EFFECTS OF COCONUT CAKE SUPPLEMENT IN DIETS ON FEED UTILIZATION, NUTRIENT DIGESTIBILITY, GROWTH PERFORMANCE AND ECONOMIC RETURN OF CROSSBRED RABBITS

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Effects of Coconut Cake Supplement in Diets on Feed Utilization, Nutrient Digestibility, Growth Performance and Economic Return of Crossbred Rabbits

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ABSTRACT

A study was conducted at the experimental farm and laboratory of Cantho University to evaluate feed utilization, nutrient digestibility and growth performance of crossbred rabbits. Sixty crossbred rabbits at 8 weeks of age were allotted in a completely randomized design with 5 treatments that were 5 supplement levels of 10, 20, 30, 40 and 50g coconut cake (COC) per rabbit per day corresponding to the COC10, COC20, COC30, COC40 and COC50 treatments, respectively. Three replications and 4 rabbits (balanced sex) per experimental unit were used. The results show that the DM intake was significantly higher for the rabbits supplemented 30g COC ($P>0.05$). The intakes of CP, EE and ME were higher for the animals fed 30, 40 and 50 g COC ($P<0.05$). The digestibility coefficients of DM, OM, CP, EE and NDF were significantly higher in the 30COC treatment ($P<0.05$). Nitrogen intake and nitrogen retention increased corresponding with increasing COC supplementation in the diets ($P<0.05$). The daily weight gain was significantly higher for rabbits given 30g COC per animal per day ($P<0.05$). The final live weight, the carcasses, thigh meat and lean meat weights were significantly higher for rabbits fed 30g and 40g COC per day ($P<0.05$). In conclusion, the crossbred rabbits supplemented coconut cake in the diets had significantly increased the OM, CP, EE and ME intakes. At the supplementation level of 30g COC per animal per day had higher growth rate, meat production and better profit.

Key Words: Crossbred Rabbit, Coconut Cake, Nutrient Digestibility, Growth Rate, Carcass Weight

INTRODUCTION

Organic rabbit farming based on green forages is an opportunity for the poor farmers for producing to erase starvation and to evaluate poverty in villages of Vietnam. However, the rabbits fed mainly forages in diets to provide protein and fiber, often gave low performance as compared to those fed the concentrate/pellet feed in the industries (Nguyen & Nguyen 2008). Therefore to improve growth performance of rabbits, supplementation of protein and energy feeds is very important to make balanced nutrient diet. Coconut cake contains 21.3% CP and 11 MJ ME/kgDM, is popular and cheap ingredient, used as a source of protein and energy supplement for growing rabbits (Nguyen Le Thu Hang 2012). Besides, water spinach leaves and *Limnophila aromatic*, vegetable residues of human beings, with high protein content (29.5% CP and 18.8% CP, respectively) could be associated with para grass in basal diet to diversity for rabbit feeding. However, the understanding of this scientific area for rabbit performance is still limited. Therefore, a study of growing rabbit performance offered green forages with different supplementation of coconut cake was investigated for improving live weight, rabbit production and increasing producers' income.

MATERIALS AND METHODS

Experiment 1. Feeding trial

Animals and experimental design

The experiment was conducted in experimental farm in Cantho city. Sixty crossbred rabbits (Local × New Zealand breeds) at 9 weeks of age with live weight average of 1040±45 g were arranged in a completely randomized design with 5 treatments, 3 replicates and four rabbits in each experimental unit. The treatments consisted of

5 different supplements of 10, 20, 30, 40 and 50 g coconut to basal diet. The feeding trial lasted for 8 weeks.

Feeds, feeding and management

Para grass, *Limnophila aromatic,* water spinach leaves, soya waste were collected and bought daily in the city, except for coconut cake bought one occasion for throughout the trial. The animals were fed three times a day at 8:00, 15:00 and 19:00h. Fresh water was available for all rabbits almost all day and night. The feed refusals and spillage were collected and weighed daily in the morning to calculate the feed intake. The animals were vaccinated to prevent some diseases, especially rabbit hemorrhagic, parasite and other common diseases.

Measurements

The feeds and refusals were taken for analyses of DM, OM, CP, EE, NDF and Ash following procedure of AOAC (1990) and van Soest et al. (1991). Daily feed intakes, growth rate, feed conversion ratios, and carcass values were measured. The economic analysis was also done among the treatments.

Experiment 2: Digestibility trial

Animals and experimental design

The second experimental design was similar to that of the feeding trial, however, 12-weeks old rabbits were used. The animals had two weeks for adaptation and another week for getting samples by fecal collection for 7 days. Feeds given and refusals were daily measured. Urine was also collected for nitrogen analysis to calculate the nitrogen retention. DM, CP, EE and NDF digestibility were employed according to McDonald et al. (2002).

