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## Production performance of KUB chicken with the inclusion of Lamtoro (*Leucaena leucocephala*) leaf flour in the feed

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## Production performance of KUB chicken with the inclusion of Lamtoro (*Leucaena leucocephala*) leaf flour in the feed

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**Abstract.** To reduce the feed cost in raising chickens it is necessary to find alternative feed sources. The feed ingredients must have relatively low prices, do not compete with human needs, and have abundant availability on location. The purpose of this study was to determine the performance of KUB chicken production with feed containing Lamtoro (*Leucaena leucocephala*) leaf flour (LLF). The study was conducted using 300 chickens aged 4 weeks, unsexed, which were allotted to 4 treatments, each with 5 replicates and 15 birds per replicate in a Completely Randomized Design. The treatments were in the form of a) T0: 0% LLF; b) T1: 3% LLF; c) T2: 5% LLF and d) T3: 7% LLF. The LLF was mixed with a basal feed in a mixture of concentrate, corn and bran. The study lasted for 6 weeks, i.e. until the chicken was 10 weeks old, with observations including daily weight gain (DWG), feed consumption, feed conversion ratio (FCR), and income over feed cost (IOFC). The results showed that the best performance of KUB chicken production was by the addition of 5% LLF in the feed, as it could increase the DWG value, reduce the FCR value and increase the IOFC value.

### 1. Introduction

The population of local chickens in Papua Province is currently 2,142,662 birds with a fairly slow population growth in the last 4 years (2014–2018), which only increased by 18.21% [1]. The causes of slow population development include the unavailability of superior chicken breeds, extensive maintenance, and no additional feeding.

In 2014 the Indonesian Agency for Agricultural Research and Development (IAARD) has released one superior local chicken line named “*Kampung Unggul Balitbangtan*” (KUB) chicken with an intensive maintenance system. The advantage of this KUB chicken is that it has an egg production rate 3 times higher than that of local chickens, reaching 160–180 eggs/year. This is due to a) a very low incubation characteristic of only 10% of the hen population, b) the body weight of 10 weeks old chickens can reach 800–1,000 g/bird, c) adult chicken feed consumption is only 85–100 g/bird/day, and d) is more resistant to disease [2]. To provide the superior local chicken seeds, 1,650 birds of one day old chicken (DOC) of KUB chickens have been introduced to the Papua Province area. However, as this chicken has to be raised in an intensive system, it is necessary to look for alternative feed ingredients to reduce the use of expensive and often unavailable commercial feed. The high price of commercial feed ingredients is a limiting factor for the development of local chicken farming [3,4].



Some local feed ingredients in the form of legume leaf meals have the potential to be used as a protein source for poultry because they have a high protein content. These feed ingredients are usually available throughout the year and at relatively cheap prices. These materials include leaf meals of *Moringa oleifera*, Gamal (*Gliricidia sp*), Lamtoro (*Leucaena leucocephala*), and others [5,6]. This leaf flour has been used as an additive for poultry to increase the productivity and quality of poultry products.

Lamtoro plants are quite widely available in the surroundings of Papua Province which are located along main roads or in suburban/rural areas. Some people also plant it as a fence between one land and another. Apart from being easy to find, this plant is also easy to obtain throughout the year, making it very suitable to be used as a chicken feed ingredient, especially due to the high price of commercial chicken feed in the Jayapura area. The chemical composition of Lamtoro leaves varies widely, e.g. crude protein content of 23.4–27.5%, crude fiber 11.95–14.2%, energy 2,574 kcal ME/kg, Calcium 1.8–2.36% and Phosphor 0.23% [7–9].

Research on the feasibility of using Lamtoro leaves in the ration of male KUB chicken has been reported previously [3]. This paper presents the results of an experiment aimed at studying the performance of unsexed KUB chicken production using various levels of Lamtoro leaf flour (LLF) in the feed.

