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Graciano Soares Gomes
Senior Lecturer in The Department of Animal Science At The Faculty of Agriculture of The National University Timor Lorosa'e, Timor-Leste

Carlito de Araújo Mali Code
Senior Lecturer in The Department of Animal Science At The Faculty of Agriculture of The National University Timor Lorosa'e, Timor-Leste

Corresponding Author:
Graciano Soares Gomes
Senior Lecturer in The Department of Animal Science At The Faculty of Agriculture of The National University Timor Lorosa'e, Timor-Leste

Effect of *Moringa oleifera* Lam leaf flour in diet to increase the production performance of local pig of timor-leste

Graciano Soares Gomes and Carlito de Araújo Mali Code

Abstract
Moringa oleifera Lam leaf flour is one of the original feed from herbal plants, which is assumed to contain growth promoters and has complete amino acids to stimulate the growth of pigs. This study aims to find out the effect of *Moringa oleifera* leaf flour (MLF) in diet to increase the production performance of East Timor local pigs. A total of 20 local pig's male in growth phase with an average initial body weight of 14.36 ± 6.92 kg were used and the randomized block design with 4 treatments and 5 replications. The experiments were carried in this study in the following way: treatment T0: without MLF in diet; T1: with 3% of MLF in diet; T2: with 6% of MLF in diet and T3: with 9% of MLF in diet. The variables observed were the production of performance and quantity of carcass and commercial pieces of carcass. The results showed that the treated of pigs in group 2 exhibited significantly different (P<0,05) on daily body gain and quantity of carcass than the group T0, T1 and T3 of pigs. No different significances (P>0,05) in the feed consumption was observed among the dietary treated. We concluded that use of 6% MLF in diets can increase production performance and quantity of carcasses of local pigs.

Keywords: Local pigs, diet, *Moringa*, production performance, consumption, carcasses

Introduction
Timor-Leste's local pigs which called "*fahi timór"* are still traditionally maintained by 71.58% of the head of household, with a total local pig population of 419,169 pigs (Timor-Leste Population and Housing Census, 2015). Those, local pigs' species has enough potential to be developed because it has been well adapted and is spread fairly evenly throughout the territory of Timor-Leste. Traditional extensive maintenance without regard to the procedure of feeding both quantity and quality and without handling reproduction of animals, this greatly affects the performance of pig production so that achieving ideal slaughtering weight takes about 2-3 years or even more. This causes high levels of local pork fat so it is less demanded.

High cholesterol content in food is one of the consideration factors for consumers in consuming foods of animal products, especially pork and is considered a source of disease, including coronary heart disease (Maliandasari *et al*., 2015) [4], which is characterized by hardening of the arterial walls and levels high fat (hyperlipidemia) in the blood especially cholesterol (hypercholesterolemia) and pork fat contain cholesterol up to 80 mg / 100 gr (Murray *et al*., 2009). Consuming high and excessive cholesterol is one of the factors causing generative diseases (Oetoro, 2009) [8].

Cholesterol levels in food must not pass the normal standard of 200 mg / dl and Low Density Lipoprotein (LDL) is lower than 100 mg / dl. For anticipation, various efforts need to be made to improve the production performance of local pigs so that can produce high-quality products in a not too long time to reduce the accumulating of fat.

Some elements of phytochemical compounds in MLF which are antibacterial, and contain Beta-carotene which act as carbohydrate color active substances, and are in principle as one of the conditions for evaluating meat quality. Phytochemical compounds contained in MLF include: *flavonoids*, *saponins*, *tannins*, and several other *phenolic* compounds that have antimicrobial activity (Bukar *et al*., 2010) [2]. Estrogen-like *flavonoids* have been shown to be able to slow down bone mass (*Osteomalasia*), reduce blood cholesterol levels and increase HDL levels, whereas *saponins* are proven to be efficacious as anticancer, antimicrobial, and reduce blood cholesterol levels (Santoso *et al*., 2002; Bidura *et al*., 2017) [1].