Statistical analysis

The data from both experiments were analyzed by analysis of variance using the ANOVA of General Linear Model of Minitab Reference Manual Release 16.1.0 (Minitab 2010). Economic analyses were done using current prices in Vietnamese Dong (VND) to compare differences of income and the feed cost among treatments.

RESULTS AND DISCUSSION

Expriment 1: Feeding trial

Feed characteristics

Chemical composition of feed ingredients of rabbit is presented in Table 1.

The coconut cake had high CP and ME contents, is a good energy feed supplement to green forage basal diet to make balanced nutrients for growing rabbits. The coconut cake consisted of 20.3% CP and 11 MJ ME/kg (Thanh 2011) (Table 1). The CP content of *Limnophila aromatic* used in this experiment was higher than the para grass, but lower than the CP content of para grass and water spinach leaves. *Limnophila aromatic* is a new forage source in Vietnam, used to diversify for rabbit feeding.

Table 1: Chemical composition of feed ingredients (% in DM, except for DM which is on fresh basis)

Feed	DM	OM	CP	EE	NDF	Ash	ME, MJ/kg DM
Coconut cake	89.50	95.70	19.20	7.71	64.20	4.35	11.00
Para grass	16.70	89.70	12.40	5.70	67.60	10.30	9.49
Limnophila aromatic	7.65	84.10	18.80	5.57	61.50	15.90	10.50
Water spinach leaves	13.10	89.00	26.30	9.09	27.10	11.00	12.00
Soya waste	11.50	94.50	21.50	7.83	33.90	5.51	11.00

DM: dry matter; OM: organic matter; CP: crude protein; EE: ether extract; NDF: neutral detergent fiber; ME: metabolisable energy
Source: Maertens et al. 2002

Feed and nutrient intakes in the Experiment 1

Daily intakes of feed and nutrients are shown in Table 2.

Daily intakes of coconut (COC) linearly increased (P<0.05) corresponding with increasing COC levels in the diets, while para grass (PG) significantly decreased (P<0.05). DM and NDF intakes were significantly higher (P<0.05) in the COC30 treatment as compared to COC10. However, daily intakes of OM, CP, EE and ME were significantly higher for animals supplemented from 30 to 50g COC per rabbit (P<0.05), possibly due to high CP and ME concentrations in COC. The DM intakes in present study are in agreement with the values of 65-75.5g DM of the previous study in which the rabbits fed water spinach basal diets (Samkol et al. 2006). The findings of CP and ME intakes in current study were in a range of 13.6- 15.4g CP and 0.65 to 0.74 MJ ME/day as stated by Nguyen Le Thu Hang (2012), however, the crude protein intakes were higher than those (8.79-11.3 g CP/day) reported by Phimmasan et al. (2004).

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Growth rate, feed conversion ratio and economic analysis in Experiment 1

The significantly higher (P<0.05) daily weight gain and final live weight were found for rabbits supplemented with 30 g COC per day as compared to other treatments (Table 3).

Table 2: Daily intakes of coconut (COC) feed and nutrients of growing rabbits (g/rabbit/day)

Item	COC10	COC20	COC30	COC40	COC50	SE/P
COC (DM)	9.00^{a}	17.90^{b}	23.60^{c}	23.00^{c}	26.70^{c}	0.830/0.001
Para grass	39.20^{a}	31.60^{ab}	32.10^{ab}	25.40^{bc}	18.20^{c}	2.260/0.001
Limnophila aromatic	10.60	10.40	10.30	10.60	10.10	1.630/1.00
DM	62.50^{a}	67.40^{ab}	73.40^{b}	69.80^{ab}	69.50^{ab}	1.680/0.012
OM	56.90^{a}	61.80^{ab}	67.50^{b}	64.20^{b}	64.20^{b}	1.470/0.005
CP	12.00^{a}	13.30^{ab}	14.40^{b}	13.90^{b}	14.10^{b}	0.320/0.003
EE	4.54^{a}	4.99^{ab}	5.45^{b}	5.24^{b}	5.29^{b}	0.110/0.001
NDF	31.00^{a}	34.00^{ab}	37.80^{b}	35.30^{ab}	35.10^{ab}	1.010/0.009
Ash	5.67	5.63	5.91	5.58	5.31	0.210/0.423
ME, MJ/kg DM	0.67^{a}	0.73^{ab}	0.80^{b}	0.76^{b}	0.76^{b}	0.020/0.006

Means with different letters within the same rows are significantly different at the 5% level

Table 3. Live weight, daily gain (g/rabbit) and economic returns (VND/rabbit) of growing rabbits in the Exp. 1

