A Response of Energy Intakes, Growth Rate and Carcass Values of Crossbred Rabbits to the Supplementation of Sweet Potato Tuber (*Ipomoea batatas)* in the Mekong Delta of Vietnam

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ABSTRACT

To evaluate effects of the supplementation of sweet potato tubers in diets on nutrient utilization, growth and meat production of growing rabbits, sixty crossbred rabbits (Californian × local) at 45 days of age (703±51 g/rabbit) were arranged in one experiment of complete randomized design with 5 treatments and 3 replications. Four rabbits balancing in sex were used for one experimental unit. The treatments were the supplementation levels of sweet potato tubers of 0, 10, 20, 30 and 40 gDM/rabbit/day corresponding to SPT0, SPT10, SPT20, SPT30 and SPT40 treatments, respectively. The fresh sweet potato tubers were prepared by washing and cut into small slides for feeding. The feeds used for the experiment were Para grass (*Brachiaria mutica*), water spinach leaves, soya waste and oil-extracted soybean meal, in which the Para grass was fed *ad libitum*. The experimental results indicated that supplementing SPT at levels of 30 and 40 gDM in diets significantly ($P<0.05$) increased for the daily dry matter (DM), organic matter (OM) and metabolizable energy (ME) intakes. However no significant ($P>0.05$) intakes of CP, EE, NDF and ADF were found in different treatments. The daily weight gains (WG) were significantly different ($P<0.05$) among the treatments and were 17.8, 19.5, 21.6, 21.9 and 21.9 g/rabbit for the SPT0, SPT10, SPT20, SPT30 and SPT40 treatments, respectively. Similarly, the carcass weight values were significantly different ($P<0.05$) among the treatments with highest value for the SPT30 treatment. The economic analysis showed that the profits were higher for the SPT20, SPT30 treatments and they were 22,054 and 21,404 VND/kgWG, respectively. It was concluded that the SPT supplementation to crossbred rabbit diets should be recommended being from 20 to 40 gDM/rabbit/day to improve the growth performance, profit and sustainable production.

Key Words: Rabbit, Soluble Carbohydrate, Supplements, Meat Production, Economic Return

INTRODUCTION

In recent year due to the serious animal diseases have been occurred in Vietnam such as porcine reproductive and respiratory syndrome (pig), avian influenza (chicken and ducks) and foot and mouth disease (cattle and buffaloes), rabbits are considered to develop for producing meat for human consumption (Otte et al. 2007). In the Mekong delta rabbits are fed green forages and local supplements available of protein or energy to improve the production and income for the producers. There are abundant feed resources for raising rabbits which farmers could collect or buy with the low prices such as Para grass (*Brachiaria mutica*), paspalum grasses, water spinach, sweet potato vines, *Operculina turpethum*, tofu waste, brewery waste, *etc*. (Nguyen Van Thu & Nguyen Thi Kim Dong 2008). Many studies have attempted to find out the supplementation sources for developing the rabbit herds in better performance. Sweet potato has been widely planted in different regions in Vietnam with 1.65 million ton per year (Rau Hoa Qua Viet Nam 2007). Particularly, in the Mekong delta in 2012 the sweet potato area was 21,500 ha in Vinh Long, Dong Thap, Tra Vinh, Soc Trang, *etc.* with the yield of 22.8 tons/ha/crop and production of 513,000 ton/year. As a results there has been a large amount of its byproducts such as the small and waste tubers which could be used for human. This is a good carbohydrate source of energy feed for animals (Scott 1995; Sangkhom & Preston 2009). Therefore the objectives of this study are to evaluate the supplementation levels of fresh sweet potato tubers as energy source in crossbred rabbit diets on intake, growth and carcass value. The results will be applied for the rabbit producers to improve their income.

