Effects of Different Supplement of Catfish (*Pangasius hypophthalmus*) Oil in Para Grass Basal Diets on Feed Utilization, Nutrient Digestibility, Growth Rate and Meat Production of Crossbred Rabbits

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ABSTRACT

An experiment was carried out in the experimental farm and laboratory of Can Tho University to evaluate feed utilization, nutrient digestibility, growth performance of Crossbred rabbits supplemented by catfish oil. It was a completely randomized design with 5 treatments that were 5 supplement levels of 0, 5, 7, 9, and 11 g catfish oil per rabbit per day, three replications and 4 rabbits (balanced sex) per experimental unit. The results show that the intakes of DM, CP and NDF were similar among the treatments (P>0.05), however the EE and ME intakes significantly increased when increasing supplement levels of catfish oil in the diets and the highest values in the CFO9 and CFO11 treatments (P<0.05).The digestibility coefficients of DM, OM, CP and NDF were similar among the treatments (P>0.05), except for the EE digestibility that was clearly improved when supplementing catfish oil in the diets and the significantly highest (91.9%) (P<0.05) was found in the CFO9 treatment. The daily weight gain and final live weight were significantly higher for rabbits supplemented 9g CFO per animal per day (P<0.05). The significantly higher weight of carcasses, thigh meat and lean meat were for the rabbits given 9g CFO per day (P<0.05). It was concluded the Crossbred rabbits supplemented CFO in the diets enhanced the EE and ME intakes, and at level of 9g CFO per animal per day had better growth performance and gave higher benefit.

Key Words: Crossbred Rabbit, Catfish Oil, Nutrient Digestibility, Growth Performance

INTRODUCTION

Rabbit meat has been also considered as good meat for high protein of 21.3%, low fat content of 6.80% and low cholesterol of 45mg/kg (Owen 1992). In the Mekong delta of Vietnam, local and crossbred rabbits have been more popular due to high resistance to diseases, their feeding mainly based on natural grasses and agro-industrial by products (Dong & Thu 2009) so the cost for rabbit production is lower than the other animal species ones. Within these feeding strategies, green forages are used as the main protein and fiber sources, while for the improved performance of growing and reproductive rabbits, sources of energy feed supplementation are very important (Leng 2008).

In particular determining the optimal level of energy-supplied for growing rabbits makes the better rabbit production and gives the income for the rabbit keepers (Ren et al. 2003). In the Mekong delta, there is a large water surface area of the Tien and Hau rivers which are suitable for catfish cultivation. A number of large factories produce frozen white cobbler filet for export, and as a result there are large quantities of by-products available, the belly is pressed to give raw fish oil, which mainly consists of the fatty acids and has an energy content of 37.6 MJ/kg (Men 2003). Catfish oil has high nutrient value, due to primarily to its long-chain, polyunsaturated, omega-3 fatty acids that are valuable energy feed sources for livestock, especially fattening rabbits. Therefore the aim of this study was to determine optimum level of catfish oil supplement to para grass basal diets on growth performance of crossbred rabbits.

MATERIALS AND METHODS

Animals and experimental design

The study was carried out at the experimental farm in Cantho city from January

in 2012 to May in 2012. Sixty crossbred rabbits (local × improved breeds) at 6 weeks of age with average initial weight from 457-491g, were arranged in a completely randomized design of a feeding trial with 5 treatments and 3 replications. Four rabbits with balance of sex were in a experimental unit. The treatments were catfish oil (CFO) supplementation to the para grass (PG) basal diet at levels of 0 (CFO0), 5 (CFO5), 7 (CFO7), 9 (CFO9) and 11g (CFO11) catfish oil/ day/one. Soya waste was offered at the level of 200g/day/animal and coconut cake was fed with the amount of 10g/day/animal for all experimental units. The feeding experimental period lasted 9 weeks.

