Nutrient intake and performance of male New Zealand White rabbits fed different level of Leucaena leaf meal in pelleted complete diets

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Abstract. This study aimed to determine nutrient intake and performance of male New Zealand White rabbits fed complete feed pellets containing different level of Leucaena leaf meal (LLM). A total of 20 rabbits was randomly divided into four groups and fed diets containing 0% (P0), 5% (P1), 10% (P2), and 15% LLM (P3), for a duration of 10 weeks. The crude proteins (CP) of the diets were 17.7-18.1% and energy of the diets were 2,277.1-2,541.7 kcal/kg. Data were collected on a weekly basis and analyzed by analysis of variance. The results showed that nutrient intake, average daily gain (ADG) and feed conversion ratio (FCR) of male New Zealand White rabbits fed pellet containing 10% LLM was higher (P<0.05) than those fed the other diets. The dry matter (DM), CP, extract ether (EE), and crude fiber (CF) intakes of P2 were highest, they were 80.04±3.96, 16.43±0.81, 6.64±0.33, 15.84±0.78 (g DM/head/day), respectively. The ADG was 20.20±2.29 g/head/day and FCR was 4.60±0.55. It is concluded that 10% LLM in complete feed pellets improved the growth performance and nutrient intakes of male New Zealand White rabbits.

1. Introduction
Rabbit production in many countries, including Indonesia, is less popular and less developed compared to other livestock industry. Masanto and Agus [1] stated that the development of rabbit industry in Indonesia was constrained by non-structured marketing and feed availability, as farmers still relied on field grass as the main feed source. Rabbits given forage feed only are low in productivity due to insufficient crude protein supply. Growing rabbits need about 16-18% crude protein (CP), crude fiber (CF) about 12-16%, crude fat (CF) about 3-6%, energy of 2500 kcal/kg of ration, and minerals about 5-6.5% [2]. Complete feed pellets containing all the necessary nutrients are most common form of feed given to rabbits, to meet the requirements of rabbits. The advantages of using complete feed in the form of pellets include increased feed efficiency and optimum nutrient intakes from forage and concentrate [3]. The high price of rabbit pellets on the market is due to the high cost of raw materials, one of which is soybean meal. Soybean meal is a protein source for livestock with a protein content of 44-51% [4]. Because prices and availability fluctuate, it is needed to find alternative materials that can replace soybean meal. Purwantari et al.[5] suggested that Leucaena leaves are highly preferred by ruminants. Leucaena leaves contain 21.5% CP and has a high...
digestibility (60-70%). Leucaena is easy to cultivate and has high yield of dry matter, so it is abundant in many parts of Indonesia. This research aims to determine the nutrient intake and performances of the male New Zealand White rabbits, fed by pellets containing varying levels of soybean meal and Leucaena leaf meal.

2. Material and methods
The research was conducted in a rabbit farm in Mangunan Village, Dlingo, Bantul. The feed analysis was carried out at the Animal Feed Technology Laboratory, Faculty of Animal Science, Universitas Gadjah Mada Yogyakarta. The animals used in this study were 20 New Zealand White rabbits with age of 2 to 2.5 months and body weight of 600 to 1000 g. There were three dietary treatments namely, P0 (0% Leucaena leaf meal, LLM), P1 (5% LLM), P2 (10% LLM) and P3 (15% LLM) as shown in Table 1. The feed given was complete feed in the form of pellets consisted of corn, pollard, Pennisetum purpureum cv. Mott meal, molasses, soybean meal, Leucaena leaf meal, copra cake, tapioca meal, and premix. The rabbits were placed in individual cages, measuring 60 cm in length, 30 cm in wide and 45 cm in height, equipped with feces collection tray and urine storage equipment. The feeder was from round clay with diameter of 10 cm and height of 5 cm. The drinker was made from bottle attached with nipple.

Table 1. Feed composition of complete pellet feed treatment diets

| Ingredients                  | P0 (0% LLM) | P1 (5% LLM) | P2 (10% LLM) | P3 (15% LLM) |
|------------------------------|-------------|-------------|--------------|--------------|
| Corn                         | 30          | 30          | 30           | 30           |
| Pollard                      | 25          | 25          | 25           | 25           |
| *Pennisetum purpureum* cv. Mott | 5           | 5           | 5            | 5            |
| Molasse                      | 5           | 5           | 5            | 5            |
| Soy bean meal                | 20          | 16          | 14           | 13           |
| Leucaena leaf meal           | 0           | 5           | 10           | 15           |
| Copra cake                   | 9           | 8           | 5            | 1            |
| Tapioca meal                 | 5           | 5           | 5            | 5            |
| Premix                       | 1           | 1           | 1            | 1            |
| Total                        | 100         | 100         | 100          | 100          |

The feeds were pelleted in a pellet machine, then dried in an oven. The dried pellets were stored in plastic bags until being fed. The nutrient content the pellets can be seen in Table 2. The feed adaptation was carried out for two weeks followed by 10 weeks of feeding trial, during which nutrient intake were measured. The pelleted feed was given in the morning at 06.00 a.m., in the afternoon at 06.00 p.m., while the drinking water was given in ad libitum. The data obtained were analyzed based on a one-way analysis of variance using the software SPSS version 16. Significant differences in the means were separated using the Duncan’s Multiple Range Test analysis.

