A RESPONSE OF REPRODUCTIVITY OF CROSSBRED RABBITS TO DIETARY CRUDE PROTEIN LEVELS FROM CONCENTRATE AND WATER SPINACH LEAVES IN THE MEKONG DELTA OF VIETNAM

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ABSTRACT

Twenty five rabbit does were arranged in a completely randomized design with 5 treatments and 5 replications to evaluate the reproductive performance of crossbred rabbits (New Zealand x Local rabbits) fed 5 levels of crude protein (CP) including 30, 32, 34, 36 and 38 g CP/doe/day corresponding to the CP30, CP32, CP34, CP36 and CP38 treatments. The crude protein supplementation in diets was from water spinach leaves and concentrate with Para grass (*Brachiaria mutica*) as a basal diet. The experiment was carried out at the experimental farm of Can Tho University from May to Sep, 2017.

The results showed that litter size at birth, weight of litter at birth, number of rabbit at weaning, weight of rabbit at weaning in litter1 enhanced with increasing of CP in the diets, the higher values were found for the treatments of 36 and 38 g CP/doe/day ($P>0.05$). The growth rate of pregnant doe and milk production (g/doe/day) of experimental rabbits increased with increasing of CP levels in the diets and the values were higher for the treatments of 36 and 38 g CP/doe/day ($P<0.05$). In litter 2, the results showed that litter size at birth, weight of litter at birth, number of rabbit at weaning, weight of rabbit at weaning improved with increasing of CP levels in the diets ($P<0.05$). The milk production (g/doe/day) increased with increasing of CP levels in the diets ($P<0.05$), the higher values for the treatments of 36 and 38 g CP/doe/day. It was concluded that the higher reproductive performance of crossbred rabbits in two litters were found in the treatments of 36 and 38g CP/doe/day.

Keywords: *crossbred rabbit, crude protein, para grass, reproductive performance, water spinach*

INTRODUCTION

Rabbit meat production has considerably increased in Vietnam in recent years in order to meet the increasing demand of human food. Rabbit meat is nutritious, low fat and cholesterol. Cost for rabbit production investment is low, because rabbit producers can utilize cheap materials for housing and local plants or wild vegetables for rabbit feeds. Crossbred rabbits (New Zealand x Local rabbits) are popularly raised in the Mekong delta due to the good adaptations to the local climate, feedstuffs and diseases. However, their productivity and reproductivity is rather low because of low quality diets of inadequate protein with natural grasses, wild vegetables and agro-industrial by products. Dietary protein is needed for growth, reproduction and health of animals, while rabbit is the animal species to utilize the plant protein efficiently for their livings and production due to the rabbit good digestion and the ceacotrophy (Nguyen Van Thu and Nguyen Thi Kim Dong, 2011). Recently dietary supplementation of protein and amino acids have had the major and traditional objective to meet rabbit requirements for production (Carabano et al., 2008). However, there is a lack of studies on nutrients requirement of reproductive crossbred rabbits in the Mekong delta in Vietnam, especially on crude protein (CP) requirement.

Several available protein-rich forages are found in the Mekong Delta, in which water spinach (*Ipomoea aquatica*) leaves (WSL) as a waste from human food has been shown to be a promising source with 28.7% CP for rabbit feed (Nguyen Thi Kim Dong and Nguyen Van Thu, 2009), while concentrate pellets are popularly fed rabbits to supply crude protein (CP) and energy. Thus the supplementation of protein from WSL in rabbit diets will be available and cheap. The objective of this study is to evaluate effects of crude protein levels from concentrate and WSL in basal diet of Para grass (*Brachiaria mutica*) on the reproductive performance of crossbred rabbits for further studies and practice recommendations.

MATERIALS AND METHODS

Animals and experimental design

The trial was carried out at the experimental farm of Can Tho University from May to Sep, 2017. Twenty five crossbred rabbit does (New Zealand x Local rabbit) from 4-4.5 months of age were arranged in a Complete Randomized design with 5 treatments and 5 replications. The five treatments were different dietary CP levels of 30, 32, 34, 36 and 38g /day/doe corresponding to CP30, CP32, CP34, CP36 and CP38 treatments, respectively. One animal was individually kept in a wire mesh and woody cage, as an experimental unit.

