International Journal of Animal Science and Technology
2022; 6(1): 1-5
http://www.sciencepublishinggroup.com/j/ijast
doi: 10.11648/j.ijast.20220601.11
ISSN: 2640-1282 (Print); ISSN: 2640-1312 (Online)

Effect of Using Rice Bran and Tofu Dregs Fermented with Moringa-based Probiotics in the Diet to Improve the Productive Performance of Male Pigs

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To cite this article:

Graciano Soares Gomes, Carlito de Araújo Mali Code, Armando Bau Mau Afonso, Domingos Caeresi Bendito Beremau Gomes. Effect of Using Rice Bran and Tofu Dregs Fermented with Moringa-based Probiotics in the Diet to Improve the Productive Performance of Male Pigs. *International Journal of Animal Science and Technology*. Vol. 6, No. 1, 2022, pp. 1-5. doi: 10.11648/j.ijast.20220601.11

Received: December 23, 2021; **Accepted**: January 17, 2022; **Published**: February 5, 2022

Abstract: The study aims to verify the effect of using agricultural by-products fermented with Moringa-based probiotics in the diet to improve the productive performance and economic value of the swine diet. The study was carried out in the Laboratory area of the Faculdade de Agricultura Hera, in the municipality of Dili from August 12 to October 16, 2021. The Experimental Method with Latin Square Design was used, consisting of 5 treatments and 5 replications. The variables observed are the productive performance and the economic value of the diet. The treatments applied composed of: T0 (as control), T1, T2, T3, and T4 use fermented by-products with different levels in the diet formulation. The study results showed that there were significant differences ($P<0.05$) between treatments. The means comparison test revealed that T3 was the best treatment compared to the other treatments. The pigs that received T3 were able to improve intake by about 1238.40g per day with a feed conversion of 2.55 and consumption efficiency of 44.78%. It increases shoulder height by 0.35 cm per day and average daily weight by 510g, in addition to providing high yields in the sale of pork. On the other hand, there were no real differences in the variables as initial and final body weight, breast circumference, hip height, animal length and body length of pig's.

Keywords: By-products, Probiotics, Fermentation, Diet, Economic Value

1. Introduction

Livestock is part of the agricultural sector that plays a very important role in providing high-quality food, mainly as a source of animal protein for consumers, which are very important for human health, through the eradication of poverty and hunger through a large-scale sustainable production in order to ensure sustainable and self-sufficient food consumption [16]. The results of the Timor-Leste Household Census showed that around 71.58% of all registered household heads at that time were involved in swine production. [8]. On the other hand, the results of the Agricultural Census revealed that there was an increase of about 8.18% in the number of pigs kept on agricultural properties and represented 20% of all herds of animals kept in the country [9]. These data show the potential for the existence of swine in the territory, however, a major challenge in this activity is that producers still use extensive rearing systems that affect the low productivity of swine, including feed management.

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 of agricultural by-products. According to Bidura and Gomes pigs need energy, proteins, minerals, vitamins and water, where these substances have certain functions and

connections in the animals' bodies [2]. One type of food with high high-quality plant-based that can replace the use of antibiotics for growing pigs is the Moringa oleifera leaf meal [2, 14]. Innovation in family farming is a key to ensuring in the long term [3]. According to Gomes et al., the supplementation of Moringa oleifera leaf flour in the basal diet from 6 to 9% had a significant effect for slaughter weight, carcass weight and carcass percentage, in addition to reducing the cholesterol content in pork [4]. *Moringa oleifera* can play an important role in the economy of the poultry industry as a good source of vitamins and amino acids [15]. Most pig farmers in rural areas use agricultural by-products to feed their animals, but without considering the issue of quality, and still use the traditional method [6]. Therefore, in this case, it is advisable to create a method of conservation and fermentation of agricultural by-products, using Moringa-based probiotic, in an effort to improve the quality of the feed and also try to improve the animal's palatability to increase the productive perfomance os pigs. This work aim to discover the effect of using rice bran and tofu dregs fermented with Moringa-based probiotics to improve the productive performance of pigs and the economic value of the feed.

2. Materials and Methods

2.1. Research Site

The study was carried out in the Laboratory area of the Faculty of Agriculture Hera, Dili municipality, from August 12th to October 16th, 2021, divided into two phases, namely the preliminary phase 7 days and data collection phase with 58 days.

