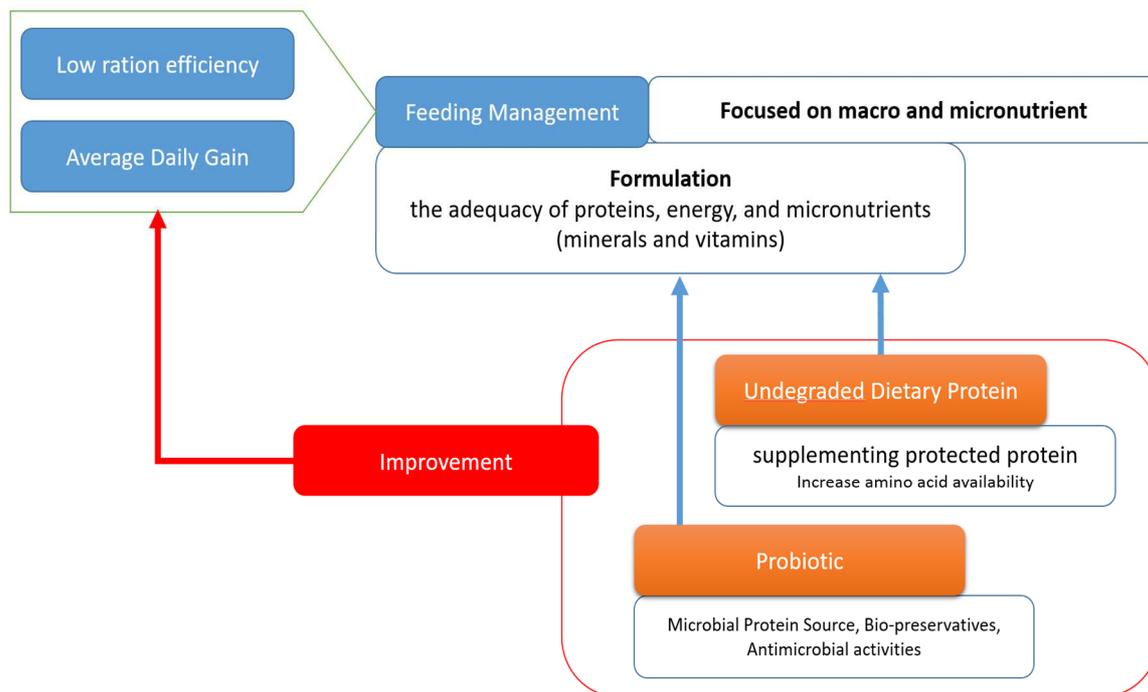


Fig. 1 Conceptual Framework

To overcome low feed efficiency, efforts must be made to improve feed digestibility. Adding probiotics to feed is one way to increase feed efficiency [6]. Probiotics in livestock can affect digestion, increase ADG, and in some cases, reduce fat. Directly, incorporating probiotics into animal feed can increase production efficiency. Probiotics used in feed supplements are typically yeast, lactic acid bacteria, or other microorganisms that benefit the digestive tract [7]. *Saccharomyces cerevisiae* is one type of probiotic used in feed supplementation because of its ability to increase ADG, feed conversion ratio, produce Volatile Fatty Acid (VFA), and change the composition of Polyunsaturated Fatty Acid (PUFA) and Saturated Fatty Acid (SFA) in the digestive tract [8], [9]. *Lactobacillus acidophilus* and *Lactobacillus lactis* are two other types of probiotics that can produce and/or utilize lactic acid, increasing ADG and feed efficiency [10]–[12].

The addition of probiotics to feed can also act as a preservative. The presence of microbes in probiotics can inhibit spoilage bacteria's growth, extending the feed's shelf life [13], [14]. Durable feed will make it easier for farmers to obtain feed throughout the year. This is extremely beneficial for breeders, especially when overcoming limited feed during the dry season. A complete preserved feed can answer farmer problems in feeding management because by using this feed, breeders can save time to procure feed and feeding. Consequently, the production capacity of breeders increases because the time needed to procure and provide feed is relatively shorter. Therefore, this study aims to determine the

effect of supplementation of UDP, probiotic, and premixes on the productivity of fat-tailed sheep.