MATERIALS AND METHODS

Animals and experimental design

The experiment was conducted at the Experimental Farm of Long Hoa, Binh Thuy of Can Tho City and the laboratory of Department of Animal Sciences of Can Tho University, Vietnam and from October 2009 to May 2010. Sixty crossbred female rabbits from 45 to 50 days of age (589±66.8 g/rabbit) were arranged in a complete randomized design with 5 treatments and 3 replications. Two males and two females were housed in a wire mesh and wood cage, as an experimental unit. The dietary treatments were sweet potato tuber supplementation to the diets at levels of 0 (SPT0), 10 (SPT10), 20 (SPT20), 30 (SPT30) and 40 g (SPT40) (DM basis). The diets were adjusted every week by increasing the allowance by 5% (DM basis). The water spinach leaves (WSL), tofu waste and soybean offered in the treatments aimed to supply protein and energy in which the crude protein (CP) level was in different treatments was around 13.0%. The experiment period was 10 weeks.

Feeds, feeding and management

Para grass was collected daily in the areas surrounding Cantho University. WSL were bought from farmers who planted and sold only WS stems for human consumption. The tofu waste was bought from the small plant making tofu for human, while the soybean cake was bought from the animal feed company. The sweet potato tubers were bought from the market with the same variety. They were cleaned by water and cloths, then eliminated the inedible parts and cut into slides for feeding. The animals were fed three times a day at 8:00, 15:00 and 19:00 h. Para grass was offered *ad libitum* for all dietary treatments. Fresh water was available at all times. 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 diarrhea and parasite diseases.

Measurements taken

The feeds and refusals were taken for analyses of DM, OM, CP, EE, NDF, ADF, and Ash following the procedures of AOAC (1990) and van Soest et al. (1991). Metabolizable energy (ME) was calculated by suggestion of Maertens et al. (2002). At the beginning of the experiment two rabbits per experimental unit were weighed individually and thereafter weekly. Daily feed intakes, growth rate, and feed conversion ratios were measured and calculated. After finishing the experiment all rabbits were slaughtered for evaluating the carcass values. An economic analysis was also done for each treatment.

Statistical analysis

The data from the experiment were analyzed by analysis of variance using the ANOVA of General Linear Model of Minitab Reference Manual Release 13.20 (Minitab 2000). Economic analyses were done using current prices in Vietnamese Dong (VND) to compare net incomes and feeds cost in the different treatments.

Table 1. Feeds sweet potato tuber (SPT) (g DM/rabbit/day) in diets used in different treatments of the experiment

Feed	Treatment				
	SPT0	SPT10	SPT20	SPT30	SPT40
Sweet potato tuber	0.00	10.00	20.00	30.00	40.00
Para grass	*Ad libitum*	*Ad libitum*	*Ad libitum*	*Ad libitum*	*Ad libitum*
Water spinach leaves	15.00	17.50	12.50	10.00	10.00
Tofu waste	10.50	10.50	8.40	8.40	6.30
Soy bean cake	5.43	5.43	9.05	11.80	12.70

SPT0, SPT10, SPT20, SPT30 and SPT40: sweet potato tuber supplemented at 0, 10, 20, 30 and 40 g per day per head

RESULTS AND DISCUSSION

Chemical composition of feeds used in the Exp

The ME of SPT in the experiment was the highest compared to the other feeds and consistent with that reported by NIAH (2002) because they were similar in DM content (26.2%). While the DM and CP contents of SPT was some what lower than those reported by Dominguez (1990) being 26.2 and 3.96%. The EE, NDF and ADF of SPT in the present study were similar to these presented by Olorunnisomo et al. (2006). There were the higher values of CF and NFE of the experiment compared to these stated by Peters et al. (2001) being 4,67 and 85,9%, respectively. The Para grass with the higher NDF content was used for main feed of rabbits and consistent with that presented by (Nguyen Thi Kim Dong & Nguyen Thanh Van 2008). The CP contents of WSL, tofu waste and soybean cake were high and used for protein supplement source. The values were similar to these stated by Phan Thuan Hoang (2009) and Phung Thi Thuy Lieu (2008).