## 2. Method

This study was conducted from September to November 2017, in collaboration with the Anugrah Farmer Group in the Yobeh Village, Sentani District, Jayapura Regency, Papua Province. A completely randomized design (CRD) was used with 300 unsexed KUB chickens of 4 weeks old. Chickens were allotted to 4 treatments with 5 replications and in each replication consisted of 15 chickens. The average body weight of the KUB chickens was 291.3 g/bird which was placed in 20 units of cages, measuring 1.5 x 3.0 m per unit.

The treatments were in the form of a) T0: 0% LLF; b) T1: 3% LLF; c) T2: 5% LLF, and d) T3: 7% LLF. The LLF was mixed with a basal feed in a mixture of concentrate, corn and bran (table 1). The feed was prepared using a least-cost diet formulation, following the recommendations for composing feed for KUB chickens [10].

**Table 1.** Feed ingredients and nutritional contents of four types of feed treatments given to the KUB chicken during the experiment.

Feed ingredients	Treatments (%)			
	T0	T1	T2	T3
Commercial concentrate	60	57	55	53
Maize flour	25	25	25	25
Rice bran	15	15	15	15
Leucaena leaves flour	0	3	5	7
Total	100	100	100	100
Nutritional contents:				
Protein (%)	17.13	17.74	17.75	17.75
Energy (kcal/kg)	3,105	3,035	2,988	2,941

Description: The treatments are the amount of *Leucaena leaves flour* in the feed: a) T0: 0%, b) 3%, c) T2: 5%, and d) T3: 7%.

The study lasted for 6 weeks, i.e. until the chicken was 10 weeks old, with observations including daily weight gain (DWG), feed consumption, feed conversion ratio (FCR), and income over feed cost (IOFC). The DWG (g/bird/day) is the difference between the final body weight and the initial body weight and divided by the number of observation days (42 days). The total amount of feed consumed is the total amount of feed eaten by the chickens during the 42 days of observation. The FCR is the ratio between the amount of feed consumed and the total body weight gain during the study. The IOFC

is gross income calculated by subtracting income from the sale of live chickens with costs incurred for feed, it is calculated using the following equation [11]:

$$\text{IOFC} = \{(\text{Weight of chicken} \times \text{live chicken price}) - (\text{Feed consumption} \times \text{Feed cost})\}$$

Data were processed using analysis of variance (ANOVA) using the computer program of Statistical Package for Social Sciences (SPSS) version 24.0. If there was any significant difference between treatments, the data were further analyzed using Duncan's Multiple Range Tests [12].

### 3. Results and discussion

#### 3.1. Body weight and weight gain

The mean initial body weight or weight at the age of 4 weeks of the unsexed KUB chicken used in this study was 291.3 g/bird (table 2). This was comparable to the weight at the same age as the female KUB chicken (277.5 g/bird) as reported earlier [13]. It was lower than the weight of male KUB chicken (334.6 g/bird) [3] and the unsexed KUB chicken (304.1 g/bird) [14]. However, it was higher than of the male KUB chicken (178.2 g/bird) [2] and of the unsexed KUB Chicken (214.3 g/bird) [15]. This difference may be due to the large diversity of individual growth capacities of the KUB chickens [16].

**Table 2.** The initial body weight, final body weight and daily weight gain of the KUB chickens given four types of feed during six weeks of the experimental period.

Treatment	Initial body weight (g/bird)	Final body weight (g/bird)	Daily weight gain (g/bird/day)
T0	291.60±6.90 <sup>a</sup>	799.47±22.24 <sup>a</sup>	12.1±0.59 <sup>a</sup>
T1	290.87±3.55 <sup>a</sup>	839.07±16.77 <sup>b</sup>	13.1±0.39 <sup>b</sup>
T2	291.73±7.29 <sup>a</sup>	857.80±18.39 <sup>c</sup>	13.4±0.27 <sup>b</sup>
T3	290.93±13.78 <sup>a</sup>	847.11±30.18 <sup>b</sup>	13.2±0.65 <sup>b</sup>
P	0.05	0.05	0.05

