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Research Article
Increase Production and Carcass Quality of Local Pig's with Low Feed Costs

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Abstract

Background and Objective: The livestock sub-sector plays an important role in the food supply but greater expenditure is required for the development of animal feed. Hence, the objective of the study was to identify the effect of using rice bran and a blood meal fermented with a probiotic based on moringa leaf extract in the pig's diet. **Materials and Methods:** A randomized block design was used consisting of four treatments and four blocks. The treatments applied in this research consist of treatment T_0 as a reference composed of 45% yellow corn, 30% rice bran, 10% blood meal and 15% soybean. Treatment T_1 is composed of 45% yellow corn, 35% fermented rice bran, 6.5% fermented blood meal and 13.5% soybean. The T_2 is composed of 45% yellow corn, 33% fermented rice bran, 7.5% fermented blood meal and 14.5% soybean. The T_3 is composed of 45% yellow corn, 30% fermented rice bran, 9.5% fermented blood meal and 15% soybean. The observed variables in the study were productive performance, income offers feed cost and carcass characteristics. The Duncan's Test was used to compare the means of treatment. **Results:** There was a significant effect for average daily weight gain, slaughter weight, carcass weight and there was a highly significant effect for back fat thickness and there was no significant effect for average daily intake, feed conversion ratio, feed intake efficiency, carcass percentage and abdominal fat weight. Mean comparison tests revealed that T_3 is the best treatment compared to the others. **Conclusion:** The T_3 treatment was very capable of improving productive performance, carcass quality and high-income offers feed cost of the local pigs.

Key words: Swine, moringa leaf extracts, fermentation, performance, carcass, economic

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Agriculture plays a very important role in providing high-quality food products in the context of eradicating hunger, reducing malnutrition, as well as improving the economy of small food producers through sustainable production to ensure food self-sufficiency and economic development in the country. One of the factors that affect the sustainability of the development of pig and poultry production in Timor-Leste (TL) is the food factor that requires greater expenditure due to less availability and production of feed for animals at the national level. In addition, due to the lack of use of appropriate technologies to take advantage of high-quality agricultural by-products in the context of reducing feed costs in animal production activity.

Animals in general and especially pigs, need energy, proteins, minerals, vitamins and water and these substances have their specific functions and connections in the body[1]. Therefore, the identification of types of food as a source of energy and protein is very interesting in the process of preparing diets for animals in general and specifically for pigs. One of the types of plant-based food as a source of high-quality protein and has been known in the world as a substitute for the use of antibiotics to improve the growth of animals is *Moringa oleifera* Lam, which can use as a source of protein and also as a probiotic production base for fermenting agricultural by-products in the context of improving quality before feeding to animals[2]. For this, innovation in animal production activity is the key to ensuring food availability for animals to guarantee the sustainability of production in the long term. The presence of plant extract substances including *Moringa oleifera* leaf extracts in the feed, mainly amino acid substances, can strengthen the circulatory system and increase the capacity of the intestine in the digestive process so that digestion takes place as much as possible to be absorbed[3]. In all cases, moringa has a higher content of vitamin A, vitamin C, calcium and potassium, compared to sanatoriums, oranges, cow's milk and banana[4].

Factors that hinder the development of animal production, in addition to genetic issues and production systems, also include food factors, types of food, conservation methods and how to use agricultural by-products[5]. The general objective of the study was to identify the effect of using rice bran and blood meal fermented with a probiotic based on *Moringa oleifera* Lam leaf in the diet on the productive performance, economic value of the diet and carcass characteristics of local pigs in the rearing phase.

MATERIALS AND METHODS

Study area: The research was carried out in Hera, Cristo Rei Administrative Post, Dili Municipality, Timor-Leste, from April to September, 2023, divided into two periods, namely the preliminary or adaptation period of 10 days and the data collection period of 52 days. The research focuses on animal production, specifically local pig production, using diets mixed with rice bran and blood meal fermented with probiotics based on *Moringa oleifera* leaf extract in the diet.

Animal selection process: The sixteen local pigs selected in this study were based on the breeding history, life stage, zage and productive characteristics of the pigs based on established criteria for obtaining the preferred type. The pre-establishments that must be met are the following: The pigs must be of the same breed, healthy or free of any disease infection and in the growth phase.

