PIG PERFORMANCES FED WITH COCONUT WATER AND PULP

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Scientific Papers. Series D. Animal Science. Vol. LXII, No. 2, 2019
ISSN 2285-5750; ISSN CD-ROM 2285-5769; ISSN Online 2393-2260; ISSN-L 2285-5750

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Abstract

*Research was conducted to evaluate the utilization of coconut meat waste and water by-product in the diets related with pigs performances. The treatments involving 30 growing pigs were arranged in a 3*2 factorial design based on completely randomized design. The treatments of factor A were including levels of coconut meat waste product equivalent to 0% (A0), 22.5% (A1) and 45% (A2) substituting the rice bran in ration meal. The treatments of factor B were applying levels of coconut water equivalent to 0% (using fresh water = B0) and 100% (using coconut water = B1) substituting the fresh drinking water of animals. Each experimental unit of factor A and factor B was repeated using 5 pigs of crossbred castrated males (Yorkshire*Landrace*Local), each maintained individually in a pen with initial weight of 59.4±1.33 kg. Ration and drinking water were daily given ad libitum to the animals. Animals were weighed on each period of 14 days for data collection of animal growth rate. The result showed that proportions of coconut meat waste product were less than planned for treatments of 22.5% and 45%, while total of 100 percents of coconut drinking water were less than planned for 100% of fresh drinking water. Results also showed that utilization of coconut meat waste product up to 50% substituting rice bran in ration with the level of 22.5% was able to yield the optimum growth rate*

Key words: *coconut waste product, growing pigs.*

INTRODUCTION

This study on the utilization of coconut meat waste and water aimed to develop locally available feedstuff sources that promise to be viable alternatives to basal meals in diets for pigs. Detailed researches of foliage utilization from new Cocoyam (*Xanthosoma sagittifolium*) leaves (Rodríguez et al., 2006), sweet potato (*Ipomoea batatas*) (Le Van An et al., 2005; Sokha et al., 2007), cassava (*Manihot esculenta)* (Bui, 2006; Nguyen, 2006), mulberry (*Morus* alba) (Chiv et al., 2007) and water spinach (*Ipomoea aquatica*) (Chhay and Preston, 2006a,b) have been reported and well documented. Focused study is now being attended to coconut waste products which are widely distributed in tropical latitudes of Indonesia, often as abundant waste product of coconut plantation.

Value Added of Coconut Products has been used as staple part of the diets of almost all Polynesian and many Asian people for centuries. It is used as food, as flavoring and made into beverages. Today's young consumers depend heavily on conventional food. It is in this sector that coconut has a good chance to increase its use. The important products of coconut in almost all countries are whole coconut (tender and mature), copra, toddy, coconut palm candy, sugar, vinegar and other technological food products and few novel recipes like banana coconut cake. To use coconut in preparations, the consumer has to break the nut transversely into two parts (Photo 1c), to shred into gratings and then process further. On the other hand, if coconut gratings, its rich milk and even prepared foods are available as such on the shelves of the market, surely consumers, especially the younger generation will be generated to encourage to them in preparations much more.

In a previous study by Berschauer et al. (1984), it was shown that the fat content of the animals fed ration containing 12% coconut fat was 15.9% and this was significantly lower (p < 0.001) than that of 21.1% measured in the animals fed rations containing 12% sunflower oil. The contents of myristic acid and linoleic acid were significantly different between sunflower oil and coconut fat; for the former values of 0.8% (sunflower oil) and 16.9%

(coconut fat) were determined, respectively, with corresponding values of 48.7 (sunflower oil) and 11.3% (coconut fat) for the latter. Rice bran is a by-product of rice grain production consisting primarily of the outer layers of the grain (Campabadal et al., 1976). The rice bran is removed during the process of milling to produce white rice for human consumption (Saunders, 1990). It usually includes the pericarp, seed coat and aleurone, as well as most of the germ (Kaufmann et al., 2005). Rice bran has highly available energy, and is generally economical. It is usually used in swine diets because it is widely grown in the East and South East of Asia. There are 40 to 45 million tons of rice bran produced annually (David, 1994). Some studies had been conducted to examine the feasibility of using rice bran as an ingredient in poultry (Hussein and Krarzer, 1982; Sayre et al., 1987; Warren and Farrell, 1990) and swine (Warren and Farrell, 1990).

