The Evaluation of Sunflower Seed Meal as Protein Source in Lamb Ration

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Abstract. Sunflower seeds meal is one of feed ingredient that has crude protein content similar to coconut meal. Sunflower seeds meal contains unsaturated fatty acids and crude fiber in high concentration. In this study we use female lamb as animal model with average of body weight 13.58 ± 1.82 kg and aged 2 to 3 months. The experimental design used a randomized block design (RBD) with 3 treatments and 4 groups, Treatment without addition of sunflower seeds meal (P0), with addition of 10% sunflower seeds meal (P1), and with addition of 15% sunflower seed meal (P2). Based on the results it can be concluded that substitution of sunflower seeds meal in diet did not improve feed consumption, body weight gain, feed efficiency, as well as metabolites of blood glucose and cholesterol. The use of sunflower seed meal in diet up to 15% is still safe for performance of ewes.

1. Introduction
Livestock production performance is not only seen from its physical growth, but also the reproductive characteristics. To produce high quality lambs, the best performance of ewes as parents, are required. Mulyono [1] states that the prospective ewes requirements are large body size, but not too fat, compact body shape, deep and wide chest, straight back and waist lines, clean and shiny fur, straight legs and look sturdy and high heels, no defects in the body, normal genital shape and size, age more than 1 year old.

Female lamb will grow well as a prospective parent (dams) by considering nutrition and the environment as well as body weight gain so that it will reach sexual and physical adulthood. Young female lambs should not be mated until its body growth ready for pregnancy and normal birth. Nutrition is very important and a major factor to enter the puberty period but if the body weight is not fulfil the condition for the first lust, then the ewes, even though their age is sufficient, still will not experience puberty, because sexual maturity occurs before physical adulthood is reached. Mature body weight occurs when a sheep enters the first oestrous period and ready to carry out the reproductive phase. Puberty in sheep can be achieved at various ages of 6-12 months or at a body weight about 55% - 60% of adult body weight [2]. Local sheep's mature body weight can reach 30-40 kg in males and females 20-25 kg with a carcass percentage of 44% - 49% [3].

Sunflower seed meal is the fourth biggest source of protein for animal feed after soybean meal, cottonseed meal, and canola cake [4]. The processing of sunflower seed plants produces
52% of sunflower seed oil and the cake is 48%. Sunflower seed meal has a higher amino acid content of methionine than soybean meal [5]. Proximate analysis of sunflower seed meal in PAU laboratory contains 20.23% of crude protein; 5.81% of crude lipid; and 45.95% of crude fiber. Research of sunflower seed meal has been carried out in several countries such as Jordan, Brazil, Nigeria, and Texas. Addition of 23% sunflower seed meal is able to replace soybean meal as much as 20% in the Shami goat ration [6] and 37.5% Sunflower seed meal is able to replace 18% of soybean meal in the Awwasi ewes ration, and the results was the body weight gain is not significantly different between treatments [7]. Sunflower seed meal as a source of protein plays a role in the reproductive process of livestock because a lack of protein will affect the anterior pituitary function so that the production and secretion of hormones Follicle Stimulating Hormone (FSH) and Luteinizing Hormone (LH) low, which causes the ovaries do not develop or ovarian hypo function that lead to anestrus [8]. In addition, the benefits of sunflower seed cake do not have anti nutrient factors such as those found in soybean or cottonseeds so that sunflower seed meal is considered safe for animal. Its use needs to be limited because of the high fiber content. The objectives of this study were to evaluate the level of sunflower seed meal in lamb ration to become potential dams and blood performance and metabolites.

2. Materials and methods

2.1. Data collection and animal management

Twelve growth periodic sheeps at age of 2-3 months old were used in this experiment. The average initial body weight were 13.58 ± 1.82 kg. The ration provided consists of forages and concentrates with a ratio of 30% grass and 70% concentrate. The ingredients used are Brachiaria humidicola grass, pollard, coconut meal, sunflower seed meal, CaCO₃, premix and salt.

