Water-Soaked *Leucaena Leucocephala* Leaf Meal as Feed For Rabbits: Effect of Inclusion on the Performance

N I Wiratmini¹*, I Setyawati¹, D A Warmadewi², N L E Setiasih³

¹Department of Biology, Faculty of Mathematics and Natural Sciences  ² Faculty of Animal Husbandry.  ³ Faculty of Veterinary Udayana University, Bukit Jimbaran Campus, Badung, Bali, Indonesia. *Corresponding author:wiratminiintan@unud.ac.id

**Abstract.** *Leucaena leucocephala* is high-nutrient legume due to its crude protein rate (20-30%). Unfortunately, its utilization needs to be restricted due to the presence of mimosine, a compound that exhibits negative effects on livestock. This study aimed to compare the performance of adult male rabbits after given commercial feed supplemented with water-soaked and air-dried *Leucaena* leaf meal (WSADL) with those given air-dried *Leucaena* leaf meal (ADL). Fifty local male rabbits, 6 months old and weighing around 2.0-2.3 kg, were used as samples. This study used a Completely Randomized Design (CRD) with five treatment groups (n=10), consisting of one control group that were fed commercial feed (R0), three groups that were fed WSADL (15%, 22.5%, and 30%) and one group that was fed 15% of ADL. Those rabbits were fed for 60 days. The independent variables being observed were the dry matter intake, daily weight gain, and feed conversion ratio (FCR). The result showed that the supplementation of *Leucaena* leaf meal which was processed through water-soaking and air-dried as much as 30% on rabbit feed did not reduce the dry matter intake, while it increased body weight gain and efficiency of feed usage.

1. **Introduction**

Indonesian population has increased from year to year. This phenomenon has resulted in increased demand for meat. Therefore, it is necessary to optimize smaller scale farming commodities such as rabbits, guinea pigs, and native chickens as an effort to meet the demand of meat at the household level. Rabbits have great potential as animal protein sources as they are able to grow and develop very rapidly by utilizing local food resources.

*Leucaena leucocephala* is one of the local feeds that can be utilized as forage. *Leucaena* plants are drought tolerant and widely available in subtropical and tropical zones [1]. The crude protein content of *Leucaena* leaf ranges from 20-30% of its dry matter [2]. However, the utilization of *Leucaena* as feed is limited due to its content of various antinutrients i.e. mimosine, condensin [3] and phytic acid [4], [5]. Spontaneous poisoning due to *Leucaena* leaves consumption occurred in cattle, sheeps and rabbits, as well as alopecia in goats [2]. The supplementation of *Leucaena* leaf meal to the diet of monogastric livestock is recommended to not exceeding over 5-10% of the total diet [6]. However, the mimosine content of *Leucaena* leaves can be reduced through soaking with water for 12 hours [7]. Ref. [8] reported that the addition of 22.5% water-soaked *Leucaena* leaf meal for 12 hours on white rat feed did not decrease the T3 and T4 hormone level. Meanwhile, there is no available data yet on the effect of water-soaked *Leucaena* leaf meal for 12 hours on the performance of local rabbits. The purpose of this study was to observe the performance of local rabbits which were given an additional up to 30% water-soaked *Leucaena* leaf meal for 12 hours on their feed.
2. Materials and Methods

2.1. Animal and management
In this study, 50 local rabbits aged 6 months old and body weight ranging from 2.0-2.3 kg were used as samples. Rabbits were held individually in iron cages of 40x60x40 cm in size, which were placed in a room maintained at temperature of 15-27°C and 50±10% humidity with a photoperiod (light:dark) of 12:12 hour. Acclimatization was carried out for 2 weeks by providing standard commercial feed ("Gemuk A" produced by PT. Japfa Comfeed Indonesia, Tbk) and clean water for drinking ad libitum.

2.2. Processing method of the experimental diets
The *Leucaena* leaves were harvested from Benoa area in Denpasar, Bali, Indonesia. The *Leucaena* leaves were then processed by two methods: *Leucaena* leaves which were air-dried only (ADL) and *Leucaena* leaves which were soaked with water (1 kg of *Leucaena* leaves in 30 liters of water) for 12 hours followed by air-drying (WSADL). The dried *Leucaena* leaves were then ground into leaf meal. As much as 200 g of meal from each samples (ADL and WSADL) were taken to be analyzed for its content of crude protein and antinutrients (mimosine, condensin and phytic acid). *Leucaena* leaf meal was then mixed with standard commercial feed to make pellets. The pellets were used as experimental feed. Proximate analysis of the chemical composition of the experimental feed was carried out by the AOAC method [9].

2.3. Experimental design
This study used a Completely Randomized Design (CRD), consisted of 5 treatment groups. Each treatment group consisted of 10 samples. The five treatment groups are R0 = 100% standard commercial feed (C) as the control group, R1 = C:WSADL (85:15), R2 = C:WSADL (77.7:22.5), R3 = C:WSADL (70:30) and R4 = C:ADL (85:15). Experimental animals were fed as much as 150 g for 60 days, twice a day.