2.2. Research Method

The experimental method was used with the Latin Square Design with 5 treatments and 5 repetitions. Each treatment was repeated 5 times to obtain 25 units of observations. The treatments applied in this study are the diets composed of yellow corn, soybean, and fermented by-products (rice bran and tofu dregs), detailed in Table 1, and the composition of food nutrition are found in Table 2.

Table 1. *Food Allotion in Feed Formulation.*

Type of food (%)	Treatment				
	T0	T1	T2	T3	T4
Corn (Zea Mays)	35	30	35	40	30
Soybean	15	15	15	15	15
Unfermented rice bran	25	0	0	0	0
Fermented rice bran	0	25	25	25	30
Unfermented tofu dregs	25	0	0	0	0
Fermented tofu dregs	0	30	25	20	25
Total	100	100	100	100	100

Obs.: T0: as control, without by-products fermented.

Tabe 2. *Pig Feed Nutrition Composition.*

Nutrition	Treatment				
	T0	T1	T2	T3	T4
ME (Kcal/kg)	3082	3065	3096	3098	3080
Crude Protein (%)	17.58	18.30	17.12	16.87	17.84
Crude Lipid (%)	6.28	6.36	6.65	6.19	6.73
Crude Fiber (%)	7.18	7.47	7.12	7.00	7.46
Calcium (%)	0.06	0.07	0.06	0.07	0.07
Phosphor (%)	0.12	0.12	0.12	0.12	0.11
Dry matter (%)	90.97	90.99	91.00	90.96	91.13

Source: Trial & Error method.

2.3. Variables Observed

The variables observed in this study include initial body weight (IBW), feed intake (FI), feed conversion (FC), feed intake efficiency (FIE), final body weight (FBW), average daily weight gain (WGDA), body linearity measure, and economic value of the diet.

2.4. Data Analysis

The data obtained were tabulated and analyzed by analysis of variance (ANOVA). If there are real differences, continue with the Duncan test based on the recommendation of Sampurna & Nandhita [12]. It also performed a descriptive analysis when estimating the economy value of the feed to identify the treatment that brings the best benefit per kilogram of pork-based on marketing standard price.

3. Results and Discussion

3.1. Productive Performance of Pigs

The result of the statistical analysis of the research data on the productive performance of pigs is shown in Table 3. The comparison of mean values showed that there were

significant differences (P<0.05) between treatments for the variables feed intake (FI), feed conversion (FC), feed intake efficiency (FIE), weight gain daily average (WGDA), and height palette (HP) of the animals. On the other hand, there were no significant differences (P>0.05) in variables such as initial body weight (IBW), final body weight (FBW), hip height (HH), animal length (AL), body length (BL) and animal breast circumference (ABC).

Table 3. *Average value of productive performance of pigs used in the study.*

Variable	Treatment					$\bar{X}$±SEM[3]
	[1]T0	T1	T2	T3	T4	
IBW (kg)	39.23	38.56	39.31	39.81	37.18	38.62±2.22
FBW (kg)	42.66	40.86	43.09	43.91	40.51	42.21±2.23
FI (g)	1586.80b[2]	965.60a	1388.40b	1238.40ab	1214.00a	1278.64±88.12
FC (kg)	5.44a	3.94b	3.51b	2.55c	3.80b	2.85±0.24
FIE (%)	26.56a	27.62a	31.14a	44.78b	30.00a	32.09±2.02
DABW (g)	303ac	250a	396abc	510b	333ac	358.40±31.25
HP (cm)	0.16ac	0.26bc	0.20ac	0.36b	0.21ac	0.24±0.02
HH (cm)	0.29	0.22	0.21	0.31	0.17	0.24±0.02
AL (cm)	0.36	0.35	0.30	0.49	0.34	0.37±0.04
BL (cm)	0.34	0.39	0.28	0.43	0.40	0.36±0.04
ABC (cm)	0.32	0.31	0.32	0.40	0.39	0.35±0.03

1. Obs.:
2. T0: Composed of corn, unfermented rice bran, unfermented tofu dregs and soybeans (control). T1: Composed of corn, soybeans, 25% fermented rice bran and 30% fermented tofu sludge. T2: Composed of corn, soybeans, 25% fermented rice bran and 25% fermented tofu sludge. T3: Composed of corn, soybeans, 25% fermented rice bran and 20% fermented tofu sludge. T4: Composed of corn, soybeans, 30% fermented rice bran and 25% fermented tofu sludge.
3. Lines with differences in letters of notation ha differ at the 5% significant level (P<0.05)
4. SEM: Standard error of the mean.