In the digestibility trial, the experimental design was similar to that of the feeding trial, however, the 9-weeks old 30 rabbits with live weight around 1100g were used. The animals had two week for adaptation and another week for getting samples according to by fecal collection for 6 days. Feeds 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 McDonald et al. (2002).

Feeds, feeding and management

Para grass was daily collected in the areas surrounding animal farm and soya waste was bought daily from soybean milk factory in the city. Catfish oil was bought in an occasion from catfish proccesing factory for using throughout the trials. The animals were fed three times a day at 7:30h, 14:00h and 18:00h. Fresh water was available for all rabbits almost all day and night time. The 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 and parasite diseases.

Measurements

The measurement taken were feed and nutrient intakes of dry matter (DM), organic matter (OM), ash, neutral detergent fiber (NDF), daily weight gain, feed conversion ratio, carcass values, economic returns, nutrient digestibility and nitrogen retention (McDonald et al. 2002).

The feeds and refusals were taken for analyses of DM, OM, CP, EE, CF, NDF and Ash following procedure of AOAC (1990) and Van Soest et al. (1991).

Statistical analysis

The data were analyzed using the General Linear Model (GLM) option in the ANOVA program of the Minitab (Version 16) software (Minitab 2010). The comparison of significant difference between two treatments was done by Tukey method of Minitab program (2010).

RESULTS AND DISCUSSION

Exp 1. Feeding trial

Feed characteristics

Feed chemical composition was shown in Table 1.

Table 1. Chemical composition of feed ingredients (%) in experiment

Feed	DM	OM	CP	EE	NDF	Ash	ME MJ/kg
Para grass	18.00	89.50	11.60	4.70	69.50	10.50	9.45
Catfish oil	94.00	99.50	-	99.00	-	0.50	27.80
Water spinach leaves	13.30	89.40	27.50	7.64	35.20	10.60	12.00
Soya waste	10.00	94.70	20.20	10.20	39.60	5.30	11.00
Coconut cake	89.40	95.70	19.60	8.18	62.20	4.28	11.00

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

Para grass (PG) was low in CP, but high in NDF and used for providing fiber component in the diets. Soya waste (SW) and coconut cake had high CP contents that were used as protein supplemental source in diets. Metabolizable energy of catfish oil (CFO) was higher than those of the other feeds and used for energy supplementation in the dietary treatments. The results of DM and CP of PG in this study are consistent with those indicated by Dong & Thu (2012a). The catfish oil used in a current study had similar ME content with the value stated by Thoai (2012).

Feed and nutrient intakes

The catfish oil (CFO) intake significantly increased from the CFO5 to CFO11 (P<0.001), and the highest values in the CFO9 CFO11 treatments. The total DM and CP intakes were similar among the treatments (P>0.05), while the EE and ME intakes linearly increased when rising levels of catfish oil supplement in the diets (P<0.05) (Table 2). The DM intake in a current trial was in a range of 56.8 to 61.8 g /day, stated by Nguyen Thi Kim Dong & Nguyen Van Thu (2012). The results are consisted with findings of a study in which the ME intake linearly increased with increasing graded levels of fresh sweet potato tuber supplement Dong & Thu (2013), but being higher than those (0.50-0.61ME MJ/rabbit/day) in a previous study of rabbits fed water hyacinth raplacing para grass in the diets (Nguyen Thu & Dong 2010).

Daily gain (DG), feed conversion ratio (FCR) and economic returns

Table 3 showed that the daily weight gain (DWG) and final live weight (FLW) of rabbits were improved when supplementing CFO in the diets, and the CFO9 treatment had the higher values (22.6 and 2079 g, respectively) (P<0.05). The results of DWG were consisted with those stated by Thanh (2011) in previous study on growing rabbits provided dried sweet potato and coconut cake (DWG being from 18,3-21,7 g/day and Dong & Thu (2012a) in study of rabbits fed different ratios of *Centrocenma* and para grass (18.4-21.2g). The feed conversion ratio ranged in 2.78-2.96 among the treatments (P>0.05), being similar to the values of 2.96-3.09 reported by Dong and Thu (2012a). The economic returns were similar to the pattern of the final live weight, with the highest profit for the animals supplemented 9 g CFO per day in the CFO9 treament. There were the linear relationship between EE and ME intakes and daily weight gain with R^2 = 0.75 and R^2 = 0.78, that were presented in following Figure 1.