II. MATERIALS AND METHOD

A. Livestock Experiment

This study used 20 male fat-tailed sheep (DEG) with 8-10 months growth periods and body weights ranging from 16.25 to 25 kg. Livestock was obtained from PT. Agro Investama, Malangbong, Garut. Before treatment, all experimental cattle were treated with deworming, shaved, washed, and confirmed to be in good health.

B. Research Enclosure

The research cage used in this study was a modified individual metabolic cage. The cage was rectangular with a length of 1 meter and a width of 0.75 meters. The cage's base used bamboo installed in ± 2 cm slits to make it easier for feces to fall. The cage also had a feeding and drinking area as well as a feces container.

C. Compilation of Research Rations

The research ratio was prepared using a trial-and-error application based on the dry matter conditions. The milling of feed ingredients with large particle sizes was also carried out to make the ratio homogeneous when mixing.

D. UDP Making

The UDP-making stage began with tannin extraction. Tannin extraction was carried out based on the calculation of

the tannin content in guava leaves and the number of UDP protein sources used. The extracted tannins were mixed with soybeans and then dried [15].

E. Forage Fermentation

Preservation of forage was carried out by making silage. The process of making silage was complemented by adding *Trichosporon beiglii*, *Cryptococcus humicolus*, and PPL (*Lactobacillus plantarum*). Fermentation was carried out for five days. To ensure the yeasts species, the isolates were characterized based on their morphological and biochemical properties, followed by molecular techniques based on Utama *et al.* [16].

F. Preparation of Livestock

This stage aimed to familiarize the livestock with the treatment ratio. The treatment ratio was given in stages until it reached 100%. The introductory period lasted for 14 days. Feeding occurred twice a day at 08.00 and 16.00 WIB.

G. Provision of Rations

The treatment stage (trial feeding) was carried out for 30 days by providing treatment rations for experimental livestock. Feeding occurred twice a day at 08.00 and 16.00 West Indonesian Time. Measurement of the amount of feed consumption was calculated every day by measuring the amount of feed given minus the amount of feed left on the next day. The feed was given as much as 3.5-4% of body weight. Feeding to measure the amount of dry matter consumption and body weight gain was carried out for 30 days. All livestock were weighed the day before the feed treatment and then weighed again at the end of the treatment to determine body weight gain during the treatment. The data collection stage for measuring the Digestibility of Dry Matter (DDM) and Digestibility of Organic Matter (DOM) lasted for seven days, with feed and feces removed and measured every seven days. The amount of fecal production was measured every day from the measured feed for digestibility calculations. This is based on the assumption that the excreted feces are the result of digesting the feed consumed the previous day. Feces were collected by taking the dirt that had been collected in the net. All feces contained in each cage were collected separately with a different plastic bag every day. The collected fresh feces were weighed, and then 10% of each sample was taken and dried in the sun to dry, and it was weighed again after drying. Dry feces in the sun collected for seven days were then taken as much as 10% to be analyzed as data to calculate their digestibility.

H. Experimental Design

The experimental design used in this study was completely randomized. All livestock were kept in a metabolic pen. Each livestock got one treatment ratio (Table 1) randomly.

I. Variable Measure

The measured variables include:

1) *Consumption of Dry Matter (Feed Intake)*: The amount of daily ration consumption is obtained as follows:

$$\text{Total consumption (grams)} = \frac{\text{The amount of feed given (grams)}}{\text{the amount of feed left on the next day (grams)}} \quad (1)$$

Measurement of ration consumption was carried out every day during the study.

TABLE I
THE TREATMENTS OF RATION FORMULATION

Feed Ingredients	Formulation (100% DM)*				
	R0	R1	R2	R3	R4
	%				
Pile	12.40	12.40	12.40	12.40	12.40
Pollard	12.00	12.00	12.00	12.00	12.00
Fine Bran	14.00	14.00	14.00	14.00	14.00
Cocoa Shell	5.00	5.00	5.00	5.00	5.00
Copra cake	20.00	20.00	20.00	20.00	20.00
Gaplek	11.00	11.00	11.00	11.00	11.00
Palm oil cake	6.54	6.54	6.34	6.54	6.34
Soy cake	5.00	5.00	5.00	5.00	5.00
Yellow corn	3.00	3.00	3.00	3.00	3.00
Molasses	8.33	8.33	8.33	8.33	8.33
Calcium powder	2.00	2.00	2.00	2.00	2.00
Salt	0.33	0.33	0.33	0.33	0.33
Urea	0.40	0.40	0.40	0.40	0.40
Premix*	0.00	0.00	0.20	0.00	0.20
Total	100	100	100	100	100