Item	COC10	COC20	COC30	COC40	COC50	SE/P
Initial weight, g	1015.00	1072.00	1056.00	1092.00	1078.00	22.90/0.23
Final live weight, g	2058.00^{a}	2183.00^{a}	2222.00^{b}	2204.00^{b}	2141.00^{a}	32.40/0.03
Daily weight gain, g	18.60^{a}	19.80^{a}	20.80^{b}	19.80^{a}	19.00^{a}	0.35/0.01
FCR	3.35	3.40	3.53	3.51	3.66	0.09/0.17
Total expense	95,627	98,827	101,027	104,227	107,427	
Total income	144,060	152,810	155,540	154,280	149,870	
Profit	48,433	53,983	54,513	50,053	42,443	

Means with different letters within the same rows are significantly different at the 5% level

The daily gains of rabbits in this study were also within the ranges (14.4 to 20.3g/day) as reported by Samkol et al. (2006), but being higher than the results of Nakkitset (2007) (15.9 to 19.4g/day). The final live weights are consistent with those of 2082-2171g (Tung 2012). Feed conversion ratio was resemble among the treatments (P>0.05), and being better than those of 4.5 to 5.5 reported by Phiny & Kaensombath (2006). The effects of intakes of DM (g/day) and ME (MJ/day) on daily weight gain of growing rabbits were presented in regression equations Y1 = 0.011 x^2 + 1.33x + 58.2, with regression coefficient R^2 = 0.74 and Y2 = 81.2x^2 + 105x + 52.4, with regression coefficient R^2 = 0.69, respectively.

The economic analysis was done and showed that the lower total expense was in the COC treatment and higher income was in the COC30 diet, resulting in more profits for animals offered 30 g COC (COC30 diet).

Mean values of slaughter weights, carcass traits and internal organs of growing rabbits

The results of carcass, lean meat and thigh meat weights were significantly higher for the COC30 and COC40 treatments (P<0.05) (Table 4). The results in this study are higher than those in a previous study, *i.e.*, 41.6 to 47.1% (Elamin et al. 2012).

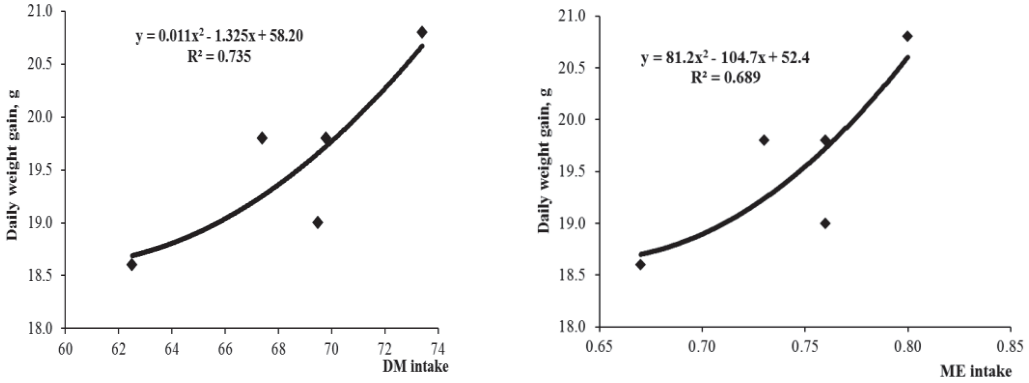

Figure 1. Relationship between DM and ME intakes and DG of growing rabbits

Table 4. Mean values of slaughter weights, carcass traits and internal organs of growing rabbits

Item	Treatment					SE/P
	COC10	COC20	COC30	COC40	COC50	
Live weight, g	2110.0^{a}	2203.0^{ab}	2253.0^{b}	2223.0^{b}	2171.0^{ab}	23.800/0.015
Carcass weight, g	1072.0^{a}	1131.0^{ab}	1183.0^{b}	1151.0^{ab}	1109.0^{ab}	20.600/0.032
% Carcass	50.8	51.3	52.5	51.8	51.1	0.620/0.411
Lean meat weight, g	813.0^{a}	856.0^{ab}	895.0^{b}	872.0^{ab}	837.0^{ab}	15.700/0.034
% Lean meat	75.8	75.5	75.7	75.6	75.5	0.480/0.993
Thigh meat weight, g	319.0^{a}	335.0^{ab}	353.0^{b}	347.0^{b}	338.0^{ab}	5.550/0.013
% Thigh meat	29.7	29.6	29.9	30.1	30.5	0.540/0.791
StomachW./Live W.	5.72	5.69	5.59	5.77	5.90	0.150/0.666
Caecum length, cm	60.8	60.4	58.6	61.4	59.8	0.720/0.154
Caecum weight, g	143	152	149	151	148	5.350/0.480

Means with different letters within the same rows are significantly different at the 5% level

Experiment 2: Digestibility trial

Daily intakes of feed and nutrients of growing rabbits in digestibility

Daily intakes (Table 5) of DM and most of nutrients such as CP, EE, NDF and ME of the rabbits were slightly lower than those obtained in the feeding trial, these may be due to data recorded was only performed in one week of the digestibility experiment.