Table 2. Daily intakes of feeds (gDM/animal) and nutrients (g/animal) of rabbits in the feeding trial

Item	Treatment					SE/P
	CFO0	CFO5	CFO7	CFO9	CFO11	
Para grass (DM)	22.600	20.300	20.100	20.600	19.800	0.720/1.000
Catfish oil (DM)	-	3.920^{a}	5.170^{b}	6.690^{c}	7.260^{c}	0.260/0.001
Total DM	57.500	60.400	61.100	62.700	61.500	2.670/0.720
OM	52.600	55.500	56.300	57.900	56.800	2.420/0.630
CP	11.000	10.800	10.700	10.700	10.400	0.420/0.910
EE	4.140^{a}	7.920^{b}	9.120^{bc}	10.600^{cd}	11.000^{d}	0.370/0.001
Ash	4.890	4.840	4.820	4.840	4.720	0.560/0.990
NDF	30.300	29.700	29.500	29.600	28.700	1.470/0.960
ME (MJ/animal)	0.620^{a}	0.717^{ab}	0.747^{ab}	0.787^{b}	0.787^{b}	0.030/0.020

CFO0: basal diet; CFO5; CFO7; CFO9; and CFO11: CFO supplementation at levels of 0.5, 7.9, and 11g, respectively. Means with different letters within the same rows are significantly different at the 5% level

Table 3. Daily gain (DG), feed conversion ratio (FCR) and economic returns of growing rabbits

Item	Treatment					SE/P
	CFO0	CFO5	CFO7	CFO9	CFO11	
Initial weight (g)	457.000	472.000	491.000	496.000	474.000	15.82/0.443
Final live weight (g)	1,829.000[a]	1,913.000[ab]	1,986.000[ab]	2,079.000[b]	1,958.000[ab]	48.42/0.045
Daily weight gain (g)	19.600[a]	20.570[ab]	21.330[ab]	22.600[b]	21.230[ab]	0.56/0.038
FCR	2.960	2.940	2.870	2.780	2.900	0.19/0.966
Feed cost (VND)	12.664	17.744	20.522	22.412	24.724	
Total cost (VND)	74.664	79.744	82.522	84.412	86.724	
Total income (VND)	118.885	124.345	129.133	135.135	127.292	
Profit (VND)	44.221	44.601	46.611	50.723	40.568	

