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# EFFECT OF INCLUSION OF COCONUT MEAL IN THE DIETS ON NUTRIENT DIGESTIBILITY OF GROWING PIGS

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***Abstract***

*Although its protein content is less than that of conventional ingredients commonly used as protein sources, copra meal represents the largest quantity of locally available feed protein in many tropical areas, such as Indonesia. It is, therefore, important that information about the nutritional value of copra meal is available. The present study was conducted to test the effect of inclusion of copra meal in growing pigs diets on nutrient digestibility. Twenty-four castrated Landrace Yorkshire pigs (3.5 – 4.0 months of age, ranged from 33 – 40 kg of body weight) were kept in individuals pens. Four treatments were arranged as follow: R1 = 95% basal diet + 5% copra meal; R2 = 90% basal diet + 10% copra meal; R3 = 85% basal diet + 15% copra meal; R4 = 80% basal diet + 20% copra meal, with six replications as blocks based on body weight. The present study was arranged in a 4 x 5 Completely Randomized Block Design with four treatments and five blocks. After a significant F test, Tukey's test (where necessary) was used to inspect differences among treatment means. Differences between treatment means were considered significant when P < 0.05. Variables measured were: daily feed and water consumption, nutrient digestibility (energy, crude protein, fat, crude fiber, calcium and phosphorus). The result showed that there was no significant effect (P>0.05) of copra meal inclusion in diet on feed and water consumption, as well as nutrient digestibility (energy, crude protein, fat, crude fiber, calcium and phosphorus). It can be concluded that inclusion of copra meal up to 20% in growing pigs diets did not affect nutrient digestibility as well as performance of the pigs. Further study on higher level of copra meal inclusion in pig diets is needed.*

***Key words**: copra, pigs, consumption, digestibility*

## INTRODUCTION

The demand for feed is increasing and co-products from the tropical food industries are increasingly used in diets fed to pigs. These co-products include copra meal and copra expellers (Stein et al., 2015). The coconut palm (Cocos nucifera) is widely distributed throughout Indonesia, especially in the Province of North Sulawesi. The production of coconut oil and copra meal in Indonesia is about 995.00 metric tons and copra meal are about 515.000 metric tons (BPS - Statistics Indonesia, 2017).

Coconut meal or copra meal is produced from the ripe fruit (nut) of the coconut palm (Cocos nucifera). The nut is split and the kernel is removed and dried below 6% moisture. This meal is called copra meal and still contains the oil. Coconut meal (copra meal) is a coproduct of the production of coconut oil. Copra meal is produced by expeller sometimes referred to as coconut meal or coconut oil meal. Copra meal is often fed to monogastric animals such as poultry and pigs (Sundu et al., 2006; Diarra et al., 2004; Jaworsky et al., 2014; Rodjan et al., 2017; Park et al., 2012) and it could be deposited in adipose tissues (Rumokoy, 2012). Although the amino acid profile and digestibility in copra meal are less favourable than in soybean meal, it can provide significant protein and energy in swine diets and may be used to reduce feed costs (Stein et al., 2015).

The protein concentration of copra meal is between 14 and 22% and the protein has a low biological value and a very high Arg:Lys ratio (Stein et al., 2015). Somkune et al., (2013) reported that dried coconut meal contains about 26% crude protein and 26% crude fiber. Copra meal is high in fiber and the energy value is relatively low when fed to pigs. Its high fiber content is an important factor that limits its used in pigs diets (Kim et al., 2011) as it reduces digestibility of nutrients and efficiency of energy utilization (Guttieres et al., 2014; Marin et al., 2017). High fiber co-products from the copra industries are by-products of the production of coconut oil. After entering and circulating in animal's body, this oil could be part of intramuscular substances composition (Rumokoy and Toar, 2014). Although its protein content is less than that of conventional ingredients commonly used as protein sources, copra meal represents the largest quantity of locally available feed protein in many tropical areas, such as Indonesia. It is, therefore, important that information about the nutritional value of copra meal is available. The present study was conducted to test the effect of inclusion of copra meal in growing pigs diets on nutrient digestibility.