* Based on table 2

R0 = Standard complete feed

R1 = Standard complete feed with Undegraded Dietary Protein (UDP) protein source

R2 = R1 + Premix

R3 = R1 + Probiotics

R4 = R1 + Premix + Probiotics

TABLE II
THE PREMIX FORMULATION

Premix Ingredients	Amount	%	Amount
Vitamin A	2,000,000 IU	100.00	2.00 mg
Vitamin D3	400,000 IU	100.00	0.40 mg
Vitamin E	1,200 mg	100.00	1,200.00 mg
FeSO ₄	5,000 mg	36.74	13,609.14 mg
MnSO ₄	6,000 mg	36.39	16,486.07 mg
ZnSO ₄	5,000 mg	40.51	12,342.82 mg
CoCl ₂	10 mg	45.39	22.03 mg
KI	15 mg	76.45	19.62 mg
SeCl ₂	20 mg	52.69	37.96 mg
MgSO ₄	5,000 mg	20.21	24,744.96 mg
CaHPO ₄	100,000 mg	22.76	439,296.10 mg
CaCO ₃	180,000 mg	40.00	450,045.00 mg
Corn Powder	up to 2,000,000 mg		1,037,286.00 mg

2) *Digestibility of Dry Matter (DDM)*: Digestibility of Dry Matter (DDM) is obtained in the following way:

$$DDM = \frac{DM \text{ Consumption} - DM \text{ in Feces} \times 100\%}{DM \text{ Consumption}} \quad (2)$$

3) *Digestibility of Organic Matter (DOM)*: Digestibility of Organic Matter (DOM) is obtained in the following way:

$$DOM = \frac{OM \text{ Consumption} - OM \text{ in Feces} \times 100\%}{OM \text{ Consumption}} \quad (3)$$

Stool samples were taken to measure DDM, and DOM carried out on days 14-20 of the study.

4) *Weight Gain (WG)(grams/day)*: Weight gain is obtained in the following way:

$$WG \left(\frac{g}{day} \right) = \frac{\text{Initial Weight} - \text{Final Weight}}{\text{Time (day)}} \quad (4)$$

J. Data Analysis

The research data were analyzed using The SAS System for Window 6.12 using ANOVA followed by Duncan's Multiple Range Test.

III. RESULTS AND DISCUSSIONS

A. The Effect of Providing Complete Rations on Dry Matter Consumption and Weight Gain

Data regarding the value of dry matter consumption and body weight gain in each treatment are presented in Table 3 and Figure 2. Based on the data in Table 3, it is known that all treatments had significantly different effects ($P < 0.05$) both on dry matter consumption and body weight gain. The treatment with the highest dry matter consumption and body weight gain was R4 (standard complete feed with UDP protein source + Probiotics + Premix) with values of 908.51 gram/ day and 208.08 gram/ day, respectively.

The microbial protein passing from the rumen to the intestines is insufficient to attain the requirement for intestinally absorbable amino acids in the high-producing dairy cow [17], [18]. Thus, providing the dairy cow amino acids from undegraded protein is necessary. Dry matter consumption is very important because it affects the nutritional intake to meet the nutritional needs of dairy cows in maintaining their health and productivity [19]. In addition, feed consumption is an important aspect to evaluate the nutritional value of feed ingredients [20]. Consumption value can be used as guidance about the utilization of feed by animals or determination of the number of nutrients from consumed feed to be used in the production.

TABLE III
THE VALUE OF DRY MATTER CONSUMPTION AND BODY WEIGHT GAIN IN EACH TREATMENT

	Treatment				
	R0	R1	R2	R3	R4
Dry Matter Consumption	758.03 a	695.65 a	768.46 ab	832.38 ab	908.51 b
Body Weight Gain	156.42 a	162.58 a	177.33 ab	173.42 ab	208.08 b

Note: According to Duncan Test, treatment marked with the same letter showed no significant difference at 5% level.