Because of the large quantity of rice bran needs throughout the world, it is important to determine not only its function in term of chemical composition, but also the variation in chemical composition arising from different feed ingredients of the animals. The hypothesis for this study was that the rice bran was competitive ingredients of pig and poultry rations, in all regions and could be changed its function in animal ration with other alternative ingredients without competing human food. Therefore, the object of this study was designed to determine the utilization effects of coconut meat waste and water on growing performance and carcass quantity of pigs as a part replacement of the rice bran ration and a complete replacement of the drinking water in weaned pigs fed the same basal diets.

MATERIALS AND METHODS

The study was conducted at the swine farm in Tomohon, North Sulawesi Province of Indonesia between April and June 2013, divided into 14 days of preliminary treatment (treatment adaptation) and 56 days of data collection periods for growing variables and ending period for slaughtering animal and carcass observation.

The treatments involving 30 growing pigs were arranged in a 3*2 factorial design based on completely randomized design. The treatments of factor A were including levels of coconut meat waste product equivalent to 0% (A_0), 22.5% (A_1) and 45% (A_2)substituting the rice bran in ration meal

The treatments of factor B were applying levels of coconut water equivalent to 0% (using fresh water = B_0) and 100% (using coconut water = B_1) substituting the fresh drinking water of animals (Table 1). Each experimental unit of factor A and factor B was repeated using 5 pigs (marked at left ear of each pig) in a pen. The pigs were crossbred castrated males (Yorkshire*Landrace*Local) with initial weight of 59.4±1.33 kg.

The coconut meat waste products were dried under sunrise (uncompetitive product with human food) and used for substitution of rice bran in pig basal ration. Materials of basal feed ingredients were weighed with the compositions of yellow corn (45.8%), rice bran waste product (45%), fish meal (8.7%) and Top mix (0.5%).

Coconut meat waste product generally contains 7.73% of crude protein, 19.82% of crude fiber, 56.86% of fat, 0.06% of Ca, 0.14% of P, and 6,805 kcal/kg or 28.5 MJ/kg of gross energy (Laboratory Analysis of Sam Ratulangi University, Indonesia, 2013).

Rations fed to animals were formulated in the composition as shown in Table 1. In this study, growing pigs were weighed in the morning, before being fed, at the beginning of the trial and after each period of 14 days. Animals were weighed four times during experimental periods involving 56 days of study. Samples of ration were collected at the initial day and end of the day in each period of treatment. The left over ration feeding was collected daily. Daily difference between feed consumed and the left over ration feeding was defined as the animal feed consumption. Table 1 gives nutrient compositions of the trial animal ration.

In addition to feed consumption, animal daily drinking water using treatments of fresh water and coconut water waste product was also measured as the treatments. Daily difference between drinking water by the animal and the left over drinking water was defined as the animal daily drinking water (liter/animal/day).

Table 1. Nutrient compositions of ration ingredients of the treatments (%)

Ingredients	R_0	R_1	R_2
Yellow corn*	45.80	45.80	45.80
Fish meal*	8.70	8.70	8.70
Rice bran**	45.00	22.50	0
Coconut meat waste product**	0	22.50	45.00
Mix	0.50	0.50	0.50
Total	100.00	100.00	100.00
Nutrient content			
Protein (%)	13.13	12.10	11.72
Fat (%)	6.06	18.52	23.34
Crude fiber (%)	11.64	10.84	9.65
Calcium (%)	1.02	0.83	0.73
Phosphor (%)	0.93	0.54	0.52
Gross Energy (Kcal/kg)	3905.00	4325.00	4475.00

*Calculated on the bases of laboratory analysis at Feed and Nutrient Laboratory–Bogor Agricultural Institute, Indonesia (2013).
** Calculated on the bases of laboratory analysis at Sam Ratulangi University-Laboratory, Indonesia (2013).