Table 2. The chemical composition of the treatment diets

| Nutrients                  | P0  | P1   | P2   | P3   |
|---------------------------|-----|------|------|------|
| Dry matter (%)            | 83.6| 84.7 | 86.9 | 87.2 |
| Crude protein (%)         | 17.7| 18.1 | 17.8 | 17.7 |
| Extract ether (%)         | 4.9 | 7.7  | 7.2  | 6.7  |
| Crude fiber (%)           | 15.1| 16.6 | 17.2 | 17.5 |
| Ash (%)                   | 9.5 | 9.6  | 9.8  | 7.9  |
| Water (%)                 | 16.4| 15.3 | 13.1 | 12.8 |
| Digestible energy (kcal/kg) * | 2,388.9 | 2,325.6 | 2,277.1 | 2,541.7 |

* Based on calculation: DE (kcal/kg) = 4253 – 32V6 x (CF%) – 144.4 x (Ash%) [6]
3. Results and discussion

3.1. Nutrient intake

The nutrient intake of male New Zealand White rabbits fed pellets with a balance of soybean meal and different Leucaena leaf meal are presented in Table 3.

Table 3. The nutrient intake of male New Zealand White rabbits fed the treatment diets

| Variable                  | P0     | P1     | P2     | P3     |
|---------------------------|--------|--------|--------|--------|
| Intake of DM (g DM/head/day) | 61.16±4.59 | 69.04±4.94 | 80.04±3.96 | 70.89±7.65 |
| Intake of CP (g DM/head/day)  | 12.92±0.97  | 14.73±1.06  | 16.43±0.81  | 14.43±1.56  |
| Intake of EE (g DM/head/day)  | 3.65±0.27   | 6.30±0.45   | 6.64±0.33   | 5.45±0.59   |
| Intake of CF (g DM/head/day)  | 11.06±0.82   | 13.51±0.97   | 15.84±0.78   | 14.20±1.53   |
| Intake/body weight (g/kg BW/day) | 69.08±12.57  | 83.63±11.91  | 98.12±13.04  | 85.64±8.63  |

Different superscript in the same row showed significant difference (P<0.05)

P0= 0% Leucaena leaf meal, P1= 5% Leucaena leaf meal, P2= 10% Leucaena leaf meal, P3= 15% Leucaena leaf meal

The DM intake of rabbits fed P2 diet was higher (P<0.05) compared to the other treatments. This was probably because the content of LLF in the complete ration, which was in accordance with the tolerance limits of rabbits to Leucaena leaf, thereby increasing rabbit palatability of feed. Yurmiaty and Suradi [7] stated that the use of 10% of Leucaena leaves in the ration could increase the palatability of the feed. Ensminger [3] stated that young rabbits with a body weight of 1.8 kg consume feed around 112 g DM/head/day. The average initial body weight of rabbits in this study was 848.4 g, the rabbits should consume feed around 52.79 g DM/head/day [3]. Satria [8] stated that New Zealand White rabbits had intake of DM 41.14 to 42.57 g/head/day. The rabbit nutrient intake in this study was higher when compared to other studies reported in the literatures. Rizqiani [9] stated that the intake of the male New Zealand White rabbit, with an average weight of 1375.28 g/head, given a complete ration with sweet potato leaves in the form of pellets was 117.78 g/head/day.

Rabbits fed P3 consumed similar amount of feed compared with P2, suggesting that there was a reduction in nutrient intake when the level of LLM was higher than 10%. The CP intake of rabbits fed P2 diet was higher (P<0.05) because the pellet palatability and high intake of DM, associated with CP intake. Ensminger [3] in Muslih et al. [10] stated that growing rabbits need 16 to 18% protein, whereas according to the National Research Council [11] that growing rabbits need 16% protein. Thus, using 10% LLM in pellet feed will produce the CP content of 16.43%, which was in accordance with the needs of growing rabbits.

The EE intake of rabbits fed P3 and P1 diets were similar because the fat contents in the feed ranged between 7.2% and 7.7%. Ensminger [3] in Muslih et al. [10] stated that growing rabbits need 3-6% fat and 12-16% crude fiber. The CF intake of P1, and P3 was in accordance with NRC [11], but P0 was significantly lower because of the high crude fiber of Leucaena leaves (14.3%) compared with that of soybean meal (3.4%).