Beef feed rations containing a UDP of 9.45% have a higher dry matter consumption value than animal feed with a lower UDP content [21]. There is a positive correlation between dry matter consumption and body weight. Low dry matter consumption and deficiency in nutrient supply (especially protein and amino acids) will lead to immunosuppression and metabolic disorders, which consist of decreased BCS value, ketosis, liver fat, and displaced abomasum [22], [23]. As a result, rations with higher levels of UDP can help sustain livestock productivity by increasing the digestibility of dry matter.

The level of dry matter consumption can be affected by the consumption of treated rations and the chemical composition of the rations. Kim and Lee [17] stated that the factors that affected digestibility included the physical form of the feed, the composition of the ration, temperature, the rate of travel

through the digestive tract, and the influence on the ratio of other nutrients [24], [25]. The role of probiotics in increasing microbes in the rumen is thought to cause the increase in dry matter consumption in R4.

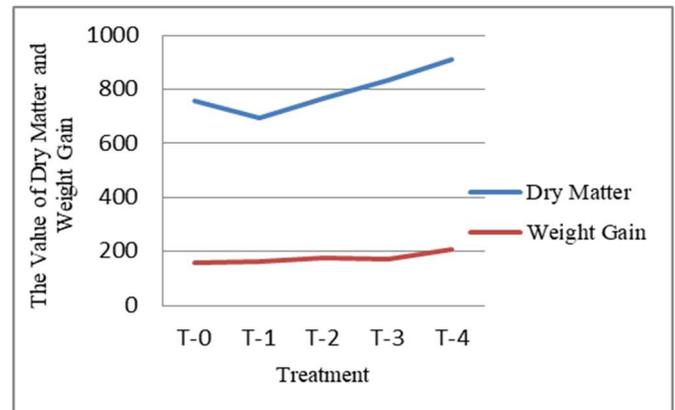


Fig. 2 Dry Matter Consumption and Body Weight Growth in Each Treatment

According to research conducted by Zamzami [26], the administration of probiotics in the feed can increase the consumption of dry matter as many as 0.436 kg/head/day or 4.5%. Rumen microbes play a role in the fermentation process of food substances, so as the number of microbes in the rumen increases, the digestion process of food becomes faster, resulting in an empty rumen quickly, which has an impact on increasing feed consumption [27]. This was also stated by Arowolo and He [28], who stated that probiotics helped stimulate rumen microbial growth and fermentation activity.

Supplementation of probiotics with the component of *Lactobacillus plantarum*, which is cellulolytic bacteria to produce cellulase enzyme, can improve population and microbial activity in rumen until it increases feed digestibility gives a chance for livestock to consume more feed [29]. Feed ratio supplemented by yeast generally tends to stimulate feed consumption. These results are under Abdel-hafeel *et al.* [6], who stated that probiotics were feed additives in the form of live microbes that could improve the balance and digestive function of the host animal and manipulate the microflora of the digestive tract to improve health conditions and increase production.

The usage of probiotics in large and small amounts in the rumen has been proved for improving feed intake when supplemented with yeast [30], [31]. Then, supplementation of Undegraded Dietary Protein (UDP) is required for ruminants by taking into account the availability of N precursors for rumen microbes [3]. A sufficient supply of N precursors for microbial protein synthesis will optimize rumen microbe proliferation, increasing fiber digestibility and dry matter consumption [32].

Undegraded Dietary Protein (UDP) supplementation would increase the value of the Average Daily Gain (ADG) of livestock [33]. All treatments given have a higher value when compared. The highest daily body weight gain in sheep is shown by the sheep receiving 10% additional UDP feed treatment. The results showed that the R4 treatment (standard complete feed with UDP protein source + Probiotics + Premix) had the highest body weight gain value and dry matter consumption. Bodyweight gain is influenced by the amount of ration consumed and the ratio quality. Previously,

Matthews *et al.* [27] stated that Body weight gain was influenced by the amount of ration consumed; the higher the level of ration consumption, the higher the body weight gain produced; conversely, the lower the consumption, the lower the body weight gain [34]. The addition of probiotics has a positive effect on growth and feed efficiency.

