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The Sustainable Pig Nutrition by Partial Replacement of Soybean Meal with Copra Meal

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A B S T R A C T

The sustainability of pig industry can be improved through nutrition by increasing efficiency in an environmentally friendly environment. Alternative feed ingredients from agricultural waste or industrial by-products have attracted sustainable pig production systems. This study aimed to investigate the effects of sustainable pig nutrition by partially replacing soybean meal with copra meal. A total of 18 crossbred (LYD) growing female pigs were reared under three dietary treatments. Treatments were 1) corn-soybean meal diet (CON), 2) white copra meal, and 3) brown copra meal. The experimental results indicated no significant difference ($P>0.05$) in feed intake and weight gain for pigs fed the three experimental diets. However, pigs fed the white copra meal diet tended to have better feed intake than brown copra meal treatment. At week 2 of the experimental period, pigs fed copra meal diets had better feed efficiency than CON diet ($P<0.001$). In conclusion, sustainability pig nutrition with copra meal may be used as an alternative for partial soybean meal in pig diets.

1. INTRODUCTION

1.1. Research Background

Feed costs represent 60-70% of total cost in intensive pig production, which is especially due to costs of protein. The increasing demand and production of meat have led to an increase in soybean meal and corn price. Soybean meal is the most widely used plant protein source in pig diets, which make the nutritionist think on alternative protein sources in pig diets [1]. Alternative feed ingredients from agricultural waste or industrial by-product have attracted in sustainable pig production systems. Alternative feed ingredients such as copra meal have attracted great attention in feed and swine industry due to their comparable nutritional values and price compared to conventional swine feed ingredients, such as soybean meal and corn [2]. Nutrition strategy is one of the important way to improve environmentally friendly and sustainable of pig production. Partial replacement of soybean meal and corn with copra meal may help to sustainability of pig nutrition.

1.2. Literature Review

One of the very important factor for pig production is pig feed cost. The increasing production of meat have led to an increase feed cost. Animal nutritionist and farmer have to consider about the selection of feed ingredients that are readily available locally, cheap and good quality [3].

Thailand is an agricultural country. An important by-product and co-product besides agricultural products is agricultural waste. Sustainability and environmentally friendly are very important for pig production recently. For the long-term sustainability of pig production, economic, societal acceptance and environmental footprint remain key components. Increased inclusion of co-products in substitution of grains in diets fed to pigs can reduce feed cost per unit of pork produced, convert human nonedible feedstuffs into high quality pork for human consumption, and thereby reduce nutrient waste. Co-products may contain fermentable fiber and starch that assist in maintaining gut health

of pigs fed diets without antibiotics [4]. Moreover, Pigs fed diets containing co-products will excrete more organic matter that should be treated as a resource for energy generation. Feeding co-products to pigs can reduce feed cost and is an important step toward reaching sustainable food production [5].

Copra meal is a residue of coconut oil production, which is a residue after oil extraction from the meat of the coconut. Copra meal has been of great interest as an alternative feed ingredient for pig diets [2]. Copra meal is produced by an expeller extracting dried coconut kernels to remove the coconut oil. Copra meal is a variable commodity, and the variation in the nutrient content of copra meal is fundamentally a function of differences in residual oil content [6]. It has been reported that the inclusion of copra meal up to 25% had no detrimental effects on the growth performance and pork quality compared to those of pigs fed the control diet containing 5% copra meal when supplemented with β-mannanase [7]. However, there is very little published information on replacing soybean meal with copra meal. Therefore, this study aimed to investigate the effects of sustainable pig nutrition by partially replacing soybean meal with copra meal.

1.3. Research Objective

This study aimed to investigate the effects of sustainable pig nutrition by partially replacing soybean meal with copra meal.

2. MATERIALS AND METHODS

2.1. Experimental site

The experiment was conducted in the pig house of the farm in the Swine division, Maejo University, Chiang Mai, Thailand. Three-way crossbred (Landrace × Yorkshire × Duroc) female growing pigs were used as experimental animals.

2.2. Animal management

Animal care for the experiment was approved by Animal Care and Use for Science and Technology Research Maejo University Animal Care and Use Committee (MACUC). Eighteen growing female pigs were used as experimental animals for 28 days. In a factorial design, the pig was blocked by weight and size to three treatments with 6 replicates per treatment. The growing female pigs were distributed into three dietary treatments randomly. Pigs were housed in partially slotted and solid concrete floor pens with an automatic watering nipple.