The use of MLF in this study was carried out as a form of alternative feed in dietary is safely without endangering pig's health. Besides that, as information material regarding the use of active substances contained in MLF to improve the production performance and quantity of carcass, especially to stimulate the growth of local pigs to get the ideal slaughter weight in accordance with the phase of life in a not too long time. Normal and rapid growth can produce high quantity and quality of carcasses and meats to meet the demands of animal protein needs.

The relatively high fat and cholesterol content in local pork can cause health problems for consumers such as obesity and atherosclerosis. This case can be overcome by the use MLF in diet of pigs. The purpose of this study was to determine the extent of the influence of MLF in diet to increase the production performance and quantity of carcasses of East Timor local pigs.

Material and Methods

Animals and experimental design: A total of 20 pigs male in growth phase were used and their intial average wight is 14.36±6.92, and randomly allocatted to four treatments in a block randomized design, were used in a 90-d growth experment. Pigs were allocated to four treament and each treatment consisted of five replications with one pig per pen in randomly block design. The experiments were carried out in this study in the following way: treatment T0: without MLF in the ration; T1: with 3% of MLF in the ration; T2: with 6% of MLF in the ration and T3: with 9% of MLF in ration. The animals were given water and feed *ad libitum* during the expermental period of 90 days.

Growth performance traits and diets: The compositions of the diets are shown in Table 1. The diet was formulated and manufactured before starting the trial, without the inclusion of any antibiotic growth promoters or antibiotic growth promoter alternatives. The experimental diets were formulate on the basis of yellow corn, rice bran and soybean meal, supplemented with Moringa oleifera leaf flour. To get the ideal ration, it is formulated based on animals needs in accordance with NRC (1998) [7] recommendations. Pigs had free access to experimental diets and drinking water. A combination of daylight and artificial light was used, with a 12-h light/dark cycle. The weight and feed disappearance were measured on day 0 and 90 post weaning for the calculation of average daily gain (ADG), average daily feed intake (ADFI) and feed conversion ratio (FCR).

Table 1: Nutrition composition of diets used in research (percentage as-fed-basis).

Total	T0	T1	T2	T3
ME Kcal/kg (% DM)	3236	3253	3269	3286
CP(% DM)	17,51	18,15	18,79	19,43
CF (%DM)	5,58	5,41	5,24	5,08
CL (%DM)	6,31	6,12	5,93	5,74
Ca (%DM)	0,10	0,18	0,26	0,33
P (%DM)	0,17	0,19	0,22	0,24

Obs.: ME: Metabolic energy; DM: Dry Matter; CP: Crude Protein; Ca: Calcium; P: Phosphor;
Source: Biochemestry and Nutrition Laboratory of UNDANA University (2018).

Table 2: East Timor *Moringa oleifera* Leaf Nutritional Content (% DM)

Composition	*Moringa* Ataúro	*Moringa* Casait
Dry Matter (DM)	89,52	90,13
Organice Matter (OM)	90,37	89,90
Crude Protein (CP)	33,68	38,84
Crude Lipid (CL)	15,92	12,75
Crude Fiber (CF)	9,01	10,17
Carbohidrate (CHO)	40,77	38,31
Non N. Free Extract (NNFE)	31,76	28,15
Gross Energy(MJ/Kg)**	17,63	16,82
Gross Energy (Kcal/Kg)**	4.197	4.003
Metabolic Energy (ME)**	2.815,40	2.956,50

Source: Biochemestry and Nutrition Laboratory of UNDANA University (2018).
Orbs: ** Calculation of prameter's

Statistical Analysis: The data had have collected should be analysis with Multiple Analysis of Variance (MANOVA) and if be significant different (P<0.05) on among the treatment group was continue with Duncan test according recommendation of Sampurna and Nindhia (2008) [9].