Drinking water treatments were given as the first meal at 07.30h. After all first drinking water was consumed by animals the remainder of drinking water of treatments was given. The same procedure was repeated at 15.00h. Nutrient contents in drinking fresh and drinking coconut water were presented in Table 2.

Table 2. Nutrient compositions in fresh drinking water and coconut drinking water

Nutrient content*	Fresh water	Coconut water
Water (%)	98.81	96.63
Protein (%)	-	0.07
Fat (%)	-	0.09
Ash (%)	-	0.06
Sodium (%)	0.04	0.12
Potassium (%)	1.01	18.04
Calcium (%)	2.68	12.29
Magnesium (%)	0.64	1.96
Nitrogen (%)	-	1.14
Glucose (%)	-	1.14
Sucrose (%)	-	2.81

*Result of Chemical Laboratory Analysis at Sam Ratulangi University, Indonesia (2013).

Variables observed in the trial involved feed consumption of ration (g/animal/day); average daily gain (ADG) (g/animal/day), and feed efficiency was calculated as ratio between the ADG (g/animal/day) and feed consumption of ration (g/animal/day). Pig drinking water was calculated as daily difference between animal drunk water and the left over animal daily drinking water. Animal body weight at slaughter period was calculated as animal weight at the end of experiment (kg/animal).

Data were analyzed using Analysis of variance (ANOVA) (Steel and Torrie, 1980). Feed consumption, ADG, feed efficiency, pig drinking water, animal body weight at slaughter period were included as dependent variable, while three treatment levels of coconut meat waste product (factor A), two treatment levels of coconut water (factor B), and the interaction (AB) were included as independent variables in the ANOVA model (Steel and Torrie, 1980). Data were analyzed using the Insert Function Procedure of the related statistical category in datasheet of Microsoft Office Excel (2007). The significant difference in the model of treatments was tested using *honestly significant difference*, while differences between variable averages at levels of drinking water were tested using pair *t-test* (Byrkit 1987).

RESULTS AND DISCUSSIONS

There were significant differences between the treatment levels of substitution of rice bran by the coconut meat waste product as shown in Table 3.

In this study, attempts were made to control the intakes of coconut meat waste product substituting rice bran in ration meal and coconut water changing fresh drinking water so as to achieve the desired proportions of these three levels of ingredients in the diets. However, this was only partially successful with the result that proportions of coconut meat waste product were less than planned for treatments of 22.5 percents and 45 percents, while total of 100 percents of coconut drinking water were less than planned for 100 percents of fresh drinking water.

As a result the nutrient content of coconut meat waste product was 7.73% of crude protein compared with 13.35% of crude protein in the rice bran of the present experiment. This lower crude protein level being possible through use of coconut meat waste product would be considered in ration formulation as a protein source. This difference in levels of protein would the major reason found this study of growing pigs. In the present study with lighter pigs on the use of coconut meat waste product represented the diet of protein content in the treatment.

Table 3. Averages of feed consumption of each treatment using coconut meat waste product substituting rice bran in ration and animal drinking water using fresh water and coconut water in the experiment

Pig drinking water levels	Coconut meat waste product levels			Average
	0 %	22.5 %	45 %	
Average feed consumption(kg/animal/day):				
Coconut water 0 %	3.99	3.39	2.43	3.273 ^{y}
Coconut water 100 %	3.51	3.24	2.07	2.939 ^{z}
Average	3.75 ^{a}	3.32 ^{b}	2.25 ^{c}	3.106
Average consumption of drinking water (liter/animal/day):				
Coconut water 0 %	5.80	5.29	4.22	5.10^{y}
Coconut water 100 %	8.47	7.08	5.19	6.91^{z}
Average	7.14^{a}	6.19^{b}	4.71^{c}	6.01
Average daily gain (ADG, gram/animal/day):				
Coconut water 0 %	773	777	470	674
Coconut water 100 %	630	673	410	571
Average	702^{a}	725^{b}	440^{c}	662
Average of feed efficiency (ADG/feed consumption):				
Coconut water 0 %	0.190	0.230	0.190	0.200
Coconut water 100 %	0.180	0.210	0.200	0.190
Average	0.185	0.220	0.195	0.200
Average of body weight at slaughter period (kg/animal):				
Coconut water 0 %	106.33	108.67	90.83	101.94 ^{y}
Coconut water 100 %	99.00	101.67	88.33	96.33 ^{z}
Average	102.67 ^{a}	105.17 ^{b}	89.58^{c}	99.14

[y,z] Means within the same variables in each column are different at $p<0.05$;
[a,b,c] Means within the same variables in each row are different at $p<0.05$.