Feeds, feeding and management

Para grass (*Brachiaria mutica*) was daily collected surrounding Can Tho University campus. Water spinach leaves were bought from farmers who grew and sold WS stems for human consumption, while the WSL was eliminated as a waste. Concentrate pellets (20% CP) was bought at the feed company in one occasion during experiment. Para grass was offered *ad libitum,* while 300g WSL per day was given to all does. Concentrate pellets were offered at levels of 50, 62, 74, 86 and 98 g/doe/day to supply a total of crude protein of 30, 33, 34, 36 and 38 g per doe per day following the research results reported by Nguyen Thi Kim Dong et al. (2008). The feedstuffs were adjusted weekly by increasing allowances by 5, 10 and 15% of total DM intake in the second, third and fourth week of pregnancy, respectively. During lactation period allowances were increased by 10% in the first week, 30% for the second and third week, and 40% in the fourth week. The rabbits had access to fresh water at any times in a day. Five crossbred bucks with good health and reproductivity were used for mating. The mating service was done at two weeks after birth. Before entering experiment all does were vaccinated to prevent Hemorrhagic and parasite diseases.

Measurements taken

Daily feed and nutrient intakes were measured by refusals and spillages collected and weighed daily in the morning. Feeds and refusals were taken for analyses of DM, OM, CP and EE following procedure of AOAC (1990), while NDF and ADF was analyzed by Van Soest et al. (1991). Reproduction criteria were recorded in 2 litters for measuring litter size at birth and weaning and daily milk yield. Daily milk yield was measured by weighing the kids before and after suckling. They were weaned at the 30th day after birth. Weights of rabbit at birth and weaning.

Statistical analysis

The data were analyzed by analysis of variance using the ANOVA of General linear model (GLM) of Minitab Reference Manual Release16.0 (Minitab, 2016). For the comparison of the reproduction criteria between two litters, the paired T test of Minitab Reference Manual was used.

RESULTS AND DISCUSSION

Chemical composition of feeds

Chemical composition of feeds used in the experiment was presented in Table 1.

Table 1. Chemical composition of feeds (% DM basis except for DM which is on fresh basis)

Feed	DM	OM	CP	EE	NDF	ADF	Ash	ME (MJ/KgDM)
Para grass	15.0	85.0	14.2	7.45	56.0	30.8	15.0	7.74
Water spinach leaves	9.87	88.4	34.4	8.22	24.7	18.2	15.6	10.5
Concentrate pellets	87.2	87.3	21.5	5.63	29.2	8.92	12.7	12.1

Note: DM: Dry matter, OM: Organic matter, CP: Crude protein, EE: Ether extraction, NDF: Neutral detergent fiber, ADF: Acid detergent fiber, ME: Metabolizable energy

Chemical composition of feeds used in the experiment was showed in Table 1. DM of Para grass was 15.0% and higher than water spinach leaves (15.2%). The CP content of water spinach leaves was 34.4%, while this was 14.2% in Para grass. It was higher than that of the report by Nguyen Thi Kim Dong and Nguyen Van Thu (2009) being 28.7%. NDF and ADF contents of Para grass were higher than those of water spinach leaves (56.0% vs. 24.7%, 30.8% vs. 18.2%), respectively. Concentrate pellets had higher CP and ME than that of the forages.

Feed and nutrient intakes and reproduction

Table 2. The DM, CP intakes and reproductive performance of does in the first litter

Item	Treatment					± SE/P
	CP30	CP32	CP34	CP36	CP38	
DM intake (g/day)	124^{d}	134^{c}	144^{b}	152^{ab}	160^{a}	1.95/0.001
CP intake (g/day)	29.9^{e}	32.2^{d}	34.4^{c}	36.4^{b}	38.5^{a}	0.225/0.001
Litter size at birth (kid)	5.67	7.00	6.00	7.00	7.33	0.42/0.076
Number of alive kid at birth	5.33	6.67	5.67	7.00	7.33	0.47/0.055
Weight at birth (g/kid)	48.9	48.7	49.1	52.2	53.6	2.04/0.372
Weight of litter at birth (g)	261^{b}	326^{ab}	277^{ab}	366^{ab}	392^{a}	27.3/0.029
Number of kid at weaning	5.33	6.00	5.67	6.67	7.00	0.45/0.12
Mean weight at weaning (g/kid)	359	355	448	450	397	30.1/0.122
Weight of litter at weaning (g)	1.905^{b}	2.124^{ab}	2.527^{ab}	3.000^{a}	2.774^{a}	228.5/0.037
Survival rate (from birth to weaning, %)	94.4	86.3	94.4	95.8	95.2	5.84/0.769

