Carcass characteristics of male New Zealand white rabbits fed complete pellet containing different levels of leucaena leaf meal

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Abstract. The objective of this study was to evaluate the growth performances and carcass characteristics of male New Zealand White rabbits, offered complete feed pellets containing different levels of leucaena leaf meal (LLM). Twenty rabbits (2.0-2.5 months old, 600-1000 g of weight) were divided into four groups, and fed pelleted diets containing 0% LLM (P0), 5% LLM (P1), 10% LLM (P2) and 15% LLM (P3). The feeding trial lasted 10 weeks. The crude proteins (CP) of the diets were 17.7-18.1% and energy ranged 2,277-2,542 kcal/kg. The feed ingredient of the pellets consisted of corn, pollard, Pennisetum purpureum cv. Mott, molasses, soybean meal, LLM, copra cake, tapioca flour, and premix. Feed was offered twice daily and water given ad libitum. After 10 weeks they were slaughtered and slaughter weight (SW), carcass and non-carcass percentage, and meat bone ratio (MBR) were determined. Data were analyzed based on a completely randomized design. The SW (2.23 ± 0.24 kg), carcass percentage (48.01 ± 5.41%), non-carcass percentage (51.99 ± 5.41%), and MBR (2.74 ± 0.53) were highest (P<0.05) in rabbits fed 10% LLM compared to those fed the other diets. It was concluded that inclusion of LLM at 10% level resulted in the highest slaughter weight, carcass percentage, non-carcass percentage and meat bone ratio compared to the other treatments. Inclusion level higher than 10% resulted in a reduction in these parameters but not significantly different from that of the controls.

1. Introduction
Rabbit production in developing countries, including Indonesia, could play a major role in animal production. Rabbits have high productivity, exhibit high growth rates, high feed conversion efficiency, high proliferation, low production costs, and high nutrient content of meat [1]. Feeding rabbits solely on forage feed will reduce productivity due to insufficient crude protein supply. On the other hand ration formulation of rabbit that are high in concentrate and low forage would increase production costs. Feed in the form of complete feed pellets containing all nutrient requirements is the most common rabbits feed. Ensminger [2] pointed out that pelleted complete feed based on forage and concentrate would increase feed efficiency and optimum nutrient intake.
The ingredients of pelleted rabbit feed affect the price and cost of production. The common protein source in formulated pellet is commonly soybean meal. Due to high price and uncertain supply, there is need to find other protein source to replace soybean meal. *Leucaena leucocephala* forage is a legume that is rich in proteins and other nutrients, and can be incorporated into the diet of rabbit [3]. Leucaena leaves contain 21.5% protein and their digestibility is high (60% to 70%). Leucaena is widely cultivated in many parts of Indonesia and is known to have a high dry matter yield. Partially replacing soybean meal with leucaena would be an alternative method of producing of pelleted complete feed for rabbits. This study was conducted to determine the carcass characteristic of the male New Zealand White rabbits, fed by pellets containing varying levels of soybean meal and leucaena leaf meal.

2. Materials and Methods
The research was conducted in a farmer’s rabbit in Mangunan, Dlingo, Bantul. The feed analysis was carried out at the Animal Feed Technology Laboratory, Faculty of Animal Science, Universitas Gadjah Mada Yogyakarta.

Twenty male New Zealand White rabbits (2.0-2.5 months old, 600-1000 g of weight) were divided into four groups, and fed pelleted diets containing 0% LLM (P0), 5% LLM (P1), 10% LLM (P2) and 15% LLM (P3). They were placed in individual wire cages provided with feeders and waterers. The pelleted complete feed consisted of corn, wheat pollard, *Pennisetum purpureum* cv. Mott meal, molasses, soybean meal, LLM, copra cake, tapioca meal, vitamin, and mineral premixes.

Feed composition and chemical composition of dietary treatments are shown in Table 1. The feed ingredients were mixed and pelleted using a laboratory pelletizer, and then were dried in an oven. The dried pellets were stored in plastic bags until used.

### Table 1. Feed ingredient and chemical composition of complete pellet feed treatment diets

| Ingredient                      | 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 meal | 5          | 5           | 5            | 5            |
| Molasses                       | 5           | 5           | 5            | 5            |
| Soybean 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          |

### Chemical composition

| Component            | P0 (0% LLM) | P1 (5% LLM) | P2 (10% LLM) | P3 (15% LLM) |
|----------------------|-------------|-------------|--------------|--------------|
| 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) | 2388.9  | 2325.6      | 2277.1       | 2541.7       |
The animals were allowed two weeks adaptation period on the treatment diets followed by 10 weeks of feeding trial during which nutrient intake were measured. The feed was given in the morning at 06.00 a.m., in the afternoon at 06.00 p.m., and the drinking water was given in ad-libitum.

2.1. Carcass Characteristic Determinations

Source: Based on calculation: DE (kcal/kg) = 4253 – 32V6 x (CF%) – 144.4 x (Ash%) [4]

Rabbits were slaughtered at 21 weeks old, thus divided into carcasses and non-carcasses. All of parts (meat and bones) of rabbits were weighed, as well as non-carcasses including skin, legs, ears, digestive tractus, reproductive and respiratory organs. Meat bone ratio is ratio between meat weights and bone weight of rabbit.

2.2. Statistical Analysis

The data obtained were analyzed using a one-way ANOVA using the software SPSS version 16. If there are any significant differences of means thus continued the Duncan Multiple Range Test (DMRT) analysis.