There were also major differences in the apparent results of the fat content of the coconut meat waste product which was analyzed to be 56.86 % in this study compared with fat content of 32.5 in the rice bran at present study. However, the highest fat content in coconut meat waste product would be able to reduce the back fat thickness in growing pigs. The accumulation of fat in the pig body is related to the activities of adipose tissue (Rumokoy et al., 2014).It was shown that the fat content of the animals fed ration containing 12% coconut fat was 15.9% and this was significantly lower ($p<0.001$) than that of 21.1% measured in the animals fed rations containing 12% sunflower oil (Berschauer et al., 1984). The contents of myristic acid and linoleic acid were significantly higher of 48.7 and 11.3% in coconut fat, respectively; compared with 0.82% and 16.9% in sunflower oil (Berschauer et al., 1984).

The interested results indicated that higher level of the coconut meat waste product substituting rice bran would decrease feed consumption and drinking water consumption by animals. In contrast, utilization of the coconut drinking water of 100 percents would also increase animal drinking water consumption. This high coconut drinking water consumption might be due to stimulation by the nutrient contents in coconut water mainly dominated by high contents of Potassium, Calcium, Magnesium, Nitrogen, glucose and sucrose (Table 2) that were increasing water palatability.

The substitution of rice bran up to 100 percents by coconut meat waste product in ration would produce lowest ADG of the animals. However, the highest ADG was reached by ration containing a balance use of rice bran (22.5%) and coconut meat waste product (22.5%) in ration. This balancing use of rice bran and coconut meat waste product was also produce the optimum feed efficiency, although feed efficiency of the animals consuming ration containing all coconut meat waste products (45 percents) was higher than that of the animals consuming ration containing all rice bran (45 percents).

Different sources of drinking water of animals using fresh drinking water and coconut drinking water produced also different ADG of the animals. Nutrient contents in coconut drinking water (Table 2) might not be able to increase more ADG of animals, even though these could be able to equalize the feed efficiency due to low feed consumption by animals consuming coconut drinking water.

The significant relationships between coconut meat waste product intake and coconut drinking water imply that if the coconut meat waste product level in diet had been highly increased with changing fresh drinking water by coconut drinking water then the back fat thickness response in animals would also have been lower. This hypothesis was approved in this experiment.

A related study to determine the use of coconut drinking water revealed the potential increase of carcass percentage, carcass length and the wide of loin eye area in growing pigs. However, the nature of the basal diet using coconut meat waste product substituting rice bran was quite limited to the present work in the component of carcass quantities.

There were significant differences in the average daily gain of the animals fed the higher contents of coconut meat waste product substituting rice bran in the diets.

The treatment with 100 % of coconut meat waste product substituting rice bran in ration had, however, 61 to 63% lower average daily gain (ADG) significantly when compared at similar ADG with the treatment using 50% of coconut meat waste product substituting rice bran in ration and control treatment without coconut meat waste product in ration, respectively.

As the lower protein concentration in diets and the growth rate were higher in correlation required per kg growth as shown for approximately protein content of 89% (R_1) and 83%(R_2) lower than that of the control treatment (R_0).

The efficiency of protein utilization combined with that of lower fat and crude fiber contents in ration containing coconut meat waste product of the animals was able to equalize the feed efficiency compared with that in control ration (R_0). The values of feed efficiency for the use of 50% coconut meat waste product substituting rice bran in ration were intermediate.

CONCLUSIONS

Utilization of coconut meat waste product up to 50% substituting rice bran in ration with the level of 22.5% was able to yield the optimum growth rate and carcass quantity of pigs.

ACKNOWLEDGEMENTS

The financial support by the Ministry of Education and Culture, Republic of Indonesia through their Research Finance Program is gratefully acknowledged.

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