The comparison of means test revealed that T3 was the best treatment for feed conversion, feed intake efficiency, shoulder height and increase in the average daily weight of the animals. However, for feed intake, the control treatment (T0) was the worst treatment compared to the others. In the T0 treatment, the animals consumed more, but showed worse feed conversion and low average daily weight gain. The result of the study showed that the feed formulated with agricultural by-products fermented with a probiotic based on Moringa leaf was able to improve the quality of the feed through superficiality, aroma, texture that can stimulate the palatability of animals and facilitate digestion and a nutrient absorption process as shown in the result of efficiency and feed conversion value. According to Hernandes et al., the presence of substances from plant extracts including Moringa oleifera 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 occurs as much as possible to be absorbed [7]. In all cases, Moringa has a higher content of vitamin A, vitamin C, calcium and potassium, compared to sanatoria, orange, cow's milk and banana [10]. The increase in the animal's body weight reflects how the nutrition and balance of amino acids contained in the given feed has a positive impact on the animal [1]. Moringa leaf meal may be useful for use as an effective food supplement in non-ruminant animals to increase feed efficiency in swine [5]. They also stated that the main mode of action of this active principle is the inhibition of microbial pathogens and endotoxins in the intestine and the increase in the activity of the pancreas, resulting in better metabolism and use of nutrients.

According to Gomes et al., *Moringa oleifera* leaf flour supplementation in 6-9% basal diet had a significant effect on slaughter weight, carcass weight and carcass percentage, it can also reduce cholesterol content and increase ß-carotene content of pork [4]. Most swine farmers in rural areas use agricultural by-products to feed their animals, without worrying about quality, and still use traditional methods [6]. *Moringa oleifera* can play an important role in the economy of the poultry industry as a good source of vitamins and amino acids [15].

3.2. Economic Value of the Diet

The results of the descriptive analysis of the estimated economic value of diet are shown in Table 4. The data showed that the animals that received treatment 3 had better productive performance and better diet saving value compared to treatments T0, T1, T2, and T4. In this research, animals that received T3 need only 2.38 kg of feed to produce one kg of meat. The profit per kg of meat obtained in T3 is US$ 6.67, higher than in other treatments. These results show that the use of 25% rice bran and 20% tofu dregs fermented in the diet is already adequate for improving consumption efficiency and feed conversion in terms of yield improvement and feed cost reduction. According to Gomes & Mali Code, consumption efficiency and better feed conversion are considered determining factors to reduce the cost of food and can improve the producer's income [6]. Furthermore, it is stated that, in general, pigs need only 2.5 to 3.4 kg of nutritious feed to produce one kg of meat.

Table 4. *Estimation of the value of economy of diet applied in research.*

Description (Items)	Treatment				
	[1]T0	T1	T2	T3	T4
Feed intake (g)	1586.80	965.60	1388.40	1238.40	1214
Feed conversion	5.44	3.51	3.94	2.38	3.80
Average daily weight gain (g)	303	250	396	510	333
Price of diet ($ /kg)	0.65	0.55	0.50	0.56	0.50
Total price of diet ($/ kg pork)	3.54	1.93	1.98	1.33	1.90
Total diet / treatment (kg)	106.12	64.70	93.02	82.97	81.34
Total price of diet / Treatment ($)	69.00	35.56	46.51	46.46	40.67
Price of pork ($ / kg)	8.00	8.00	8.00	8.00	8.00
Benefit ($ / kg pork)	4.46	6.07	6.02	6.67	6.10
Loses ($/kg pork)	0.00	0.00	0.00	0.00	0.00

Obs.: T3 is the best treatment composed of 40% yellow corn; Soybean 15%; fermented rice bran 25% and Tofu dregs fermented 20%.

The results of the feed economy estimate show that each treatment increased the live weight of the pigs as shown in Figure 1. The data show that the pigs increase their total weight in each treatment as follows: T0: 19.38 kg, T1: 15.60 kg, T2: 26.58 kg, T3: 32.40 kg, and T4: 21.78 kg. For this, the weight of all animals is 115.74 kg. To calculate gross yield from feed savings value, normally take 75% of weight as carcass weight including commercial and non-commercial cuts and if all cuts were marketed they would have a gross yield of $694.40. However, the cost of purchasing food materials to formulate the animal feed during 65 days of research was about $216.82. So the revenue is $477.60. In the animal production activity, always start with a thought that will spend little to produce more in terms of quantity and quality of the products obtained. *Moringa oleifera* can play an important role in the economy of the poultry industry as a good source of vitamins and amino acids [15].