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

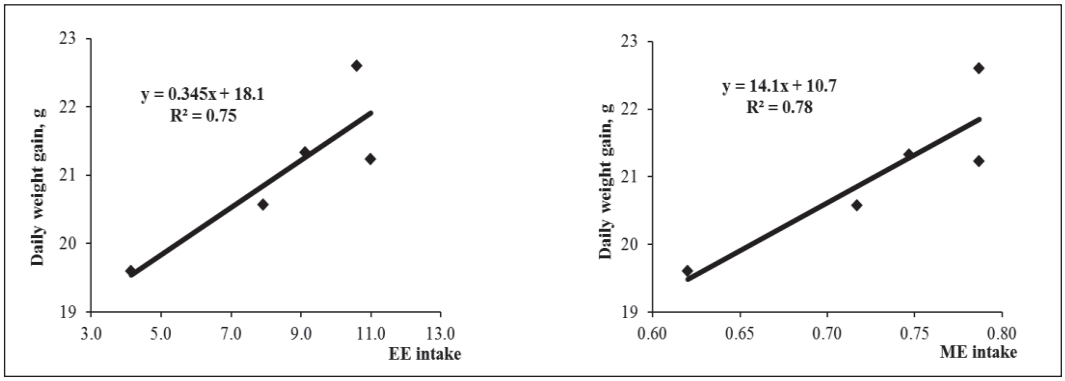

Figure 1. Effect of EE and ME intakes on DWG of rabbits

Mean values of slaughter weights and carcass traits of growing rabbits

The results of carcass, lean meat and thigh meat weights were significantly higher (P<0.05) for the animals offered 9g CFO per day (CFO9) (Table 4). The results in our study are in agreement with those in a trial of Crossbred rabbits supplemented dried cassava chips in diets that the carcass weight (852-1143g), lean meat weight (630-881g), thigh weight (242-333g) of growing rabbits supplemented dry cassava chips (Dong & Thu 2012b). The percentage of carcasses in our study are slightly higher than the findings of 43.5 to 48.5% reported by Elamin et al. (2012). The contents of crude protein and ether extract of rabbit meat in the present experiment were from 19.9 to 20.5% and from 4.17 to 4.51%, respectively. These values could be compared to 21% and 8%, respectively, found by Lebas et al. (1986). The differences could be caused by different breeds and nutrition.

Exp 2. Digestibility trial

The results of the digestibility trial were shown in table 5 and 6. The intakes of DM and CP, EE and ME in this digestibility trial had the same tendency with the feeding one. The results of DM intake were higher, but lower CP intake than the report of (Hiep & Man 2008) in which rabbits fed guinea grass basal diets with Kudzu leaves replacing soybean residues (17.8-20.5 g CP/rabbit/day).

Daily intakes of feeds and nutrients of rabbits in the digestibility trial

Apparent nutrient digestibility (%) and nitrogen retention (g/kg $W^{0.75}$) of rabbits were

showed in Table 6. The digestibility of DM, OM, CP and NDF tended increase with supplementing CFO in the diets (P>0.05), however EE digestibility was significantly higher for the rabbits provided 9 g CFO per day (CFO9) (P<0.05). The results indicate that supplementation energy feed from CFO in the diets could improve nutrient digestibility resulting in better growth performance of rabbits. The digestibility values of DM and OM in present study are in agreement with, but CP and NDF values are higher than the findings in the trial of rabbits fed different ratios of *Centrocema pubescens* and Para grass in basal diet (DMD: 66.6-72.7%, OMD: 66.7-72.9%, CPD: 81.2-84.6% and NDFD: 48.4-55.4%, respectively) (Dong & Thu (2012a). Howerver, the results of some nutrient digestibility were higher than reports by Cuong et al. (2008) 57.8-81.0% CPD and 33.1-78.8% NDFD, respectively). The results of CP apparent digestibility in the present experiment was better than the data found (74.9-77.9%), reported by El-Tahan (2012).

Nitrogen intake and nitrogen retention were closed (P>0.05) among the dietary treatments. It seemed to be graded supplement levels of CFO in the diets being not influence nitrogen retention.

Table 4. Mean values of slaughter weights, carcass traits and meat quality of rabbits