Note: The numbers with different superscript letters in the same row were significantly different (P < 0.05)

The DM and CP intakes proportionally increased in the diets with the increasing CP levels and they were significantly different (P<0.05) among treatments (Table 2). Daily DM intakes of the does in the experiment were higher than those reported by Nguyen Tan Nam (2011), which ranged from 111 to 134 g per day. CP intakes of treatments in the experiment were similar to the findings of Tran Thi Hong Trang (2012) and Nguyen Thanh Nhan (2009) being 24.2-44.5 gCP/doe/day and 24.7-31.2 gCP/doe/day, respectively. The litter size at birth significantly improved (P<0.05) within increasing CP levels in the diets and the CP38 diet got the highest value (7.33 kids) while CP30 diet got the lowest value (5.67 kids). Number of alive rabbits at birth and at weaning in the first litter significantly increased with increasing dietary CP levels with the highest value for the CP38 treatment. The litter sizes at birth were similar to those cited by Fayeye and Ayorinde (2016) being 4.25-6.5 kids/litter for domestic rabbit in Nigeria, Luu Nguyen Tam Thao (2012) being 6.33-7.50 kids/litter and Nguyen Thi Vinh Chau (2008) being 5.33-6.67 kids/litter. The results reported by Brecchia et al. (2012) with New Zealand White rabbits, showed a higher litter size at birth (6.2-9.8 kids) but similar of litter size at weaning (5.5-7.4 kids) compared to that in the present study.

Table 3. The DM, CP intakes and reproductive performance of does in second litter

Item	**Treatment**					**± SE/P**
	CP30	**CP32**	**CP34**	**CP36**	**CP38**	
DM intake (g/day)	118^{c}	124^{c}	134^{b}	142^{ab}	151^{a}	2.11/0.001
CP intake (g/day)	$29{,}8^{e}$	$31{,}5^{d}$	$34{,}3^{c}$	$36{,}4^{b}$	$38{,}6^{a}$	0,14/0,001
Litter size at birth (kid)	5.33^{b}	6.0^{ab}	7.67^{a}	8.00^{a}	7.67^{a}	0.52/0.015
Number of alive kid at birth	5.33^{b}	6.0^{ab}	7.67^{a}	7.67^{a}	7.67^{a}	0.47/0.012
Mean weight at birth (g/kid)	44.4^{b}	47.7^{ab}	48.8^{ab}	49.4^{a}	48.8^{a}	0.91/0.029
Weight of litter at birth (g)	236^{b}	286^{ab}	375^{a}	379^{a}	382^{a}	23.9/0.04
Number of kid at weaning	5.33^{b}	5.67^{b}	7.00^{ab}	7.67^{a}	7.67^{a}	0.39/0.004
Weight at weaning (g/kid)	356^{d}	341^{cd}	369^{bc}	384^{ab}	406^{a}	6.05/0.001
Weight of litter at weaning (g)	1.895^{b}	1.984^{b}	2.590^{ab}	2.945^{a}	3.107^{a}	158/0.001
Survival rate (from birth to weaning, %)	100	94.4	92.1	96.3	100	3.48/0.455

The numbers with different superscript letters in the same row were significantly different (P < 0.05)

Table 3 shows that the DM and CP intakes obtained in litter 2 were similar pattern those in litter 1. The daily intake average of DM and CP increased when increasing the CP levels in diets (P<0.05) with the highest value for the CP38 treatment (151 g/day and 38.6 g/day, respectively). The DM consumption of does in this experiment consisted with the findings of Cherfaoui and Berchiche (2012), who studied on local rabbit in Algerian, being 128-183 gDM/day. The litter size and weight at birth were significantly lower ($P<0.05$) for the CP30 treatment compared to the others. Weight at birth of present study were consistent with results found by Fayeye and Ayorinde (2016) being 41-54 g/kid. The litter size at birth was in agreement with that cited by Phan Thi Huyen Thoai (2012) being 5,67-7,33 kids/litter and Nguyen Thanh Nhan (2009) being 6.50-7.67 kids/litter. Number of kid at weaning and weight of litter at weaning were significantly different ($P<0.05$) among the treatments with the higher values for the CP38 diet (7.67 kids and 3.107 g, respectively) and the lower values for the CP30 diet (5.33 kids and 1.895 g, respectively). The survival rate to weaning of kids in the present study for both two litters was high (from 86.3 to 100%). These results were similar to findings on domestic rabbit in Nigeria stated by Fayeye and Ayorinde (2016) being 72.5-100%.