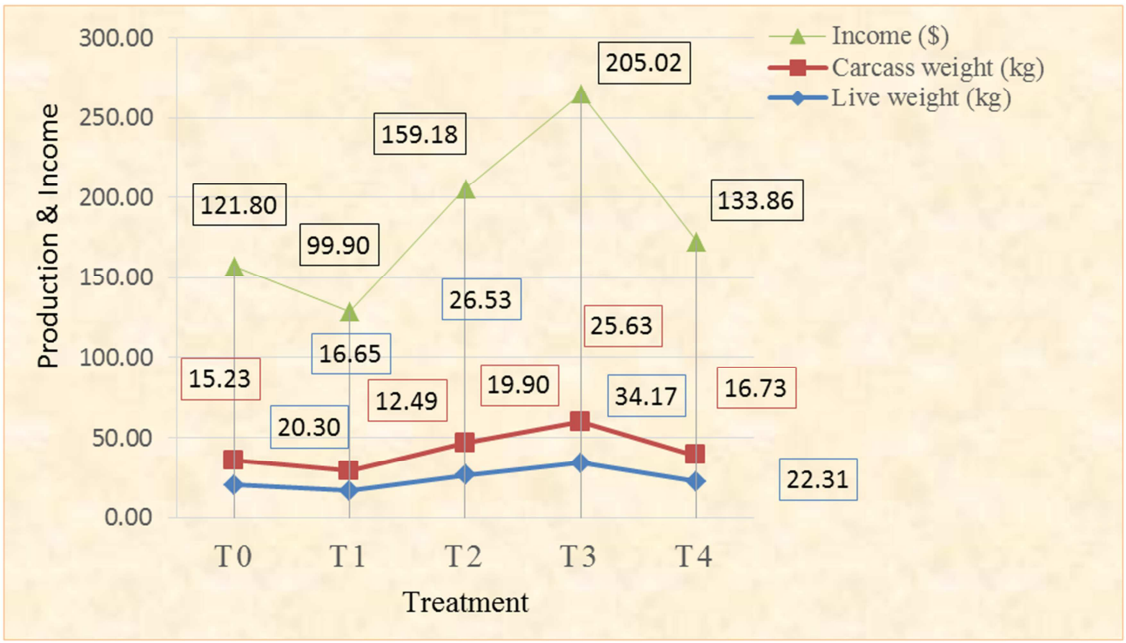

Figure 1. *Live weight, carcass weight, and income per treatment.*

Food costs can represent up to 75% of production costs [2]. According to the authors, it is essential that producers adapt their nutritional strategies to maximize the feed efficiency of animals. The pressure to reduce feed costs and the continuous effort to obtain a more balanced feed, formulated with less expensive and more available ingredients, are the biggest challenges facing animal production today. The cost of feed prepared by the producer depends on the volume produced, the price of ingredients and the equipment used [13]. According to Portes et al., 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 production of live pigs [11]. The authors also stated that corn and soybeans can represent a great influence on the competitiveness of production, for example, if the herd feed conversion is 3.1 and the feed represents 70% of production costs, the minimum equivalence between prices should be 4.4 (the price of the pig must be at least 4.4 times the price of the feed) so that the producer balances production costs with the sale price of the animals.

4. Conclusion

According to the research results, it is concluded that the use of fermented agricultural by-products (rice bran and tofu dregs) in the diet of pigs in the T3 can improve feed intake, feed conversion, feed intake efficiency, shoulder height and the average daily weight of pigs. In addition, it can bring a high yield in the marketing of each kilogram of pork compared to other treatments. On the other hand, there were no real differences in the variables as initial and final body weight, breast circumference, hip height, animal length and body length of pig's. Recommended that producers and other interested parties in the area of animal production, especially swine production, can use the T3 in the context of improving productive performance and saving the value of pork feed.

Conflicts of Interest

We decclare that no conflicts of interest regarding the publication of this article**.**

Acknowledgements

The work was funded by the East Timor Nactonal Institute of Science and Technology - INCT-TL. Therefore, the authors would like to thank you for all the support, guidance, and funding of the research.

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