In Table 3 indicated that the daily SPT intake increased gradually from the SPT0 to SPT40 treatment ($P<0.05$), while the Para grass, WSL and tofu waste intake generally reduced when increasing the SPT. The soybean cake intake was significantly different ($P<0.05$) among the treatments and increasing from the SPT0 to the SPT40 treatment. The DM and OM intakes were significantly different ($P<0.05$) among the treatments and gradually increased from the SPT0 to the SPT40 treatment. The DM and OM intakes of the treatment of SPT30 and SPT40 were significantly higher ($P<0.05$) than those of SPT0 treatment. Similarly the daily ME intake in different treatments also followed the pattern of DM and OM intakes ($P<0.05$) with the lowest value for SPT0 (0.60 MJ ME/rabbit and the highest one for the SPT40 (1.10 MJ ME/rabbit). However, the other nutrients of CP, EE, NDF and ADF were not significantly different ($P<0.05$) among the treatments.

The daily DM intakes of the present study were similar to those of crossbred rabbit from 8 to 18 weeks of age being from 60.7 to 65.0 g DM/rabbit (Nguyen Van Thu & Nguyen Thi Kim Dong 2008), while these figures of New Zealand rabbit from 7 to 13 weeks of age were from 62.3 to 81.8 gDM/rabbit (Yamani et al. 1994). The daily CP intakes in the experiment were higher than the report of Fatufe et al. (2010) in crossbred rabbit in Nigeria being from 9.46 to 10.2 g/rabbit, however they were lower than the CP intakes reported by Doan Thi Gang et al. (2006) for the growing New Zealand rabbits being from 20.1 to 25.4 g/rabbit. The daily EE intakes in the present experiment was higher than those reported by Akinmutimi & Osuagwu (2008) being from 2.39 to 3.09, but lower than results in crossbred rabbit presented by Phung Thi Thuy Lieu (2008) being from 5.07 to 6.33 g/rabbit. The NDF and ADF intakes were tendentiously reduced when increasing SPT in the diet and they were 15.7 and 27.0 g/rabbit, respectively. In the experiment on different levels of NDF in diets of crossbred rabbits Nguyen Thi Kim Dong & Nguyen Truong Giang (2008) indicated that the daily NDF and ADF intakes were from 24.0 to 50.0 g/rabbit and from 14.7 to 23.0 g/rabbit, respectively.

Table 2. Chemical composition (%DM) of feed used in Exp

Thực liệu	DM	OM	CP	EE	CF	NDF	ADF	NFE	Ash	ME* MJ/kg
SPT	26,20	96,90	3,96	1,86	3,24	8,59	5,48	87,90	3,06	15,60
Para grass	17,30	88,50	12,10	3,33	26,60	66,40	33,80	46,50	11,50	8,32
WSL	12,20	90,00	25,60	6,74	12,90	33,30	20,20	44,90	9,99	12,00
Tofu waste	11,10	96,00	22,50	9,23	17,50	32,40	27,80	46,80	3,99	11,00
Soybean cake	87,60	90,00	42,50	2,22	5,80	27,20	18,50	39,50	10,00	11,70

SPT: sweet potato tuber; WSL: water spinach leaves; DM: Dry matter; OM: organic matter; CP: crude protein; EE: Ether extract; CF: crude fibber; NDF: Neutral detergent fiber; ADF: Acid detergent fiber; NFE: nitrogen free extract; ME*: metabolizable energy (Maertens et al. (2002)

Table 3. Daily feed, nutrient (g DM/rabbit) and ME intakes of rabbit in the experiment