2.4. Measurement parameters

2.4.1. Dry matter intake
Daily dry matter consumption (BK) was calculated daily by subtracting the total amount of given feed with the residual feed on the same day.

2.4.2. Daily live weight gain
The animal body weight was measured once a week in the morning before the animal was fed. Weighing was done using a digital scale with capacity of 120 kg. The body weight gain was calculated by subtracting the initial body weight with the final body weight. Furthermore, additional daily body weight can be determined by dividing the difference in body weight by the total duration of the experiment.

2.4.3. Feed conversion ratio (FCR)
Feed conversion ratio was calculated as the comparison between the amount of dry matter consumed and weight gain during the experimental period.

2.5. Statistical analysis
Data was presented in form of mean ± standard deviation (SD) and was analysed by One Way Analysis of Variance (ANOVA) followed by a Duncan test for multiple comparisons test using the SPSS statistics 22.0 software. We set the confidence level of P<0.05.
3. Result and Discussion

3.1. The content of antinutrient factors and crude protein in processed Leucaena leaf

The antinutrient content of the Leucaena leaf meal WSADL (12 hours water-soaked before dried) and ADL (only dried) were presented in Table 1.

Table 1. The content of antinutrients and crude protein of Leucaena leaf

| Parameter          | ADL  | WSADL |
|--------------------|------|-------|
| Mimosine           | 10.52| 2.71  |
| Crude protein      | 25.13| 23.15 |
| Condensed tannin   | 1.23 | 0.95  |
| Phytic acid        | 10.50| 3.38  |

From Table 1, it can be seen that the content of mimosine, condensed tannin, phytic acid and crude protein in WSADL decreased to 74.2%, 25.2%, 67.8% and 7.9% respectively when compared to ADL.

3.2. Proximate analysis of the experimental feed composition

The results of the proximate analysis of feed composition in each of five treatment groups were presented in Table 2.

Table 2. Nutrient composition of concentrate mixture of the five treatment feed

| Parameter                | R0   | R1   | R2   | R3   | R4   |
|--------------------------|------|------|------|------|------|
| Dry Matter (%)           | 86.33| 89.39| 89.25| 89.48| 89.73|
| Ash                      | 6.49 | 6.40 | 6.37 | 6.33 | 6.55 |
| Crude Protein            | 21.54| 21.68| 21.62| 22.25| 22.66|
| Crude Fiber              | 6.26 | 6.62 | 6.52 | 6.74 | 6.92 |
| Extract Ether            | 1.50 | 3.03 | 4.39 | 6.02 | 5.53 |
| Nitrogen Free Extract    | 54.54| 54.66| 44.55| 53.04| 52.67|
| Mimosine                 | 0    | 0.41 | 0.61 | 0.81 | 1.57 |

R0 = 100% commercial pellets (C), R1 = mixed pellets of 85% C with 15% WSADL, R2 = mixed pellets of 77.5% C with 22.5% WSADL, R3 = mixed pellets of 70% C with 30% WSADL, R4 = mixed pellets of 85% C with 15% ADL.

It can be seen that the lowest dry matter content was 86.33% found in the R0 feed while the R1, R2, R3 and R4 feed ranged from 89.25-89.73% (Table 2). The highest crude protein content was found in R4 and R3 feed (22.66% and 22.25%, respectively). The highest crude fat content was 6.02% in R3 and the lowest was 1.50% in R0 feed. The crude fiber content of the five treatment feeds ranged from 6.02-6.92%. The highest mimosine content was found in R4 feed (1.57%) and the lowest was 0.41% which was found in R1 feed.

The mimosine content of WSADL (Leucaena leaf meal soaked in water for 12 hours before air-dried) decreased to 74.2% when compared to an air-dried only method of Leucaena leaf meal (ADL). The tannin and phytic acid content also decreased to 25.2% and 67.8% in WSADL, respectively. The results of this study were different from those reported by Laconi and Widiyastuti [7] which only reduced 50.1% of mimosine content of 12 hours water-soaked Leucaena leaf meal. Fayemi [10] reported that soaking Leucaena leaf with water was the most effective way to reduce the mimosine and tannin content. Ref. [11] also reported that soaking Leucaena leaf with water could reduce the content of mimosine, tannin and phytic acid more significantly compared to the air-dried method. Feed containing WSADL significantly increased the dry matter consumption compared to the control. This showed that...
rabbits prefer to consume feed containing *Leucaena* leaf meal as supported by the study conducted by Onwudike [12].