Table 4. Effect of different dietary CP levels on pregnant period, daily weight gain and milk production of does in first and second litter

Litter	**Item**	**Treatment**					**P /± SE**
		CP30	**CP32**	**CP34**	**CP36**	**CP38**	
1	Pregnant period (day)	29.7	30.7	30.7	30.7	30.3	0.33/0.226
	Daily weight gain of doe (g)	12.3^{b}	13.5^{ab}	13.7^{ab}	16.3^{ab}	17.7^{a}	1.10/0.031
	Daily milk production (g/doe)	62.4^{c}	79.5^{b}	84.9^{ab}	92.2^{a}	95.3^{a}	2.27/0.001
2	Pregnant period (day)	30.0	30.0	30.3	29.7	31.0	0.49/0.431
	Daily weight gain of doe (g)	11.8	12.5	13.8	12.9	14.4	0.73/0.148
	Daily milk production (g/doe	66.0^{c}	81.4^{b}	87.5^{b}	92.2^{ab}	101^{a}	2.51/0.001

Note: The numbers with different superscript letters in the same row were significantly different ($P < 0.05$)

Daily milk production (Y) was highly effected by crude protein intake (X) with the relationship by $Y_1=3.93X_1-50.6$ ($R^2=0.910$) for the litter 1 and $Y_2= 4.04X_2-51.7$ ($R^2=0.951$) for the litter 2 (from the data of Table 4). In both two litters, daily milk yield was the lowest for the CP30 treatment (62.4 g/day for the first litter and 66.0 g/day for the second litter) with the significant improvement ($P<0.05$) when increasing CP levels in the diets, while the highest milk yield was for the CP38 diet (95.3 and 101 g/day for the first and second litter, respectively). These results obtained in a present study are similar to the values (72.0 – 137 g/day) of does reported by Tran Thi Hong Trang (2012). However, the values recorded in our study were considerably higher than these of 72.4-87.0 g found by Phan Kim Ngan (2014). These could be explained by the better nutrition for the does in our study. The daily weight gain of does in the first litter was significantly improved

(P<0.05) by increasing CP levels in the diets, however, there was no significance was found for the second litter (P>0.05).

Table 5. A comparison of the reproductive performance between two litters

Item	**Litter 1**	**Litter 2**	**± SE/P**
Litter size at birth at birth	6.60	6.93	0.347/0.353
Litter size at birth at weaning	6.13	6.67	0.274/0.072
Weight at birth (g/kid)	50.5	48.0	0.878/0.014
Weight at weaning (g/kid)	402	373	15.7/0.086
Weight of litter at weaning (g)	2466	2504	115/0.745
Daily weight gain of doe (g)	14.7^{a}	13.1^{b}	0.548/0.01
Milk production (g/doe)	82.8^{b}	85.5^{a}	0.69/0.042

A comparison of reproductive criteria of does between two litters is presented in Table 5. There was no significant difference in litter size at birth and at weaning, weight of litter at weaning and mean weight at weaning (P>0.05) between two litters, while mean weight at birth and milk production were significantly higher (P<0.05) for litter 2, *due to the mature of the reproductive organs and more nutrient consumed by the does of the litter 2 compared to those of litter 1.*

CONCLUSION

It was concluded that increasing dietary crude protein intake of crossbred does improved feed and nutrient intakes. The does fed diets containing 38 g CP gave better reproductive performance of litter size, weight of birth and weaning and milk production. The weight at birth of kids and milk production were higher for litter 2. Water spinach leaves being locally available CP source could be effectively supplemented for crossbred rabbit does under conditions of Mekong delta of Vietnam.

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