Items	Treatment					±SE/P
	SPT0	SPT10	SPT20	SPT30	SPT40	
Sweet potato tuber	-	10.30[a]	22.00[b]	29.50[c]	39.40[d]	1.470/0.001
Para grass	25.00[a]	23.60[ab]	21.40[ab]	18.30[b]	17.10[b]	1.070/0.003
Water spinach leaves	14.60[a]	14.90[a]	12.70[ab]	9.95[b]	9.82[b]	0.810/0.002
Tofu waste	10.60[a]	10.60[a]	9.59[a]	8.84[ab]	6.95[b]	0.460/0.001
Soybean cake	7.62[a]	7.71[a]	9.10[ab]	11.30[ab]	11.90[b]	0.820/0.011
DM	57.40[a]	66.80[ab]	74.70[ab]	77.90[b]	85.10[b]	3.970/0.005
OM	52.20[a]	61.40[ab]	69.30[bc]	72.60[bc]	79.70[c]	3.680/0.003
CP	12.90	13.20	13.30	13.30	13.30	0.740/0.995
EE	3.27	3.42	3.37	3.20	3.16	0.160/0.761
NDF	26.90	27.00	26.10	24.10	23.60	1.280/0.260
ADF	15.40	15.70	15.20	14.20	13.90	0.760/0.411
Ash	5.22	5.44	5.45	5.23	5.38	0.300/0.962
ME (MJ/rabbit/day)	0.60[a]	0.75[ab]	0.90[bc]	0.97[bc]	1.10[c]	0.050/0.001

SPT0, SPT10, SPT20, SPT30 and SPT40: sweet potato tuber supplemented at 0, 10, 20, 30 and 40 g per day per rabbit. The data with different superscript letters in the same row differ significantly (P<0.05)

Table 4. Growth rate, feed conversion ratio and economic return of rabbits supplemented sweet potato tubers

Item	Treatment					±SE/P
	SPT0	SPT10	SPT20	SPT30	SPT40	
Final live weight (g/rabbit)	1951.000[a]	2093.000[ab]	2255.000[bc]	2282.000[c]	2271.000[c]	37.300/0.001
Daily weight gain (g)	17.800[a]	19.500[ab]	21.600[bc]	21.900[c]	21.900[c]	0.460/0.001
Feed conversion ratio	3.230	3.420	3.460	3.550	3.890	0.190/0.248
Cost of feed (VND/kg WG)	7,971	8,524	9,082	9,975	10,845	
Total cost (VND/kg WG)	29,786	28,843	27,946	28,596	29,563	
Profit (VND/kg WG)	20.214	21.157	22.054	21.404	20.437	

SPT0, SPT10, SPT20, SPT30 and SPT40: sweet potato tuber supplemented at 0, 10, 20, 30 and 40 g per day per rabbit .The data with different superscript letters in the same row differ significantly (p<0.05). Profit was calculated based on the price of SPT (700 VND/kg), Para grass and water spinach leaves (300 VND/kg), tofu waste (300 VND/kg), soybean cake (10,000 VND/kg) and rabbit live weight (50,000 VND/kg)

The daily ME intakes of crossbred rabbits of the present study were from 0.60 to 1.10 MJ ME/rabbit and similar to those showed by Lam Thanh Binh (2009) when feeding crossbred rabbits from 8 to 18 weeks of age with water spinach, tofu waste and cassava chip (0.72-0.89 MJ ME/rabbit).

The final live weights of rabbit of the SPT30 and SPT40 treatments were significantly higher (P<0.05) than those of the SPT0 and SPT10 treatments, and similarly the daily weight gains followed the pattern of the final live weight. The profit was higher for the SPT20 and SPT30 treatments. The final live weights of rabbit were consistent with those reported by Nguyen Thi Xuan Linh (2008), and the relationship between daily weight gain and ME intake was presented in the figure 1 with $y= -17.48 x^2 + 38.04 x + 1.367$ and $R^2=0.836$.