Results

Local Pigs Production Performance

The results of production performance shown in Table 3. The performance of local pigs that were given Moringa leaf flour (MLF) in diets had no significate effect (P>0.05) on feed consumption and had significate effect (P<0.05) on the final body weight and significantly lower effect on the feed convesion ration (FCR). Teste Duncan revelate that the treatment T2 shows higher results when compared with T0 (without MLF in diet) and treatment T1 and T3 each with MLF as much as 3% and 9% in diets.

Table 3: Effect of *Moringa oleifera* leaf flour in diets on pigs production performance

Variable	Treatment[1]				CV[3]
	T0	T1	T2	T3	
Initial body weight (kg)	13,29±6,16a[2]	15,64±10,67a	14,43±6,68a	14,09±6,92a	21,23
Last body weight (kg)	28,71±7,49a	30,61±11,29a	35,90±5,95b	28,05±2,54a	24,72
Daily weight (g/d)	171,40±20,52b	161,60±14,77b	237,60±11,95a	155,00±32,38b	16,05
Feed consumption (g/d)	966,00±40,01a	858,00±84,28a	908,00±82,58a	854,00±81,48a	9,24
FCR (feed comsuption/ADG)	5,47±0,30b	4,86±0,97b	3,46±0,18a	4,80±1,07b	21,94

Description:

1. The basal diet without *Moringa oleifera* as a control (T0); Diet with *Moringa oleifera* 3% (T1); Diet with*Moringa oleifera* 6% (T2); Diet with *Moringa oleifera* 9% (T3).
2. Values with different letters on the same line indicate a real distinct real (P<0.05).
3. CV: Coefficient of Variance; ADG: Average daily gain

The content of amino acids in MLF among others arginine, isoleusine, lysine and threonine serves as growth promoters can accelerate the growth of local pigs. The high quality feed can strengthen the circulation system and improve intestinal ability in the digestive process so can use the maximum nutritional application for animals growth (Hernandes *et al*., 2004) [3].

Discussion

The average value of each treatment indicates that the diet T2 with MLF supplementation as much as 6% in diet resulted in the highest average of DGW of local pigs around 237, 60 ± 11.95 g/day (with a range of 225.65-249, 55g/day) or about 27.86% higher when compared with control treatment without 0% MLF in diet and the treatment T1 and T3 where each of them with 3% and 9% MLF in diets. These results indicate that the presence of amino acids in MLF, among others like arginine, isoleucine, lysine and threonine can serve as growth promoters and can accelerate the growth of local pigs. Dietary substances especially amino acids can strengthen the circulation system and improve intestinal ability in the digestive process so that the application of food nutrients maximally for the living staple and growth of pigs (Hernandes *et al*., 2004) [3].

The productivity of the pigs to be more efficient and profitable, it relies heavily on the understanding of the concepts of genetics, environment, health, management and nutrition of animals itself (Sumadi, 2018) [10]. It is further asserted that there are several factors that can affect the need for nutrient in local pigs, this requirement is a combination of genetic potential and growth rate as well as feed intake. Zahra (1996) [12] states that the weight of an animal is influenced by several factors include food and season. The growth of an animal is usually detected through measurements of weight that can be done by repeated weighing and presented as weight gain every day (Tilman *et al*., 1998) [11].

The use of MLF as much as 6% in the diet T2 can suppress the feed conversion rations (FCR) as much as 36.75% lower than other treatment, its means that, the pig only need 3.46 ± 0.18 to produce 1 kg body weight or meat. At the treatment T2 can increase pig's ability to change the feed as much as 3.28-3.64 kg to be 1 kg body weight when compared with treatment T0 as control (without MLF in diet), treatment T1 and T3 where the three treatment each require 5.47; 4.86 and 4.80 to produce 1 kg of body weight.

Conclusion

The use of *Moringa oleifera* leaf flour up to 6% in diets can increasing the growth performance and can pressing the feed conversion rate on East Timor local pigs.

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Conflict of Interest Declaration

We certify that there is no conflict of interest with any financial organization regarding the material discussed in the manuscript.

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