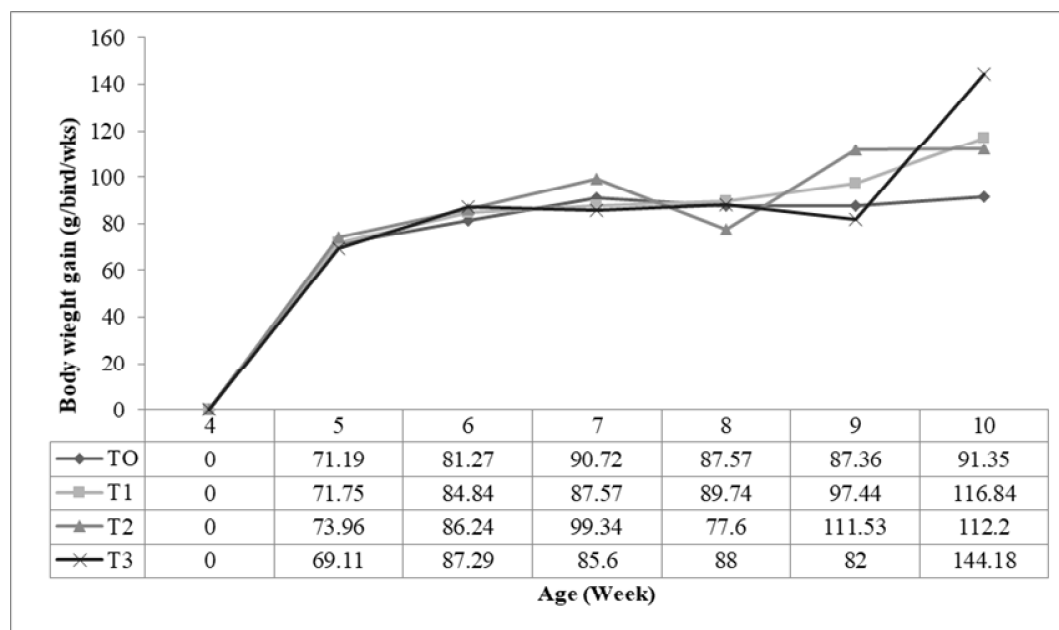
Description: Different letters in the same column indicate a significant difference (P<0.01). The treatments are the amount of *Leucaena* leaves flour in the feed: a) T0: 0%, b) 3%, c) T2: 5%, and d) T3: 7%

The results of the analysis of variance showed that the use of LLF in the feed had a significant effect (P<0.05) on the final body weight and body weight gain of the KUB chickens of 10 weeks old. It was found that the final body weight of the KUB chickens was in the range of 799.5–857.8 g/bird (table 2). The results of this study are in line with those reported by previous researchers that the weight of the KUB chickens raised in cold regions in Ciawi Regency, West Java Province, at the same age for the male KUB is 830.55 g/bird [2] and for the unsexed KUB 910.5 g/bird [13]. However, it was higher than the unsexed KUB chickens reared in Bandung City, West Java Province, which only ranged between 556.9–618.0 g/bird [15] and those raised in the Cati Bay Village, South Kalimantan Province, the average body weight of KUB chickens of 2–3 months old weighs were between 650–750 g/bird (male) and 555–675 g/bird (female) [17].

Differences in the growth rate of chickens obtained were probably due to differences in the local environmental temperatures. In general, poultry is only able to regulate body temperature within a narrow range of environmental temperatures, between 16–26°C, while in tropical areas the environmental temperatures are usually above this zone [18]. It is evident that the KUB chickens raised in cold regions (15–20°C), as in Ciawi Regency, have a higher growth rate than the KUB chickens raised in hotter areas of Papua and South Kalimantan Provinces.

It was found in this study that the weekly weight gain (WWG) looks almost the same until the chickens were 8 weeks old, with the body weight gain ranging from 77.6–89.7 g/bird/week (figure 1). After the chickens were 8 weeks old, there was an increase in the WWG, except for the KUB chickens

without the LLF administration. This is probably related to the limiting factors of the LLF which require a long adjustment. The main problems limiting the use of LLF in poultry rations are the high level of fiber and the presence of anti-nutritive substances, such as mimosine [19].