3.2. Growth Performance

The daily body weight gain of the male New Zealand White rabbits fed pellets with a balance of different soybean meal and Leucaena leaf meal are presented in Table 4.

The initial body weights of rabbits were not different between the treatments, but the final body weight of rabbits fed diet P2 had the highest value compared with the other treatments (P<0.05). This finding was in line with the high intake of DM, CP, EE, CF, intake per total body weight and high daily weight gain in this treatment group. Daily weight gain P2 was higher than other treatments (P<0.05). The rabbits in other treatment groups (P0, P1, P3) had similar daily weight gain even though the nutrient intake was different. Ayyat et al. [12] showed that daily weight gain in New Zealand White rabbits ranged from 19 to 24 g/day. Rizqiani [9] found that the daily body weight gain of the male New Zealand White rabbits given complete rations with sweet potatoes in the form of pellets was
17.60 ± 10.92 g/day. In this study, the body weight gain of rabbits fed diets containing 10% LLM were within the range reported in the literature.

**Table 4.** The daily body weight gain of the male *New Zealand White* rabbits fed the experimental diets

| Variable                  | P0                  | P1                  | P2                  | P3                  |
|---------------------------|---------------------|---------------------|---------------------|---------------------|
| Initial body weight (g)   | 899 ± 98.32         | 835 ± 91.45         | 824 ± 79.48         | 836 ± 131.69        |
| Final body weight (kg)    | 1.28 ± 0.78         | 1.84 ± 0.96         | 2.24 ± 0.20         | 1.77 ± 0.18         |
| ADG (g/head/day)          | 10.56 ± 3.99        | 14.29 ± 2.66        | 20.20 ± 2.29        | 13.34 ± 2.64        |

* Different superscript in the same row showed significant difference (P<0.05)

P0= 0% Leucaena leaf meal, P1= 5% Leucaena leaf meal, P2= 10% Leucaena leaf meal, P3= 15% Leucaena leaf meal

Feed-cost per gain of the male *New Zealand White* rabbits, fed the experimental diets are presented in Table 5. The feed conversion of the rabbits fed diet P0 (0% LLM) was significantly higher than those fed the other diets. The feed conversion of rabbits fed diet P3 was lowest compared to the other diets suggesting that this level of LLM was optimum in the pellets. This was due to the quality of pellet feed, which meet the requirement, good food adaptation and palatability. Possibly, the digestibility of CP, EE, and CF pellet feed was very good, thus feeding 4.60 ± 0.55 kg can increase 1 kg of body weight. Satria [8] stated that *New Zealand White* rabbit feed conversion was 3.63 to 5.63 kg, similar with feed conversion obtained in P2.

**Table 5.** Feed conversion and the feed-cost per gain of the male *New Zealand White* rabbits fed the experimental diets

| Variable                  | P0                  | P1                  | P2                  | P3                  |
|---------------------------|---------------------|---------------------|---------------------|---------------------|
| Feed conversion           | 7.88 ± 3.24         | 5.85 ± 91.17        | 4.60 ± 0.55         | 6.34 ± 1.71         |
| Feed cost per gain (IDR/g)| 33,015 ± 13.56      | 23,218 ± 4.62       | 17,671 ± 2.10       | 23,859 ± 6.43       |

* Different superscript on the same row showed significant difference (P<0.05)

P0= 0% Leucaena leaf meal, P1= 5% Leucaena leaf meal, P2= 10% Leucaena leaf meal, P3= 15% Leucaena leaf meal

Feeding 15% LLF increased the feed conversion value was increasing again, because the rabbit body metabolism was disrupted by the presence of antinutrient compounds in LLF, one of which was mimosine which can cause hair loss and food poisoning. Tillman *et al.* [13] stated that feed conversion was influenced by nutrient intake, quantity and quality of feed, weight gain, and rabbit species.

The P2 resulted the smallest feed cost per gain than the other treatments (P<0.05). Feeding pellets with 10% LLM had the highest daily weight gain and the lowest feed conversion value, so the costs incurred were proportional to the increase of 1 kg of body weight. Feed cost per gain of the *New Zealand White* rabbit, given forage rind and tofu pulp and bran concentrates, was 39.412 ± 10.390 [14, 15]. Astrini [16] stated that Rex rabbits, fed with the addition of dried water spinach in the feed treatment in mash form, had feed cost per gain of IDR 46.60 ± 17.1, and in feed treatment in the form of pellets had feed cost per gain IDR 21.60 ± 5.85.

4. Conclusion

It is concluded that pelleted diet containing 10% LLM in complete feed improved the growth performance and nutrient intakes of male *New Zealand White* rabbits.

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