Feed and water were provided *ad libitum* during the entire experimental period of 4 weeks of growth performance. Feed was provided in a mash form in the feeder. The feeders were checked twice daily at 6 A.M. and 6 P.M. to remove and weigh the residue and ensure the feeders were not empty. Feed refuse and feed supplied are carefully weighed before feeding times. The feed was about 0.5 to 1 kg more than the pigs could eat. The feeder residue was collected into a plastic container and weighed every evening.

2.3. Diets

The calculated composition of the experimental diets is presented in Table 1. Three experimental diets containing 0% and 3% copra meal were formulated to meet National Research Council (2012) [8]. Recommendations. The diets were formulated to be isocaloric and isonitrogenic to meet the nutrient requirements of growing pigs.

Treatment 1: CON (corn-soybean meal diet, 0% Copra meal),
Treatment 2: Corn-soybean meal diet, 3% White copra meal),
Treatment 3: Corn-soybean meal diet, 3% Brown copra meal)

Table 1 Composition of dietary treatment (% on a fed basis)

Ingredients	Treatments		
	CON	WC	BC
Corn	72.20	69.90	69.90
Soybean meal	22.80	22.10	22.10
Dicalcium phosphate (DiCaP)	0.70	0.70	0.70
Calcium carbonate ($CaCO_3$)	0.70	0.70	0.70
Mineral premix[1/]	0.15	0.15	0.15
Vitamin premix[2/]	0.15	0.15	0.15
Soybean oil	3.00	3.00	3.00
Copra meal[3/]	-	3.00	3.00
Salt (NaCl)	0.30	0.30	0.30
Calculated nutrient content on an as-fed basis			
ME, Kcal/kg[4/]	3,265	3,265	3,265
Crude protein, %	16.00	16.00	16.00
Calcium, %	0.52	0.52	0.52
Phosphorus, %	0.19	0.19	0.19
Lysine, %	0.66	0.66	0.66
Methionine + cysteine, %	0.45	0.45	0.45
Threonine, %	0.52	0.52	0.52

[1/]Mineral premix were contained: Cu, 48.21 mg; Fe, 26.76 mg; K, 0.04 mg; In, 0.13; Mn, 10.71 mg; Zn, 29.46 mg; Co, 0.13 mg; Se, 0.04; BHT, 30mg. [2/]Vitamin premix were contained: vitamin A, 2,678 IU; vitamin D3, 508 IU; vitamin E, 8 mg; vitamin K3, 0.44 mg; vitamin B1, 0.20 mg; vitamin B2, 0.86 mg; pantothenic acid, 2.70 mg; nicotinic acid, 3.86 mg; vitamin B6, 0.53 mg; Folic Acid, 0.05 mg; vitamin B12, 0.01 mg; choline chloride 50%, 227 mg; Biotin, 0.02 mg. [3/]Copra meal: white copra meal and brown copra meal is a by-product from Ampol Food Processing Company Limited. [4/]ME is calculated, whereas all other values are analyzed.

2.4. Measurements

The growth performance trial lasted four weeks, during which daily feed intakes were recorded for each pig. The daily feed consumption and weekly body weight were recorded for Average Daily Feed Intake (ADFI), Average Daily Weight Gain (ADWG), and Feed Efficiency (FE) calculations.

The pigs were weighed at the beginning of the experiment and every week after that before being offered feed. Values obtained from these measurements were used to determine body weight gains. Data on daily feed intake offered and refused were also collected, and the difference was calculated to determine feed intake. The average daily gain was calculated as the difference

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between end-of-trial weight and initial weight divided by the number of days on feed. Feed efficiency was calculated by dividing the live weight gained each week by the total quantity of feed consumed in the same period. For each animal, ADFI, ADWG and FE ratios were calculated weekly using the formulas: ADFI = Total weekly feed intake/7; ADWG = Total weekly WG/7; FE = ADWG/ADFI.

2.5. Statistical analysis

The experimental data on growth performance were analyzed as a randomized complete block design with one pen as the experimental unit. Pigs were blocked based on initial weight and analysis of variance was performed using the general linear model (GLM) procedure of SAS software (2021) [9]. Differences among treatment means were determined using Duncan's New Multiple Range Test (DNMRT) at P<0.05 significant level.