Research method: The experimental method was used with a Randomized block design (RBD) composed of four treatments and four blocks. Each treatment was repeated four times, totaling 16 units of observations. The treatments applied in this research consist of the treatment T_0 composed of yellow corn (YC) 45%, rice bran (RB) 30%, blood meal (BM) 10% and soybean 15% as a control treatment. The T_1 is composed of YC 45%, fermented rice bran (FRB) 35%, fermented blood meal (FBM) 6.5% and soybean meal (Sb) 13.5%. The T_2 is composed of YC 45%, FRB 33%, FBM 7.55% and Sb 14.5%. The T_3 is composed of 45% YC, 30% FRB, 9.5% FBM and 15% Sb. Allocation of food for the formulation of the ration based on the nutritional needs of the animals in the growth phase, with an initial live weight of 10.63±3.90 kg. The variables observed in this study were productive performance, the income offers feed cost (IOFC) and pork carcass characteristics. Measurements of feed intake, daily weight gain, feed conversion and change in body linearity of the pigs were taken to determine product performance and the price of the feed used was analyzed to identify the most profitable treatment. Measurements were also made of carcass weight and percentage, abdominal fat and back fat thickness to identify the quality of carcasses.

Statistical analysis: The collected data were submitted to Analysis of Variance (ANOVA) and if there is a significant difference ($p<0.05$) then Duncan's Test was used to compare the mean values of the treatments[6]. A descriptive statistical analysis was also conducted to locate the treatments that show the best income over feed cost in the study.

Ethical consideration: This research involved animals that compulsorily follow the animal welfare rules (the five animal freedoms) based on the Farm Animal Welfare Council[7].

RESULTS

The results of the statistical analysis revealed that there was a significant effect ($p<0.05$) for average daily weight gain, slaughter weight and carcass weight and there was a highly significant effect ($p<0.01$) for backfat thickness. However, there was no significant effect ($p>0.05$) for average daily intake, feed conversion ratio, feed intake efficiency, carcass percentage and abdominal fat weight. The results of the mean comparison test were shown in Table 1 and 2 and the results of the descriptive analysis for the income offer feed cost of the diets as described in Table 3.

Table 1: Average values of the productive performance of local pigs used in the research

Treatment	ADWG (g)	ADI (g)	FCR	FIE (%)	SW (g)
T_0	198.50^{bc}	810.87	4.19	24.39	21.78^{abc}
T_1	239.50^{ab}	971.56	4.02	26.86	24343^{abc}
T_2	177.25^{bc}	775.55	4.34	23.04	17925^{c}
T_3	313.50^{a}	1172.89	3.70	27.08	28658^{a}
Mean	232.19	932.72	4.06	25.59	23151
SEM	17.47	78.57	0.18	1.47	164
CV (%)	7.52	8.42	4.43	5.74	0.71
p<value	<0.024	>0.301	>0.658	>0.619	<0.048

Treatment T_0: Composed of yellow cor (YC) 45%, rice bran (RB) 30%, blood meal (BM) 10% and Soybean 15% as control treatment, T_1: Composed of YC 45%, RB fermented 35%, BM fermented 6.5% and soybean 13.5%, T_2: composed of YC 45%, RB fermented 33%, BM fermented 7.55% and soybean, 14.5%, T_3: Composed by YC 45%, RB fermented 30%, BM fermented 9.5% and soybean 15%, Values with different letter notations in the same column show significant differences between treatments in terms of 5% ($p<0.05$), CV: Coefficient of variation, ADWG: Average daily weight gain, ADI: Average daily intake, FCR: Feed conversion ratio, FIE: Feed intake efficiency and SW: Slaughter weight

Table 2: Result of the comparison test of means of carcass characteristics of local pigs fed with fermented rice bran and blood meal in diets

Treatment	CW (g)	CP (%)	AFW (g)	BFT (mm)
T_0	14,110^{abc}	65.01	538	5.67^{b}
T_1	15,170^{abc}	62.40	898	10.47^{a}
T_2	11350^{c}	63.31	496	5.10^{b}
T_3	18,860^{a}	65.55	803	13.43^{a}
Mean	14,872	64.07	684	7.53
SEM	113	2.87	81	1.09
CV (%)	0.76	4.48	11.84	14.49
p<value	<0.030	>0.281	>0.269	<0.004

Observation: T_0-T_2: Treatment, CW: Carcass weight, CP: Carcass percentage, AFW: Abdominal fat weight, BFT: Bacon thickness, SEM: Standard error of the mean, CV: Coefficient of variation, Values with different letter notations in the same column show significant differences between treatments in terms of 5% ($p<0.05$)