2.2. Animal housing

Sheep are kept in an individual cage for 3 months and equipped with feed and drinking water container. The sheep were individually weighed at the beginning of the experiment to obtain average initial body weight. The animals were fed 4 times a day at 7.00, 9.00, 12.00 and 16.00 o'clock divided equally between concentrate and grass, the remaining feed is weighed every day. Ingredient composition of concentrates is presented in Table 1.

| Ingredients            | Treatments          |
|------------------------|---------------------|
|                        | P0 | P1 | P2 |
| Coconut meal           | 55.00 | 45.00 | 40.00 |
| Pollard                | 43.50 | 43.50 | 43.50 |
| Sunflower Seed Meal    | 0.00 | 10.00 | 15.00 |
| CaCO₃                  | 0.50 | 0.50 | 0.50 |
| Premix                 | 0.50 | 0.50 | 0.50 |
| Salt                   | 0.50 | 0.50 | 0.50 |

P0 = control diet, P1 = experimental diet with 10% of sun flower seed meal, P2= experimental diet with 15% of sun flower seed meal

Chemical analysis of concentrate and grass of Brachiaria humidicola in ration fed to weaning ewes throughout the experiment is presented in Table 3.
Table 2. Nutrients composition of concentrate and grass of *Brachiaria humidicola*
(dry matter basis)

| Nutrients* | Konsentrat | forage\(^1\) |
|------------|------------|--------------|
| Dry matter | \(\ldots\) | 69.22 | 69.03 | 68.59 | 20.88 |
| Ash        | 5.78       | 5.79 | 5.81 | 7.29 |
| Crude Protein | 14.47 | 14.69 | 14.79 | 12.88 |
| Fat (EE)   | 3.71       | 3.56 | 3.49 | 0.76 |
| Crude Fiber (CF) | 18.57 | 20.73 | 21.82 | 33.20 |
| Nitrogen-Free Extract (NFE) | 56.4 | 54.15 | 53.03 | 45.86 |
| Ca         | 0.42       | 0.46 | 0.48 | 0.63 |
| P          | 0.73       | 0.74 | 0.74 | 0.35 |
| TDN (Total Digestible Nutrient) | 69.41 | 67.09 | 65.94 | 55.01 |

\(^*\) Analysed by PAU laboratory, IPB University (2016); value of %TDN = \(22.82-1.440(CF)-2.875(Fat)+0.655(NFE)+0.863(CP)+0.020(CF)-0.078(Fat)-0.018(CF)(NFE)-0.045(Fat)(NFE)-0.085(Fat)(CP)+0.020(Fat)(CP)(Hartadi et al. 1980); \(^1\)Dinaniar (2013)

2.3. Blood sampling
Blood sampling was taken once a day, in the end of experiment period, to analyse level of glucose, cholesterol and blood plasma. Blood was taken from jugular vein of the animals by using disposable syringe with needle. The collected blood was immediately preserved in the tubes containing 3 mL of anticoagulant ethylene diamine tetraacetic acid (EDTA). Preserved blood samples were centrifuged at 3000 rpm for 15 minutes for further analysis.

2.4. Measurements

2.4.1. Feed and nutrient intake (g day\(^{-1}\)).

Feed intake was calculated individually by subtraction of orts from the total amount of feed offered to each group. The orts were weighed on the next day.

Feed intake (DM basis, g.day\(^{-1}\)) = Feed intake (as fed basis, g) × %DM of feed

Nutrient intake (g.day\(^{-1}\)) = Feed intake (DM basis, g.day\(^{-1}\)) × %Feed nutrient

2.4.2. Daily weight gain

Lambs were weighed individually twice a week before feeding and ADG, feed intake and feed efficiency were calculated.