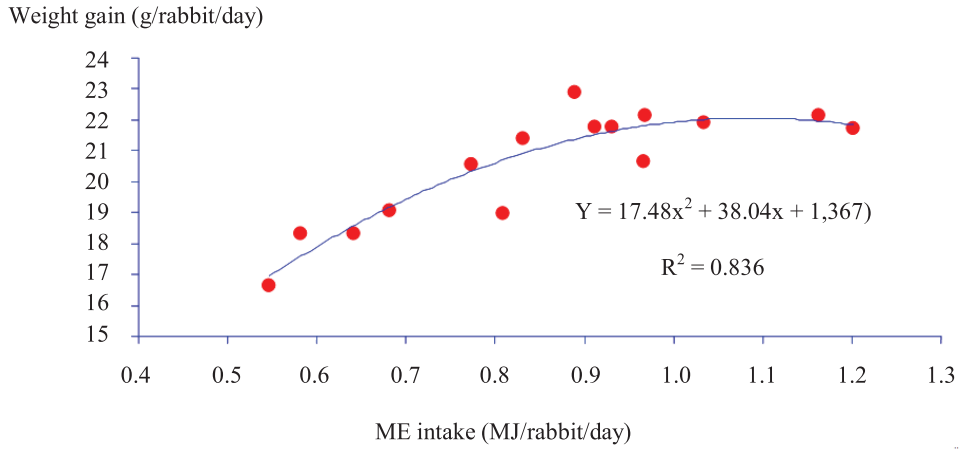

Figure 1. The relationship between daily weight gain and ME intake of growing rabbits

The carcass quality and viscera of rabbits in the experiment were presented in Table 5.

In general the carcass value and meat production were improved by the SPT supplementation. The carcass and meat weights were significantly different (P<0.05) among the treatments with the highest value for the SPT30 treatment, however their percentages were not significantly (P>0.05). They were from 49.0 to 51.0% and from 55.7 to 71.4%. The hind thigh weight of rabbit was numerically improved by the supplementation, but not statistically different (P>0.05). The digestive tract, stomach and caecum length were not significantly different (P>0.05) among the treatments. Ouyed & Brun (2008) reported that the carcass percentage of crossbred rabbits fed pellets (16% CP and 2735 kcal ME/kg) was from 52.4 to 54.8%. However, the carcass percentage of the present study was consistent with that stated by Farinu (1994) being from 49.0 to 49.9%. The meat percentage calculated on the carcass of crossbred rabbits in this experiment was from 55.7 to 71.4% and it was lower than that presented by Phung Thi Thuy Lieu (2008) being from 71.3 to 75.3%.

Table 5. The carcass quality and viscera of rabbits supplemented different levels of sweet potato tuber

Criteria	Treatment					±SE/P
	SPT0	SPT10	SPT20	SPT30	SPT40	
Live weight (g)	1880.00^{a}	2000.00^{ab}	2106.00^{ab}	2240.00^{b}	2180.00^{b}	55.500/0.007
Carcass weight (g)	938.00^{a}	979.00^{ab}	1036.00^{ab}	1143.00^{b}	1093.00^{ab}	38.800/0.023
Carcass percentage (%)	49.90	49.00	49.20	51.00	50.20	1.660/0.910
Meat weight (g)	525.00^{a}	668.00^{ab}	722.00^{ab}	815.00^{b}	767.00^{b}	49.000/0.016
Meat percentage (%)	55.70	68.20	69.60	71.40	70.20	3.800/0.080
Hind thigh weight (g)	286.00	301.00	302.00	334.00	3070.00	17.200/0.442
Hind thigh percentage (%)	30.50	30.80	29.10	29.20	28.10	0.980/0.335
Digestive tract (%)	23.80	23.30	23.40	24.90	23.20	1.000/0.755
Stomach (%)	6.37	7.09	7.57	7.32	7.14	0.450/0.454
Caecum length (cm)	47.30	50.70	49.30	50.30	50.70	1.930/0.711

SPT0, SPT10, SPT20, SPT30 and SPT40: sweet potato tuber supplemented at 0, 10, 20, 30 and 40 g per day per rabbit .The data with different superscript letters in the same row differ significantly (P<0.05)

CONCLUSION

It was concluded that under feeding condition of the present study supplementing from 20 to 40 g sweet potato tuber gave better rabbit growth performance and profit, and fresh sweet potato tuber should be used to supplement rabbits for improving the ME intake, growth and economic return.

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