## MATERIALS AND METHODS

Animals, diet, and management: twenty castrated Landrace X Yorkshire crossbred grower pigs aged 3.0 to 3.5 months old were assigned to four treatments as follow: T1 = 95% basal diet + 5% copra meal; T2 = 90% basal diet + 10% copra meal; T3 = 85% basal diet + 15% copra meal; and T4 = 80% basal diet + 20% copra meal. The present study was arranged in a 4 x 5 Completely Randomized Block Design with four treatments and five blocks. The initial body weight of animals was 28 to 37 kg. Pigs were divided into five blocks as follow: I = 28 to 29 kg; II = 30 to 31 kg; III = 32 to 33 kg; IV = 34 to 35 kg, and V = 36 to 37 kg. Pigs were placed in individual metabolic crate to facilitate the separate collection of urine and faeces. The diet, based on yellow corn, rice bran, soybean meal, bone meal, salt, and pigmix (premix), was formulated (Table 1) to meet or exceed all requirements for growing swine as defined on a percentage basis by the NRC (2012).

Table 1. Composition of basal (control) diet

| Ingredients | % |
|---|---|
| Yelow Corn | 50,0 |
| Rice Bran | 25,0 |
| Soybean Meal | 22,0 |
| Bone Meal | 1,0 |
| Salt (NaCl) | 1,0 |
| Mineral(Pig Mix) | 1,0 |
| Total | 100 |
| *Nutrient Assyed* | |
| Dry matter (%) | 18,31 |
| Protein (%) | 15,35 |
| Crude fiber (%) | 6,32 |
| Ether extract (%) | 5,87 |
| Calcium (Ca) (%) | 0,70 |
| Phosphorus (P) (%) | 0,68 |
| Zinc (Zn)(mg/kg) | 107 |
| Digestible Energy (DE) (kcal/kg) | 3436,0 |

Table 2. Composition of Experimental Diets

| | Treatmens | | | |
|---|---|---|---|---|
| | T1 | T2 | T3 | T4 |
| | % | | | |
| Control diet | 95 | 90 | 85 | 80 |
| Copra meal | 5 | 10 | 15 | 20 |
| Total | 100 | 100 | 100 | 100 |
| *Nutrient Assayed:* | | | | |
| Dry matter (%) | 84,31 | 84,31 | 83,22 | 84,94 |
| Protein (%) | 15,35 | 15,37 | 15,66 | 16,00 |
| Crude fiber (%) | 6,32 | 6,56 | 7,01 | 7,87 |
| Ether exract (%) | 5,87 | 5,88 | 5,92 | 5,97 |
| Calcium (%) | 0,70 | 0,71 | 0,72 | 0,72 |
| Phosphorus (%) | 0,68 | 0,69 | 0,70 | 0,72 |
| DE (kkal/kg) | 3436,20 | 3437,10 | 3445,20 | 3425,30 |

*) Provided per kg of diet: vitamin A, 4800 IU; vitamin D3, 470 IU; vitamin E, 22 IU; menadione, 2.2 g; riboflavin, 2.7 g; niacin, 22 g; d-pantothenic acid, 1.5 g; thiamine, 550 mg; d-biotin, 150 mg; vitamin B12, 20 mg

The diet was offered to the pigs as a mass. Fresh water was provided in the trough ad libitum until the time of feeding. Feed was provided and after 30 min, the uneaten portion was removed and weighed. The trough was refilled with water until the next feeding period. Feed and water intake were recorded during the total experimental period. The design of the trough in the metabolism crate essentially eliminated wastage of feed or water. Trays placed below the crates revealed insignificant wastage. Total (24 h) faecal output was collected beginning at 08.00 h on day 70. Total samples were frozen and retained for later assay of dry matter, nitrogen, calcium, and phosphorus. Feed samples were collected during the experimental period and retained daily for later analysis of dry matter, energy, protein, fat, crude fiber, calcium and phosphorus, according to methods defined by the A.O.A.C (2016). All data were analysed using the GLM Procedure (SAS Institute, 1989). A Completely Randomized Block Design (Steel and Torrie, 1997) was used to examine the treatment differences. After a significant F test, Tukey's test (where necessary) was used to inspect differences among treatment means. Differences between treatment means were considered significant when P<0.05).