Body weight gain (g) = Final weight (g) - Initial weight (g)

Average daily gain (ADG) (g head\(^{-1}\) day\(^{-1}\)) = \(\frac{\text{Final weight (g) - Initial weight (g)}}{\text{days fed}}\)

2.4.3. Feed efficiency

Feed efficiency is calculated from average body weight gain (ADG) daily divided by the average consumption of dry matter per day.
Feed efficiency(%) = \frac{\text{ADG (g/head/day)}}{\text{Feed intake (DM basis, g/head/day)}} \times 100\%\

2.4.4. *Glucose and plasma cholesterol level (mg dL}^{-1})*
Glucose and plasma cholesterol level were analyzed by using measurement kit.

2.5. *Data analysis*
The experimental design used was a randomized block design (RBD) with 3 treatments and 4 groups. The model was designed to determine the effect of different treatments on the variables measured throughout the experiment. Analysis of variance (ANOVA) was performed and if obtained significantly different data then further tests of Orthogonal Contrast were performed.

3. *Results and discussions*

3.1. *Feed Consumption (DM basis)*
The results showed that the feed consumption of dry matter basis from each treatment was not significantly different. The average feed consumption is presented in Table 3.

| Table 3. Feed consumption (DM basis) |
|-----------------------------------|
| Parameters                        | Treatments     |
| Consumption                       | P0             | P1             | P2             |
| Grass                             | 161.28±24.37   | 152.54±12.64   | 151.67±31.74   |
| Concentrate                       | 270.86±24.68   | 284.55±3.64    | 280.49±44.44   |
| Total consumption                 | 432.14±47.71   | 437.08±15.67   | 432.17±71.56   |
| %Body weight                      | 2.15±0.11      | 2.29±0.09      | 2.19±0.21      |
| Ratio (G: C)                      | 37.32:62.68    | 34.90:65.10    | 35.10:64.90    |

P0 = control diet, P1= suplementation of sunflower seed meal 10%, P2= suplementation of sunflower seed meal 15%.

There were no differences in the consumption of dry matter indicate that palatability of the three types of experimental is the same. The same palatability is because physically has the same texture. This is supported by the statement of Pond et al. [9], that the texture of feed ingredients can affect its palatability. Consumption of ration in basis of DM, in the control diet (P0) to the 15% of sunflower seed meal (P2) ranges from 432.14-437.08 g tail\(^{-1}\) day\(^{-1}\). Standart consumption of DM for ewes with body weight of 10-20 kg and ADG of 100 g tail\(^{-1}\) day\(^{-1}\) ranging from 210 - 410 g tail\(^{-1}\) day\(^{-1}\) or around 2.5 -3.1% of body weight. Palatability level affects the level of ration (DM basis) consumption, and influenced by odor, taste, texture, and temperature [9]. Dry matter consumption in this study was ranges from 2.15-2.29% of body weight. The data obtained are in agreement with Farida [10] who stated that the amount normal consumption of DM is 2-3% of the body weight of sheep.

3.2. *Nutrient intake*
Nutrient intake as CP, lipid, CF, TDN and Beta-N are presented in Table 4.

| Table 4. Average nutrient intake |
|---------------------------------|
| Parameters                      | Treatments     |
|---------------------------------|----------------|
|                                |                |                |
|
Protein is highly needed by livestock because its amino acid content (essential and nonessential) is important during growth and development for reproduction [11]. Consumption of crude protein that does not differ between treatments is in accordance with the amount of crude protein in dry matter rations. High DM consumption also increases protein consumption in feed [12]. Consumption of crude protein in this study ranged from 59.97-61.45 g tail\(^{-1}\) day\(^{-1}\). According to Kearl [13] the standard consumption of crude protein for local sheep with 10-15 kg BW and body weight gain of 100 g tail\(^{-1}\) day\(^{-1}\) is around 70-95 g. There is no difference in TDN consumption was calculated in this experiment and no differences were observed among all rations fed.