3.3. Dry matter intake

Feeding with WSADL significantly increased consumption of dry matter (P<0.05) compared to the control. However, the consumption of dry matter between groups R1, R2, R3 and R4 did not show any significant difference (P>0.05). The dry matter consumption of R1 and R4 groups were not significantly different (P>0.05) compared to the control, as presented in Table 3.

| Parameter               | R0             | R1             | R2             | R3             | R4             |
|-------------------------|----------------|----------------|----------------|----------------|----------------|
| Initial body weight (g) | 2170.0±67.49a  | 2140.0±96.60a  | 2170.0±67.49a  | 2150.0±84.98a  | 2130.0±94.86a  |
| Final body weight (g)  | 2920.0±225.09b | 3050.0±232.13b | 3070.0±182.87b | 3370.0±163.63a | 2890.0±179.19b |
| Daily live weight gain (g/d) | 0.01±0.00 b    | 0.01±0.00 b    | 0.01±0.00 b    | 0.02±0.00 a    | 0.01±0.00 b    |
| DM Intake (g/d)         | 153.09±12.677a | 161.12±11.02a  | 168.09±9.66a   | 167.24±7.24a   | 159.13±14.29ab |
| FCR                     | 12.99±3.30a    | 11.19±2.63a    | 11.46±1.57a    | 8.32±0.90b     | 13.05±2.85ab   |

Values were presented as means ± SD of 10 replicates per treatment. Means with different superscripts in the same row were significantly different (P<0.05). R0 = control of 100% commercial pellets (C), R1 = mixed pellets from 85% C with 15% WSADL, R2 = mixed pellets from 77.5% C with 22.5% WSADL, R3 = mixed pellets from 70% C with 30% WSADL, R4 = mixed pellets of 85% C with 15% ADL.

The insignificantly different of dry matter consumption between groups R1, R2, R3 and R4 in this study showed that the addition of *Leucaena* leaf meal into rabbit feed did not affect the dry matter consumption. Ref. [13] reported that the addition of 15% fermented *Leucaena* leaf did not significantly affect the dry matter consumption of broiler chickens. Although the dry matter consumption between groups R1, R2, R3 and R4 were not significantly different, the final body weight and daily body weight gain in group R3 were significantly higher compared to other treatment groups. This could probably due to higher content of crude protein and fat in R3 feed compared to R0, R1 and R2 feed. Protein is very important for growth, thus lack of protein in the body can interfere the growth. Protein plays role as a builder, regulatory agent, and also maintains the body endurance. The crude protein content of the R4 feed was almost the same as R3, but it was not able to increase the rabbits final and daily body weight. The high content of antinutrients i.e. mimosine, condensin and phytic acid in the R4 feed was thought to cause inhibition of weight gain. According to Ref. [10], monogastric animals are intolerant with feed contained mimosine above 1%. The mimosine content in the R4 feed in this experiment contained 1.57%, while the other treatment groups were still below 1%. The higher content of condensin and phytic acid in ADL compared to WSADL caused the R4 feed to contain higher antinutrients content compared to R0, R1, R2 and R3. According to Ref. [14], the condensed tannin content interfere with the digestibility of the feed protein, thereby inhibiting livestock growth. Ref. [15] reported that the phytic acid contained in the feed would bind phosphorus and protein feed, resulted in stunted chicken growth.

The results of this experiment were in line with the study reported by Ref. [16] which discovered that feed contained 15% of unprocessed *Leucaena* leaf meal also reduce the weight gain, nutrient digestibility and growth performance of rabbits. A high protein and a tolerable antinutrient content in the R3 feed lead to significantly higher daily body weight gain compared to the control, R1, R2 and R4 groups. Thus, the value of feed conversion ratio in group R3 was the lowest which meant that the feed usage was the most efficient. Supplementation of *Leucaena* leaf in the experimental diet did not cause death in all treatment groups, in contrast to those reported by Ref. [10], that 50% of rabbits died when treated with feed contained 20% of *Leucaena* leaf soaked in hot water.
3.4. Daily live weight gain
Statistical analysis of rabbit body weight at the beginning of the experiment showed no significant difference ($P>0.05$) between control and treatment groups. After 60 days of feed treatment, the body weight of the R3 treated rabbits showed a significant increase ($P<0.05$) compared to R0, R1, R2 and R4. The daily body weight gain of R3 rabbits were also significantly ($P<0.05$) higher compared to R0, R1, R2 and R4.

3.5. Feed conversion ratio (FCR)
The lowest feed conversion ratio in this study was found in the treatment group R3. The statistical analysis showed a significant difference ($P<0.05$) compared to groups R0, R1, R2 and R4. The highest FCR value in the R4 group was not significantly different ($P>0.05$) compared to groups R0, R1, and R2.

4. Conclusion
The addition of 30% *Leucaena* leaves which were processed through water-soaking for 12 hours into rabbits feed did not reduce the dry matter consumption, while it increased the body weight gain and efficiency of feed usage.

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**Acknowledgements**

The author would like to thank Udayana University Research and Community Service and Directorate General of Research and Development Strengthening, Ministry of Research, Technology and Higher Education of Indonesia who have provided Grand Funding Research with the Letter of Agreement of Research Implementation Number 492.54/UN14.4.A/LT/2019, on March 13th 2019.