3. RESULT AND DISCUSSION

3.1. Effects of dietary treatment on feed intake of pigs

Feed intakes of growing pigs fed the experimental diets are presented in Table 2. No significant differences (P>0.05) of feed intake were observed in any treatment. However, pigs fed the white copra meal diet tended to have better feed intake than brown copra meal treatment. Moreover, during week 2 and week 3 of the experimental periods, pigs fed WC (white copra meal) had the greatest feed intake among the dietary treatments.

Many investigators have presented the positive effects of coconut oil in pig diets. On the other hand, few studies have been conducted to evaluate the efficiency of different types of copra meals on the feed intake of growing pigs. The results of the present study indicated a tendency for the white copra meal to partially replace soybean meal and corn in growing pig diet to improve feed intake.

The copra meal is very palatable, making it highly desirable for inclusion in rations for pig diets. Adding flavor ingredients that combine aroma and flavor to feed may stimulate pigs to be more interested in feed [10]. In contrast, one study found that increasing dietary copra meal decreased feed intake. These authors attributed this to increased fibre in the diet, reducing intake through its effect on gut fill [11]. There may also be a palatability problem with high inclusion levels of copra meal [6].

Table 2. Effect of diet on feed intake of the experimental growing pigs (g/day)

	Treatments[1/]			SEM[2/]	Sig.[3/]
	CON	WC	BC		
wk 1	1.24	1.22	1.04	0.05	ns
wk 2	1.14	1.22	1.09	0.04	ns
wk 3	1.17	1.34	1.11	0.05	ns
wk 4	1.20	1.19	1.01	0.04	ns

[1/]: Treatment 1: CON (corn-soybean meal diet, 0% Copra meal), Treatment 2: Corn-soybean meal diet, 3% White copra meal), Treatment 3: Corn-soybean meal diet, 3% Brown copra meal); [2/]: SEM: Standard error of mean; [3/]: Probability of significance: ns, not significant, P>0.05

3.2. Effects of dietary treatment on weight gain of pigs

Effects of dietary treatment on weight gain of pigs are shown in Table 3. The results showed that weight gain was not affected by dietary treatment (P>0.05). However, the results from week 1 through week 3 of the experimental period showed a similar trend was observed for the dietary treatment in which growing pigs in white copra meal group had the highest weight gain among dietary treatments, followed by brown copra meal group and CON group.

The results of this study indicated that there were a tendency for partial replacement of corn-soybean meal in growing pig diet to improve weight gain. These findings are in concordance with previous study, there reported that copra meal 150 g CMP/kg can improved performance of pig [12]. Moreover, some previous study in pig also reported that using copra meal 200 g CPM/kg in pig diet not have negative effects in pig growth performance [6].

Table 3. Effect of diet on weight gain of the experimental growing pigs (g/day)

	Treatments[1/]			SEM[2/]	Sig.[3/]
	CON	WC	BC		
wk 1	0.75	0.98	0.57	0.07	ns
wk 2	0.62	0.65	0.77	0.03	ns
wk 3	0.56	0.77	0.49	0.05	ns
wk 4	0.54	0.47	0.46	0.04	ns

[1/]: Treatment 1: CON (corn-soybean meal diet, 0% Copra meal), Treatment 2: Corn-soybean meal diet, 3% White copra meal), Treatment 3: Corn-soybean meal diet, 3% Brown copra meal); [2/]: SEM: Standard error of mean; [3/]: Probability of significance: ns, not significant, P>0.05

3.3. Effects of dietary treatment on feed efficiency of pigs

The feed efficiency of growing pigs fed the experimental diets are presented in Table 4. The results showed that during week 2 of the experimental period, feed efficiency of growing pigs effected by dietary treatments was significant (P<0.001). At week 2 of the experimental period, pigs in brown copra meal group had the greatest feed efficiency. However, during week 1 and week 3 of the trial pigs consuming the white copra meal diet had the greatest feed efficiency, but the effect was not significant (P>0.05).

Thorne et al. [11] reported that poor growth performances of pigs fed high levels of copra meal have been associated with reduced voluntary feed intake, and finally decreased feed efficiency and performance. In agreement with this, careful consideration must be given to inclusion of copra meal in pig diets. The inclusion of copra meal at 200 g/kg as a replacement for barley lowers pig performance and should be avoided [6].