Table 3: Income offers feed cost (IOFC) of the diets

	Diet			
Description	T_0	T_1	T_2	T_3
Average daily feed intake (g)	810.86	971.56	775.55	1172.89
Feed conversion rate (FCR)	4.19	4.14	4.34	3.70
Average daily weight gain (g)	198.50	239.50	177.25	313.50
Diet price ($/kg)	0.56	0.54	0.55	0.56
Total diet price/kg pork ($/kg)	2.35	2.24	2.39	2.07
Total food needed per treatment (kg)	42.16	50.52	40.33	60.99
Total food price (US$/treatment)	23.61	27.28	22.18	34.15
Price pork (US$/kg)	8.00	8.00	8.00	8.00
Yield per kg of pork ($)	5.65	5.76	5.61	5.93
Losses per kg of pork ($)	-	-	-	-

Source: Own elaboration and Observation: T_0-T_3: Treatment

DISCUSSION

The results of the mean comparison test (Table 1) revealed that the T_3 was the best treatment for productive performance, with emphasis on average daily weight gain (ADWG) of about 232.19±17.47 g per day, slaughter weight (SW) is 23151±164 g, carcass weight (CW) is 14872±113 g and carcass characteristics such as backfat thickness (BFT) is 13.43 mm and abdominal fat weight (AFW) is 684±81 g (4.59% of the carcass weight). The presence of plant extract substances, mainly amino acids, in *Moringa oleifera* extract substances in food can strengthen the circulatory system and increase the ability of the digestive organs in the process of digestion to occur as much as possible to be absorbed and reduce the content of fat[8]. Although the ADWG obtained in this study was still lower than the research result reported by Mukumbo *et al.*[9] that pigs fed diets including rice bran and tofu dregs fermented with probiotics based on *Moringa oleifera* leaves extract showed an ADWG of 358.40±31.25 g per day. However, the average BFT and AFW value obtained in this study is still approximately equal to the research result of local pigs fed diets including 9% *Moringa oleifera* leaf meal had an average BFT value of around 13.40±1.57 mm and AFW around 3.63±0.79% of the carcass weight[10].

The use of fermented by-products such as rice bran and tofu dregs in the diet can improve feed conversion, feed efficiency, body linearity and average daily weight gain of pigs[11]. The increase in the animal's body weight reflects how the nutrition and balance of amino acids contained in the feed have a positive impact on the animal organism[8]. The growth rate is influenced by many factors, such as dietary factors that affect growth are the content and digestibility of these ingredients, as well as genetic, hormonal and castration factors[12]. The increase in the levels of reducing sugars and soluble proteins occurs from the degradation of carbohydrates and protein components in the food fermentation process[13].

The results of the descriptive analysis of income offer feed cost (IOFC) of the diets used in the research revealed that T_3 is the best treatment due to its low cost to the treatments T_0 as reference treatments and T_1 and T_2 which contain a de different percentage of fermented by-products (rice bran and blood meal) in the diet. The treatment T_3 is only requiring $2.07 to produce a kilogram of pork and also the diet of T_3 was able to strengthen the capacity and efficiency of the digestive organs in the process of nutrient absorption. The average feed conversion value described in Table 3 shows that pigs fed the T_3 diet need only 3.70 kg of feed to produce 1 kg of meat and can generate a profit of US$ 5.93 compared to T_0 (as a reference treatment), T_1 and T_2. Consumption efficiency and better feed conversion are considered determining factors to reduce the cost of food and can improve the producer's income. Furthermore, it is stated that, in general, pigs need only 2.5 to 3.4 kg of nutritious feed to produce 1 kg of meat[10]. The cost of feed prepared by the producer depends on the volume produced, the price of ingredients and the equipment used[14]. Corn and soybean meal are the main ingredients used in pig diets, therefore taking into account that feed costs can reach around 70 to 80% of the total cost of pig production[15].

The results of this research showed that agricultural by-products, mainly rice bran and blood meal, can be used in the formulation of diets for pigs within the recommended limits, considering the antinutrient substances and crude fiber. For this, a pre-treatment is necessary to improve the quality before including it in the diet formulation, mainly in the diets of monogastric animals such as pigs.

CONCLUSION

Based on the research results, it was concluded that the use of fermented rice bran and blood meal in the diet, especially in the treatment T_3 was able to improve the productive performance, high quality of carcass and high-income offer feed cost of the local pig's production activity. For this, it is recommended to all relevant entities and especially producers can use the diet formulation as referenced in the T_3 treatment to increase the zootechnical performance and the income offer feed cost of local pigs.

SIGNIFICANCE STATEMENT

This study revealed the growth performance, income offers feed cost (IOFC) and carcass traits of local pigs in Timor-Leste and provides essential information on how to increase local pig production using rice bran and fermented blood meal in the diet. Finally, the results of this study can contribute to improving food security, reducing malnutrition and increasing the income of small producers in rural areas.

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