Item	Treatment					SE/P
	CFO0	CFO5	CFO7	CFO9	CFO11	
Live weight (g)	1,845.00^{a}	1,918.00^{a}	2,005.00^{ab}	2,115.00^{b}	1,987.00^{ab}	40.8/0.004
Carcass weight (g)	937.00^{a}	991.00^{a}	1,039.00^{ab}	1,106.00^{b}	1,046.00^{ab}	27.6/0.015
Carcass (%)	50.80	51.70	51.80	52.30	51.10	0.77/0.671
Lean meat weight (g)	703.00^{a}	753.00	794.00^{ab}	853.00^{b}	800.00^{ab}	23.1/0.010
% Lean meat	75.00	76.00	76.40	77.10	76.40	0.66/0.332
Thigh meat weight (g)	277.00^{a}	301.00^{b}	314.00^{b}	353.00^{c}	325.00^{bc}	6.16/0.001
% Thigh meat	29.70	30.40	30.30	32.00	31.10	0.96/0.501
Stomach W/Live W	5.60	5.83	5.65	5.59	5.90	0.18/0.655
Caecum length (cm)	60.70	59.80	58.20	60.90	60.20	0.87/0.267
Caecum weight (g)	146.00	139.00	146.00	149.00	147.00	5.35/0.480
Nutrient composition (%) of rabbit meat (fresh matter)						
Dry matter	26.60	25.90	26.10	26.20	26.60	0.25/0.252
Organic matter	97.80	97.30	98.00	97.60	97.80	0.54/0.913
Crude protein	19.90	20.20	20.50	20.10	20.00	0.40/0.845
Ether extract	4.17	4.23	4.44	4.41	4.51	0.11/0.224

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

Table 5. Daily intakes of feeds (gDM/animal) and nutrients (g/animal) of rabbits in digestibility experiment

Item	Treatment					SE/P
	CFO0	CFO5	CFO7	CFO9	CFO11	
DM	52.30	53.90	54.50	57.00	55.00	2.16/0.66
OM	48.30	50.10	50.70	53.10	51.00	2.02/0.59
CP	10.30	9.80	9.60	9.83	9.13	0.54/0.68
EE	3.83^{a}	8.87^{ab}	10.10^{ab}	12.30^{b}	11.60^{b}	1.53/0.02
Ash	4.03	3.77	3.83	3.83	3.93	0.15/0.75
NDF	24.10	22.40	22.60	22.90	22.90	0.85/0.66
ME (MJ/rabbit)	0.64	0.76	0.79	0.85	0.82	0.10/0.62

Table 6. Apparent nutrient digestibility (%) and nitrogen retention (g/kg $W^{0.75}$) of rabbits

Item	Treatment					SE/P
	CFO0	CFO5	CFO7	CFO9	CFO11	
Apparent nutrient digestibility (%)						
DMD	69.80	70.70	72.80	73.80	72.30	1.45/0.36
OMD	69.90	70.90	72.90	73.90	72.40	1.45/0.36
CPD	81.20	82.40	83.90	84.60	84.30	0.90/0.11
EED	85.60[a]	88.20[ab]	90.20[bc]	91.90[c]	88.40[ab]	0.66/0.001
NDFD	57.60	58.30	63.10	65.70	65.70	4.19/0.51
Nitrogen balance (g/kgW0.75)						
N intake	1.38	1.29	1.30	1.28	1.25	0.05/0.50
N retention	0.88	0.91	0.93	0.96	0.95	0.08/0.95

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

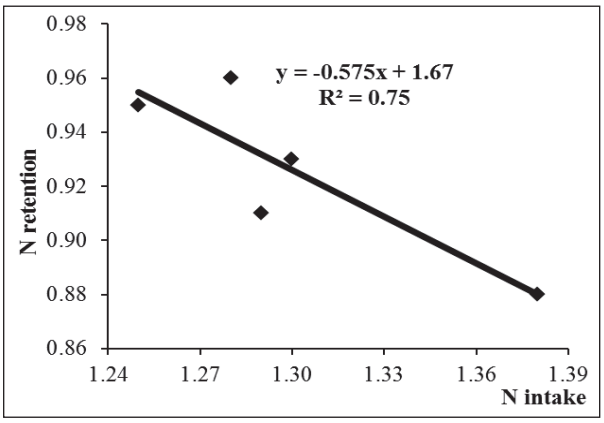

Figure 2. Relationship between N intake and N retention of growing rabbits

CONCLUSION

The conclusion was that catfish oil could be supplemented growing rabbits to improve nutrient intake and digestibility. The supplementation of catfish oil at level of 9 g/ rabbit/day to para grass basal diet gave the highest daily weight gain, carcass performance and better profits.

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