**Figure 1.** The fluctuation of body weight gain of growing KUB chicken fed diets containing respectively 0% (T0), 3% (T1), 5% (T2) and 75 (T3) of *L. leucocephala* leaves meal according to age.

At week 10, there was a fairly high increase of the KUB chickens weight gain, from 82.0 g/bird/week to 144.2 g/bird/week in the T2 treatment feed. A quite high increase also occurred in the T1 and T3 feed treatments, but there was no significant increase in the T0 feed treatment. Overall, it was found that the DWG of the KUB chickens that were not given the LLF (T0) was lower than those given the LLF, and there was no significant difference in the DWG of the KUB chicken given 3% (T1), 5% (T2) and 7% (T3) of the LLF in the rations (table 2).

The use of the LLF up to a level of 20–21% with iso-protein and iso-calorie feed content significantly affected broiler performance [7,20]. These results are different from the results obtained by other investigators which found that the use of the LLF in broiler chickens rations should not exceed 10% [21,22]. The use of the LLF in the layer chickens ration is recommended to only be a maximum of 5% [23]. The difference of the results obtained in the study was probably due to the different types of chickens used and the difference in the period of time of using the LLF, which had an impact on the performance of chicken production.

The use of *L. leucocephala* feed up to 50% to replace soybean meal in broiler chickens feed has no side effect on the performance of the broilers [24]. Meanwhile, the results of different studies using 10% of *L. leucocephala* feed and *Moringa oleifera* leaf meal in Rhode Island Red type laying hens did not harm the production and quality of other eggs produced [25].

As an inexpensive and highly nutritional source of plant-based protein, the *L. leucocephala* is one of the most delicious and high-quality forage legumes in the tropics, often described as the 'tropical alfalfa'. The *L. leucocephala* provides nutritious and high protein forage as poultry feed and has the effect of varying degrees of *L. leucocephala* supplementation on egg production and quality in laying hens due to its high nutritional value [8].

### 3.2. Feed consumption and conversion ratio

Most of the feed consumed by chickens is intended for meeting the energy needs for body tissue growth, egg production, maintaining physical activity, and maintaining normal body temperature [26]. The KUB chicken feed consumption is slightly different from ordinary native chickens, this is influenced by genetics including body weight, production level, stress level, activity, protein content, the energy content in the feed, and environmental temperature.

Results of the analysis of variance showed that the use of the LLF in the feed had a very significant effect ( $P < 0.01$ ) on feed consumption. The addition of the LLF led to an increase in feed consumption from 34.4 g/bird/day to 35.1 g/bird/day with the addition of 3% and 7% LLF (table 3). Giving 5% of LLF caused the highest increase in feed consumption, which was 35.4% g/bird/day. This indicates that the composition of the feed given has different nutritional content and quality as well as different levels of palatability. Palatability determines the amount of feed consumed, which is related to the energy level contained in the feed. Chickens consume feed following their energy needs for their bodies, if energy needs have been met then the chickens will stop consumption, on the other hand, if it is not enough, it will increase consumption [26].

**Table 3.** The Feed consumption, Feed conversion ratio, and Input over feed cost (IOFC) of the KUB chicken has given four types of feed during six weeks of the experimental period.

Treatment	Feed consumption (g/birds/day)	Feed conversion ratio	IOFC (IDR/birds/42 days)
T0	34.36±0.29 <sup>a</sup>	2.83±0.13 <sup>a</sup>	21,037.57±994.42 <sup>a</sup>
T1	35.05±0.32 <sup>b</sup>	2.69±0.07 <sup>b</sup>	22,840.15±714.50 <sup>b</sup>
T2	35.38±0.42 <sup>b</sup>	2.65±0.05 <sup>b</sup>	23,731.15±1,082.04 <sup>c</sup>
T3	35.12±0.68 <sup>b</sup>	2.65±0.09 <sup>b</sup>	23,474.60±1,297.38 <sup>b</sup>
P	0.05	0.05	0.01

Description: Different letters in the same column indicate a significant difference ( $P < 0.01$ ); The treatments are the amount of *Leucaena* leaves flour in the feed: a) T0: 0%, b) 3%, c) T2: 5%, and d) T3: 7%

The use of LLF up to 7% in feed tends to reduce feed consumption when compared to the use of 3% and 5% LLF. The content of anti-nutritional substances in the form of mimosine in LLF causes inhibition of feed consumption, excessive LLF administration may create an unpleasant aroma for chickens. Broilers chicken fed *Leucaena* or *Sesbania* or a combination of both showed results that were not significantly different but could reduce the level of consumption and growth of chickens [27]. The reason is that anti-nutritional or toxic factors such as mimosine in *Leucaena* and canavanine in *Sesbania* have a negative or inhibitory effect on poultry productivity.