3. Results and Discussion

The carcass and non-carcass percentage of rabbits fed pelleted diets containing different levels LLM is presented in Table 2.

Table 2. Carcass and non-carcass percentage of New Zealand White rabbits fed pellet contains different level of soybean meal and LLM

| Variable                  | P0                      | P1                      | P2                      | P3                      |
|---------------------------|-------------------------|-------------------------|-------------------------|-------------------------|
| Slaughter weight (kg±g)   | 1.71a±227.69            | 1.84a±96.37             | 2.23b±242.72            | 1.74a±33.49             |
| Carcass weight (g±g)      | 729a±207.7              | 872a±78.01              | 1,060b±110.86           | 784a±75.51              |
| - Percentage (%)ns        | 42.11±8.29              | 47.49±3.34              | 48.01±5.41              | 44.92±2.75              |
| Non-carcass weight (g±g)  | 981a±129.57             | 963a±75.83              | 1,160b±217.26           | 958a±39.49              |
| - Percentage (%)ns        | 57.89±8.29              | 52.51±3.34              | 51.99±5.41              | 55.08±2.75              |

abc Different superscript on the same row showed significant difference (P<0.05)
P0 : 0% leucaena leaf meal  P2 : 10% leucaena leaf meal
P1 : 5% leucaena leaf meal  P3 : 15% leucaena leaf meal

Rabbits fed pellet contains 10% LLM had a higher slaughter weight than those on other treatment (P<0.05). This is in line with the high increase in average bodyweight gain, which was 20.20±2.29 g/head/day in this treatment. Similarly, carcass weight of rabbits fed pellet 10% of LLM were higher than those on other treatment (P<0.05). The increasing slaughter weight was affected by the increase of carcass weight [5]. However, both slaughter weight and carcass weight were lower than those fed diet P2 suggesting that growth was affected when the level of leucaena in the diet was increased to 15% LLM due to the reduction in nutrient intake [6] of the male New Zealand White rabbits. It appears that 10% inclusion of LLM is the optimum level possibly due to the mimosine or other anti-nutritional factors contributed by the leucaena. However, the processing and heat treatment during processing may have reduced the anti-nutritional compounds to some extent, hence did not affect intakes at levels below 10%.

The 10% leucaena leaves in rabbits’ diet has no adverse effects on the growth performance and carcass yield of growing rabbits [7], and is supported by the findings of [8] who showed that Leucaena leucocephala leaf meal at 10% inclusion level may be used as an alternative source of protein in the diet of rabbit as there was no adverse effect (toxicity).
Carcass percentage of rabbit fed pellet with LLM showed no significant differences among the treatments and is influenced by the slaughter weight [9]. The percentage of healthy rabbit carcass ranged between 50 to 59 [10]. The addition of up to 10% LLM in the pellet showed that percentage of carcass was increased (compared to the controls) but were not as high as those reported by [10]. Similarly, the percentage of non-carcasses parts of rabbits that were given pellets using LLM showed non-significant differences among the treatments although addition of 10% of LLM had the lowest value suggesting much of the increase in body weight were in the muscle and bones.

Meat bone ratio is a comparison between meat and bone produced from cutting the rabbits. The ratio of meat and bone is a comparative number to find out how much meat is produced from the bone [11]. The results of this study showed that the meat bone ratios of rabbits fed pellets with different levels of LLM were not affected by the dietary treatments (Table 3).

| Variable                  | P0               | P1               | P2               | P3               |
|---------------------------|------------------|------------------|------------------|------------------|
| Meat (g±g)                | 499 ± 161.51     | 630 ± 75.15      | 777 ± 113.71     | 529 ± 65.27      |
| - Percentage (%)ns        | 28.75 ± 6.77     | 34.38 ± 4.19     | 35.11 ± 5.55     | 30.23 ± 2.64     |
| Bone (g±g)                | 206 ± 43.82      | 259 ± 37.04      | 319 ± 36.12      | 247 ± 18.20      |
| - Percentage (%)ns        | 13.36 ± 1.79     | 13.11 ± 2.43     | 12.89 ± 1.07     | 14.69 ± 0.48     |
| MBRns                     | 2.14 ± 0.32      | 2.74 ± 0.91      | 2.74 ± 0.53      | 2.06 ± 0.18      |

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

P0 : 0% leucaena leaf meal  P2 : 10% leucaena leaf meal
P1 : 5% leucaena leaf meal  P3 : 15% leucaena leaf meal

The meat weight of New Zealand White rabbits fed pellet containing 10% LLM had the highest value from other treatments (P < 0.05), this was appropriate as the carcass weight was also high (1,060 ± 110.86 (g ± g)). Overall, rabbits fed diets with LLM did not show significant difference in meat weights. Similarly, the bone weight and percentage were not significantly different.

The meat bone ratio of the male New Zealand White rabbits fed pellets contains LLM showed non-significant difference. The rabbits raised in individual cages produced 3.21 ± 1.01 of meat bone ratios [9]. The National Research Council [12] proposed that the ratio of meat and bone to rabbit carcass ranged from 2.8 to 3.7. It is also obvious that the meat and bone ratio depends on the meat weight and carcass bone weight [11].

4. Conclusion
The results of this study showed that the highest carcass and non-carcass percentages were obtained in rabbits fed diet P2 (10% leucaena) suggesting that addition of leucaena leaf meal at 10% increased slaughter weight and carcass percentage. However, it appeared that at levels higher than 10% there was a reduction in these parameters thereby implying that factors other than protein may affect the carcass characteristics.

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