Table 4 Effect of diet on feed efficiency of the experimental growing pigs (g feed/g)

	Treatments[1/]			SEM[2/]	Sig.[3/]
	CON	WC	BC		
wk 1	0.59	0.82	0.57	0.06	ns
wk 2	0.55^{b}	0.54^{b}	0.71^{a}	0.01	***
wk 3	0.49	0.58	0.43	0.04	ns
wk 4	0.49	0.40	0.44	0.04	ns

[1/]: Treatment 1: CON (corn-soybean meal diet, 0% Copra meal), Treatment 2: Corn-soybean meal diet, 3% White copra meal), Treatment 3: Corn-soybean meal diet, 3% Brown copra meal); [2/]: SEM: Standard error of mean; [3/]: Probability of significance: ns, not significant, P>0.05; ***: P<0.001

4. CONCLUSION

In conclusion, the results of the present study demonstrated that the copra meal inclusion up to 3% in the diet of growing pigs did not negatively affect feed intake, weight gain and feed efficiency of growing pigs. Pigs consumed white copra meal diet had better feed intake, weight gain and feed efficiency at week 1 through week 3 than CON diet. However, Brown copra meal showed tendency to improve feed efficiency of growing pigs at week 2. Therefore, it can be concluded that sustainability pig nutrition with copra meal may be used as an alternative for partial soybean meal in growing pig diets without any negative effects on pig performance.

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REFERENCE

[1] X. Ma, Q. Shang, J. Hu, H. Liu, C. Brøkner and X. Piao, 2019. Effects of replacing soybean meal, soy protein concentrate, fermented soybean meal or fish meal with enzyme-treated soybean meal on growth performance, nutrient digestibility, antioxidant capacity, immunity and intestinal morphology in weaned pigs, Livestock Science. 225, 39-46.

[2] J.C. Jang, D.H. Kim, J. S. Hong, Y.D. Jang and Y.Y. Kim, 2020. Effects of copra meal inclusion level in growing-finishing pig diets containing β-mannanase on growth performance, apparent total tract digestibility, blood urea nitrogen concentrations and pork quality, 2020. Animals. 10, 1-11.

[3] T. A. Woyengo, E. Beltranena and R.T. Zijlstra, 2014. Nonruminant nutrition symposium: Controlling feed cost by including alternative ingredients into pig diets: A review. Journal of Animal Science. 92(4), 1293-1305.

[4] R.T. Zijlstra and E. Beltranena, 2013. Swine convert co-products from food and biofuel industries into animal protein for food, Anim. Front. 3(2), 48-53.

[5] E. Beltranena, 2022. Reducing feed cost in grow-finish: alternative feedstuffs and production strategies. Adv. Pork Prod. Proc. Banff Pork Seminar. 33: 95-105.

[6] J.V. O'Doherty, M.P. McKeon, 2000. The use of expeller copra meal in grower and finisher pig diets, Livestock Production and Science. 67, 55-65.

[7] H.J. Kim, S.O Nam, J.H. Jeong, L.H. Fang, H.B. Yoo, S.H. Yoo, J.S. Hong, S.W. Son, S.H. Ha and Y.Y. Kim, 2017. Various levels of copra meal supplementation with β-Mannanase on growth performance, blood profile, nutrient digestibility, pork quality and economical analysis in growing-finishing pigs. J. Anim. Sci. Technol., 59, 19.

[8] NRC. 2012. Nutrient requirement of swine. 11th edition. National Academy Press. Washington, DC.

[9] SAS. 2021. Statistical Analysis System: SAS User's Guide: Statistics. SAS Institute Inc. Cary., NC. U.S.A.

[10] R. Assawarachan, 2016. Effects of Temperature and Layer Thicknesses on Drying Kinetics of Coconut Residue. Thai Society of Agricultural Engineering Journal, 22(1).

[11] P.J Thorne, J. Wiseman, D.J.A. Cole and D.H. Machin. 1992. Effects of level of inclusion of copra meal in balanced diets supplemented with synthetic amino acids on growth and fat deposition and composition in growing pigs fed ad libitum at a constant temperature of 25 ^{O}C., Animal feed science and technology, 40(1), 31-40.

[12] S.S. Diarra, Effects of enzyme products in the diet on growth, dressing-out percent and organ weights of light pigs fed copra-meal-based diets, Anim. Prod. Sci. 57, 683-689.

 https://doi.org/10.29165/ajarcde.v7i2.276