There was a decrease in body weight in broiler chickens fed with dried *L. leucocephala* leaves by 20% [28]. The high intake of *L. Leucaena* leaves in the study resulted in only a slight increase in body weight. This is different from the results of this study, where the level of giving *L. leucocephala* leaves as much as 5% was able to increase the body weight of KUB chickens.

Feed conversion reflects the success in selecting or arranging quality feed. The addition of LLF in the ration caused a decrease in the FCR value from 2.83 to 2.65–2.69. The feed conversion value obtained in this study was higher than that reported by previous researchers [2], that the conversion value of the KUB chicken feed with concentrate feed maintained for 10 weeks had a feed conversion value of 2.3 meaning to produce 1 kg of weight. live required feed of only 2.3 kg/bird. This shows that the use of LLF causes a decrease in the efficiency of feed use by KUB chickens.

### 3.3. Income over feed cost

The results of the study on the use of various levels of LLF in the feed had a very significant effect ( $P < 0.01$ ) on the IOFC value. Factors that influence IOFC are final body weight, selling price per kg

live chicken, feed consumption, and feed cost. The calculation of feed costs greatly affects the IOFC value in this study. Generally, the IOFC value is influenced by the feed conversion value, because of the lower the feed conversion value, the better the IOFC value.

The use of LLF as much as 3% (T1), 5% (T2), and 7% (T3) in KUB chicken feed caused an increase in the IOFC value compared without the use of the LLF (T0). The IOFC value for 6 weeks of observation period without the LLF provision was 21,038 IDR/bird/42 days. However, the IOFC value obtained by giving the three levels of LLF still provides a high enough advantage. The IOFC value increased significantly to 22,840 IDR/bird/42 days with the addition of 3% of LLF in the ratio and increased to 23,731 IDR/bird/42 days when the LLF was increased to 5%. However, the IOFC value was reduced slightly to 23,475 IDR/bird/42 days when 7% of LLF was added in the ration. The significant difference between treatments was due to differences in the sales of KUB chickens and the cost of feed used during the study.

The higher the use of *L. leucocephala* in feed, can reduce feed costs but reduce net income [29]. This is because the cost of feed decreases progressively with the increasing use of *L. leucocephala* in the feed. The results of these studies showed that the use of *L. leucocephala* in the ration did not affect the health status of the chickens but rather suppressed their growth.

Another opinion related to the economic value, states that *L. leucocephala* plant cultivation through direct seeding can be done if *L. leucocephala* is planted with companion plants that will not compete directly with *L. leucocephala*, e.g. maize and *L. leucocephala* [30]. Extensive planting efforts for the production and or propagation of seeds or seedlings in large quantities can be provided to farmers at affordable prices. This approach will be useful because it will be able to provide ecological and economic benefits for farmers, as *L. leucocephala* is an important and sustainable source of tropical food and does not need to be replanted for more than 15–20 years. *L. leucocephala* is one of the local forages in the form of legumes in the tropics, as an alternative and efficient source of protein in pig and poultry feed to reduce farmers' dependence on protein concentrates in the form of commercial protein supplements which are usually quite expensive [31].

#### 4. Conclusion

The inclusion of LLF in the ration can increase the production performance of the KUB chicken and the best performance was by the addition of 5% LLF, as it could increase the DWG value, reduce the FCR value and increase the IOFC value. The addition of LLF more than 5% in the KUB chicken ration is not recommended because there are limiting factors contained in the LLF, which could cause a decrease in the KUB chicken production performance.

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