Probiotics are non-pathogenic microbes that can be found in nature abundantly and the gastrointestinal tract of ruminants, and the presence of probiotics can positively influence the host physiologically [31]. Probiotics fix the microbial ecosystem, nutrient synthesis, and their bio-availability, which increase a better growth performance in farm animals [6], [13], [28]. In addition, the supplementation of probiotics also increases nutrient absorption so that it directly affects the body weight of livestock.

Probiotics increase the activity of digestive enzymes, resulting in complete food breakdown and absorption, allowing livestock to properly use absorbed food for tissue growth and weight gain [10], [31]. In this study, the supplementation of probiotics, UDP, and Premix in treatment 4 (R4) has denoted the good effect on body weight proved by the highest body weight gain (208.08) compared to control the other treatments. The probiotics used in this study are yeast and lactic acid bacteria (LAB).

Supplemented probiotics can improve daily gains and average body weights. The supplementation of yeast culture in diets of Awassi lambs generated a higher body weight gain (266 g/day) compared to control (212 g/day) [35]. This is in line with Ayala-Monter *et al.* [36], which discovered that probiotic supplementation increases body weight gain in the lambs. Probiotics can improve body weight gain in the lambs because of augmented microbial protein synthesis leading to more amino acid supply at the post-ruminal level [13].

Probiotics could improve body weight gain by 1.90% and daily gain by 2.50% in lambs fed diets with probiotics Bio plus 2B compared to the control group. The better weight gain might also be related to higher consumption and better efficiency of feed utilization in the group supplemented by probiotics. Lambs fed diets with Probios® had improved weight gain (24.7 and 6.4%) during the first two weeks and from the 2nd to 4th week [37]. In addition, Adem *et al.* [38] reported higher body weight gain in Kivircik male yearling lambs supplemented with direct feed microbial culture (Cylactin® LBC ME 10) than the control group. Khalid *et al.* [37] reported that supplementation of 2 g of cyc-methionine/d resulted in significantly higher total body gain and average daily gain than the control group.

Dinata *et al.* [39] reported a significantly higher body weight gain in the goatling supplemented with probiotics orally (curds) 15 ml/day compared to the control group. It is indicated that curds as probiotics impact improving growth performance. Probiotics can improve digestion and feed FCR and body weight gain in small ruminants like goats and sheep [32]. The higher body weight gain in ruminants may be due to the higher cellulolytic activity yielding the improvement of fiber degradation caused by probiotic activity [30], [31].

Sufficient data on lamb production bolster that gave probiotics supplementation to the basal diet is effective and might be the potential to improve the growth performance of the ruminants. The efficiency of feed utilization is repaired in growing lambs fed diets supplemented with probiotics which

were denoted by the biological changes in the rumen [28], [29]. The better efficiency of feed utilization in lambs has been shown in the lambs fed with probiotics in the diets compared to the diets without probiotics [35]. Better efficiency of feed utilization was also noted in lambs fed diets containing Probios® during the 1st two weeks and from the 2nd to 4th week [37].

The supplementation of yeast culture (YC; Diamond V®YC) in Awassi lambs resulted in a better value of FCR [40]. The supplementation of 2 g of cyc-methionine/lamb/day showed a better value of FCR compared to control [41]. It indicates that feeding Awassi lambs' yeast and methionine in the form of cyc-methionine with a low level of 2 g/day improves the feed efficiency. According to the quality of the meat, the addition of UDP and Probiotics will affect the tenderness of the meat. The addition of UDP and probiotics resulted in meat tenderness that was still of fairly good quality [42]. The use of UDP probiotics will affect the fat content of the resulting meat. This is because the use of UDP can result in fat depots in meat.