## RESULTS AND DISCUSSIONS

The results of the performance indices and nutrient digestibility values of the experimental pigs are presented in Table 3. Feed and water intake, daily gain, nutrient digestibility (energy, protein, fat, crude fiber, calcium and phosphorus) of the pigs were all not affected (P>0.05) by treatments. Increasing copra meal inclusion in the growing pig's diets had no significant effect on all parameters measured in the present study.

A report based on unpublished research by Jaworski et al., (2017) of University of Illinois at Urbana-Champaign, USA on research conducted from 2008 to 2017, indicated that growth performance declines with increasing inclusion of copra meal at day 20 of experimental period. Average daily gain, average daily feed intake, and gain:feed ratio all showed a linear decrease (P=0.05) as the inclusion rate of copra meal increased. The inclusion of copra meal must be less than 25% in diets for growing-finishing pigs (Stein et al., 2015).

The differences in nutrient digestibility among experiments may be due to differences in nutrient composition, drying procedures, oil extraction procedures, and the degree and duration of heat processing that is used during oil extraction. Quality problems may be attributed to the high moisture content of copra during drying and storage (Stein et al., 2015). Copra meal may be included in diets fed to growing and finishing pigs by up to 30 % without affecting growth performance (Stein et al., 2015), but negative effects of increasing levels of copra meal in the diet have been reported. Results with copra meal have been improved if diets either were semi-purified diets or if they were formulated based on digestible amino acid rather than based on crude protein (Jaworski et al., 2017).

Copra meal is incorporated in pig diets as a source of plant protein. On the other hand, copra meal has some limitations due to its high fiber content and its low protein quality that can affect its nutrient digestibility when incorporated into pig diets at high level. As was proposed in the present study that the inclusion of copra meal up to 35% in the growing pig diets could affect digestibility of energy and protein as well as the performance of the pigs. Indeed, the inclusion of copra meal from 5, 10, 15, and 20% in the diets did not give a significant (P>0.05) results in all parameters measured. It seems that as the level of copra meal inclusion increased in the diets has not given a major change Palatability of the diets did not change and so that feed consumption did not give a significant difference (P>0.05). As a consequence, digestible energy (DE) in the present study among treatment did not give a significant difference as well due to the energy spent in fiber digestion was similar. Increment of copra meal among level was not too big so that that fiber content did not change much. This could also be the one that contributed to the insignificant result on energy spent in fiber digestion, although fiber content of copra meal is high enough. NRC (2012) stated that ingredients or diets high in fiber always followed by low energy content. In that matter, the increased in feed consumption will be followed by fiber consumption that increased energy used in digesting nutrients and reduced digestible energy per se of the feed as well as its feed efficiency. Copra meal contains between 10 and 16% crude fiber and approximately 47% total dietary fiber (Jaworsky et al., 2014). Concentrations of β-mannans, galactomannans, arabinoxylogalactan, and cellulose are relatively high and the water binding capacity of copra meal is high. Water binding capacity is an estimate of the amount of water that a fiber can absorb and hold after an external force has been applied to it via centrifugation. High water binding capacity will usually result in reduced feed intake of animals because of swelling in the intestinal tract. The relatively high concentrations of fermentable fiber in copra ingredient may result in increased needs for dietary Threonine because dietary fiber increases the endogenous losses of amino acids, and therefore increases the loss of Threonine. Protein levels of copra meal and copra expellers typically range from 20 to 26% (Jaworsky et al., 2014). The concentration of gross energy in copra meal is greater than in corn, but because of the high concentration of fiber in copra meal and copra expellers, concentrations of digestible energy (DE) and metabolizable energy (ME) are less than in corn (NRC, 2012; Sulabo et al., 2013).

## CONCLUSIONS

Inclusion of copra meal up to 20% in growing pigs diets did not affect nutrient digestibility as well as performance of the pigs. Further study on higher level of copra meal inclusion in pig diets is needed.

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