Apparent digestibility of dietary nutrients, nitrogen retention of growing rabbits

The apparent digestibility coefficients of DM and CP were significantly higher (P<0.05) in the COC30 diet as compared to the COC10. Also, EE and NDF digestibility values were higher (P<0.05) for the animals offered 30 g and 40 g COC per day, possibly due to higher NDF intake in these diets (Table 7). Our results are in agreement with, but higher than the findings of the DM and CP digestibility (69.6 to 75.7% and 64.4 to 74.8%, respectively) reported by Nguyen & Nguyen (2010).

The results indicated that the nitrogen intake and nitrogen retention increased with increasing levels of COC supplement in the diets from 30 to 50 g per day (P<0.05), this probable explanation is higher CP intakes in these dietary treatments. There was linearly regression between N intake and N retention of growing rabbits with $R^2 = 0.97$ (Figure 2).

Table 5. Daily intakes of feed and nutrients of growing rabbits in digestibility exp 2 (g DM/rabbit)

Nutrients	COC10	COC20	COC30	COC40	COC50	SE/P
DM	48.40^{a}	56.90^{ab}	66.70^{b}	64.00^{ab}	61.10^{ab}	3.68/0.040
OM	44.20^{a}	52.40^{ab}	61.50^{b}	59.80^{b}	57.40^{ab}	3.26/0.023
CP	9.97^{a}	11.20^{ab}	14.30^{c}	13.70^{bc}	14.00^{c}	0.59/0.001
EE	3.73^{a}	4.40^{ab}	5.13^{bc}	5.33^{bc}	5.50^{c}	0.21/0.001
NDF	21.40^{a}	26.00^{ab}	31.70^{b}	30.30^{b}	28.90^{ab}	1.82/0.018
Ash	4.20^{ab}	4.57^{ab}	5.20^{a}	4.27^{ab}	3.67^{b}	0.42/0.202
ME* (MJ/kg DM)	0.53^{a}	0.63^{ab}	0.73^{b}	0.73^{b}	0.71^{b}	0.04/0.016

Means with different letters within the same rows are significantly different at the 5% level

Table 6. Apparent digestibility (%) of dietary nutrients and nitrogen retention of growing rabbits

Item	COC10	COC20	COC30	COC40	COC50	SE/P
Apparent digestibility (%)						
DM	65.4^{a}	72.5^{ab}	76.8^{b}	74.6^{ab}	69.8^{ab}	2.11/0.03
OM	65.8^{a}	73.3^{ab}	77.3^{b}	75.8^{b}	71.3^{ab}	2.00/0.02
CP	80.5^{a}	82.9^{ab}	85.4^{b}	85.0^{ab}	82.9^{ab}	1.06/0.05
EE	74.2^{a}	79.8^{ab}	82.9^{b}	82.6^{b}	81.0^{ab}	1.72/0.03
NDF	45.1^{a}	57.2^{ab}	63.8^{b}	61.3^{b}	52.4^{ab}	3.26/0.02
N balance (g/kg $W^{0,75}$)						
N intake	1.13^{a}	1.29^{ab}	1.57^{c}	1.42^{bc}	1.52^{bc}	0.060/0.002
N retention	0.78^{a}	0.92^{ab}	1.26^{c}	1.13^{bc}	1.16^{bc}	0.060/0.001

Means with different letters within the same rows are significantly different at the 5% level

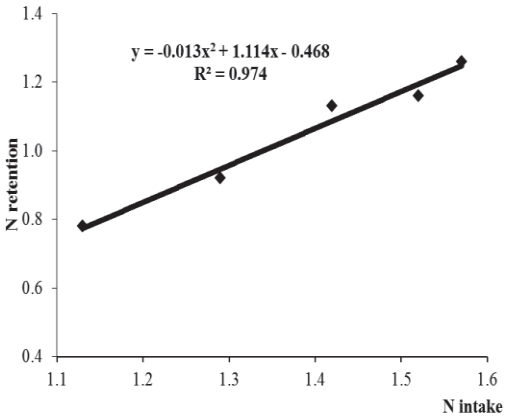

Figure 2. Relationship between N intake and N retention of growing rabbits

CONCLUSION

Supplementation of coconut cake 30 to 40 g/rabbit/day to the diets enhanced dry matter and nutrient intakes, and nutrient digestibility of the diet. At level of 30 g coconut supplementation gave higher growth rate and carcass traits and gave better benefits for rabbit production.

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FEED INGREDIENTS

Para grass

Coconut cake

Limnophilia aromatica

Soya waste

Water spinach leaves

Rabbits in Exp.