B. The Effect of Providing Complete Rations on Digestibility of Dry Matter (DDM) and Organic Matter (DOM)

Data regarding the digestibility value of dry matter and organic matter in each treatment are presented in Table 4. Based on the Analysis of Variance (ANOVA), all treatments had no significant effect ($P < 0.05$) on the digestibility value of Dry Matter (DDM) and Organic Matter (DOM). However, when compared to control (R0), all treatments had a higher value. R2 was the treatment with the highest DDM and DOM values of 62.37 and 61.58, respectively. This shows that the balance of macronutrients and micronutrients and the addition of probiotics to feed can improve feed efficiency.

TABLE IV
THE DIGESTIBILITY VALUE OF DRY MATTER (DDM) AND ORGANIC MATTER (DOM) IN EACH TREATMENT

Parameter	Treatment				
	R0	R1	R2	R3	R4
DDM	60.53 ^a	61.38 ^a	62.37 ^{ab}	60.19 ^{ab}	59.80 ^b
DOM	60.29 ^a	61.40 ^a	61.58 ^{ab}	60.08 ^{ab}	58.89 ^b

Note: Treatment marked with the same letter showed no significant difference at 5% level according to Duncan Test.

This suggests that feed protection using tannin extracts tends to have a greater effect in increasing the digestibility of dry matter and organic matter than the one without giving tannin extracts. The 0.25% tannin extract protection gave the best effect on the protein protection of soybean meal [43]. Then, the decrease in the concentration of Volatile Fatty Acid (VFA) associated with microbial amino acid metabolism indicates that the protected protein will be more resistant to microbe degradation [44].

With protein sources treated with protection, such as tannins, the amount of Non-protein Nitrogen (NPN) reaching the duodenum increases as microbial digestion resistance increases [45]. Non-protein nitrogen is a term utilized in creature sustenance to allude on the whole to parts, for example, urea biuret uric acid and other ammonia, which are not proteins but rather can be changed over into proteins by

organisms in the ruminant stomach. Urea is a basic compound that contains 46.7 percent nitrogen contrasted with 16% for most proteins [46]. There is no doubt that urea and other NPN can be taken care of securely to ruminants to supplant part of the dietary protein. When urea with feed sources enters the rumen, it is quickly broken down and hydrolyzed into ammonia by bacterial urease [47], [48].

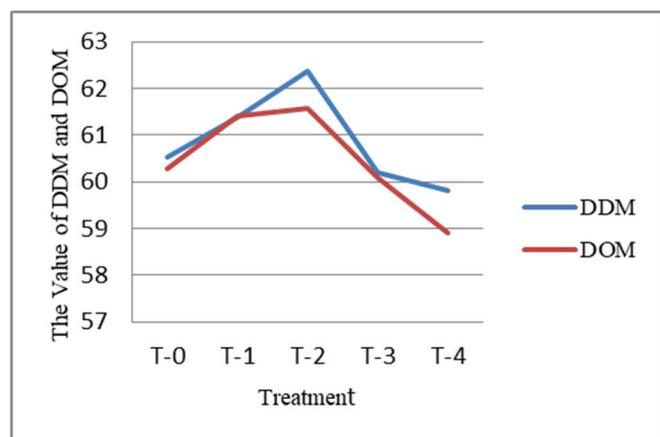


Fig. 3 The Digestibility Value of Dry Matter and Organic Matter in Each Treatment

The higher amount of NPN in the duodenum in this ratio will increase the amount of amino acid concentration in the duodenum when compared to the control ratio. This is caused by a decrease in microbial protein breakdown susceptibility, which reduces the number of N microbes that reach the small intestine and reduces the efficiency of protein synthesis by microbes [49].

IV. CONCLUSION

The balance of macro-micronutrients in fat-tailed sheep feed and the addition of probiotics can improve feed efficiency and fat-tailed sheep productivity. In addition, the supplementation of probiotics is also able to elevate the meat quality by improving the tenderness of the resulting meat. The results showed that all treatments have no significant impact ($P < 0.05$) against the Digestible of Dry Matter (DDM) and Organic Matter (DOM). When contrasted with the control, practically all treatments have a higher value than the control. Though in the boundaries of body Weight Gain (WG) and Dry Matter (DM) utilization, all treatments had essentially various impacts ($P > 0.05$), with P4 (R1 + Premix + Probiotics) offering a higher benefit than any treatments. Therefore, the arrangement of apportions containing UDP and Probiotics can build the productivity of sheep.

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