3.3. Glucose and cholesterol
Blood glucose and cholesterol level of ewes are presented in Table 5.

| Variables       | Treatments | Ref* |
|-----------------|------------|------|
|                 | P0         | P1   | P2   |
| Cholesterol (mg/dL) | 70.40±2.55 | 58.62±12.53 | 53.02±24.86 | 43-103 [14] |
| Glucose (mg/dL)  | 48.24±12.72 | 50.85±2.64 | 41.85±8.62 | 37-62 [15] |

P0 = control diet, P1= suplementation of sunflower seed meal 10%, P2= suplementation of sunflower seed meal 15%.

The application of sunflower seed meal in the ration did not significantly influence (P>0.05) on sheep blood cholesterol and glucose level. Blood glucose levels in this experiment ranged from 41.85-50.85 mg dL\(^{-1}\) and according to Wahyuni et al. [15], the normal value of blood glucose levels in sheep ranged from 37-62 mg dL\(^{-1}\). The blood glucose level of sheep in this study is still within the normal range. The value of sheep blood cholesterol decreased with the addition of sunflower seed cake in the ration as shown in Table 5. The blood cholesterol in this study ranged between 53.02-70.40 mg dL\(^{-1}\) the range of sheep blood cholesterol is still in the normal range as explained by Jackson and Peter [14] that sheep blood cholesterol levels range from 43-103 mg.dL\(^{-1}\).

3.4. Body weight gain
The statistical analysis showed that the addition of sunflower seed meal in the ration had no significant effect (P>0.05) on the body weight gain of sheep (Table 6). This is in line with the consumption of crude protein (CP), crude fat and TDN which are not significantly different (Table 4).
Table 6. Body weight gain and feed efficiency

| Treatments | P0          | P1          | P2          |
|------------|-------------|-------------|-------------|
| Initial BW (Kg) | 13.58±1.82  | 13.60±1.34  | 13.63±1.07  |
| Final BW(Kg)    | 20.16±3.00  | 19.13±1.34  | 19.83±3.73  |
| Body weight gain (g head⁻¹) | 6585±1980.18 | 5530±836.10 | 6202.50±2870.71 |
| ADG (g head⁻¹ day⁻¹) | 70.81±21.29 | 59.46±8.99  | 66.69±30.87 |
| Feed Efficiency (%) | 15.25±3.92  | 12.80±1.84  | 14.23±5.12  |

P0 = control diet, P1= suplementation of sunflower seed meal 10%, P2= suplementation of sunflower seed meal 15%.

The body weight of ewes in three treatments increased during the study. This happens because the sheep are in a growth phase at the age of 2-3 months. This is in line with the opinion of Mathius [16] which states that the body weight of sheep will increase rapidly until reaching adulthood, namely the age of 6-8 months and will become slower growth when reaching adult age. Daily body weight gain in this study ranged from 59.46-70.81 g tail⁻¹ day⁻¹.

The body weight gain were still within the normal range for local sheep because the average daily body weight gain (ADG) of local sheep reached 57-132 g tail⁻¹ day⁻¹ [17]. Giving sunflower seed meal in the ration did not affect (P>0.05) the daily weight gain of sheep and feed efficiency.

The provision of 10% sunflower seed meal in P1 ration has the lowest daily body weight gain and the lowest final weight as shown in Table 6, the low feed efficiency is presumed because the metabolized feed is widely used for respiration and replacing damaged tissue.

Feed efficiency is obtained from the ratio between daily body weight gain and consumption of dry matter, the higher value of feed efficiency, the better use of feed in increasing livestock growth. According to NRC [18] weight gain is influenced by several factors including genetic conditions, the environment, the condition of each individual, and maintenance procedures. The standard deviation for sheep body weight gain is indeed quite high as shown in the graph below:

![Average daily body weight gain (ADG)](image-url)
4. Conclusion
Addition of sunflower seed meal to a level of 15% in the concentrate did not affect feed consumption, body weight gain, or blood metabolites of sheep. The final body weight of the ewes in this study has reached Mature body weight.

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