RESPONSE OF REPRODUCTIVE PERFORMANCE OF RABBIT DOES TO ANTIOXIDANT VITAMIN C SUPPLEMENTATION IN DIETS

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ABSTRACT

An experiment was carried out to evaluate the effects of different supplement levels of ascorbic acid in diets on the reproductive performance of crossbred (New Zealand White breed x local breed) rabbits in three litters. The experiment was a completely randomized design with five treatments and four replications. One female rabbit at 4 - 4.5 months of age with average live weight at 2,500g was an experimental unit. The five treatments were different supplement levels of ascorbic acid (mg/kg DM diet) at 0, 125, 250, 375 and 500 mg, corresponding to C0, C125, C250, C375 and C500 treatments, respectively. The results showed that feeds and nutrients intake of rabbits in three litters were significantly increase (P<0.05) by increasing the supplement levels of ascorbic acid in diets. In the first litter, the litter size at birth, litter weight at birth, litter size at weaning and milk yield were significantly improved (P<0.05) by increasing supplement levels of ascorbic acid in diets with the highest values for C500 treatment with 7.00 kids and 361g, 6.50 kids and 72.3g/day, respectively. For the second and third litters, the milk yield were significantly improved (P<0.05) by gradually using ascorbic acid levels in diets but they gave a negative result for C375 and C500 treatments. It was concluded that using ascorbic acid at 125mg/kg DM diet could improve reproductive performance of does.

Key words: *ascorbic acid, doe, milk yield, litter size at birth, rodents.*

INTRODUCTION

In the Mekong Delta in Viet Nam, the domestic rabbits have been developed as a good alternative source of dietary protein for the increasing human population. In hot climate regions, rabbit production is faced with many problems such as heat stress as any other animal production. The thermo neutral zone of rabbits is around 18-21°C (Habeeb et al., 1998). At environmental temperature of 32°C and higher, heat stress occurs leading to production losses. The greatest losses from heat stress may happen when temperature of 35°C and higher (El-Moneim et al., 2013).

Vitamin C is not considered a required dietary nutrient, but under certain adverse environmental conditions, the metabolic need for this vitamin may exceed the inherent biosysthetic ability of ascorbic acid (Abou-Ashour et al., 2004). Ascorbic acid synthesized in rabbit liver has been demonstrated to protect the animal from heat stress and improve disease resistance in rabbits by optimizing the function of the immune system. But during stress, ascorbic produced is rapidly consumed and amount synthesized fall below animal requirements (Zeweil et al., 2009). Vitamin C (ascorbic acid) is one of the most widely studied vitamins used to alleviate heat stress in rabbits. Vitamin C has a role in lowering viral pathogenic actions and in protecting animals from heat stress as well as in the enhancement of the immune system of infected rabbits (Amakye-Anim et al., 2000); El-Ghaffer et al., 2000).

Rabbit does used water supplemented daily with ascorbic acid (1g/L) inceased daily feed consumption, receptivity and conception rate. The enhancement of litter size and weight at both kindling and weaning obtained in the vitamin C group. Moreover, the pre-weaning death percentage was lower in does using vitamin C (Yassien et al., 2008). Vitamin C supplementation increased daily feed intake, nutrient digestibility, bunny weight, litter weight and litter size all at 21 and 28 days of age as well as viability % from birth to 21 days (Zeweil et al., 2009). Similarly, using vitamin C at 400mg/kg diet improved feed intake during pregnancy and lactation, litter size at birth and weaning, litter weight at birth and weaning and milk production (Abdel-Khalek et al., 2008). Rabbit producers in the Mekong delta of Vietnam raised rabbits by using locally available feed resources while those studies mainly used commercial pellets for rabbit feeding. Therefore, this study aimed to verify whether productive, reproductive performance of female rabbit does could be improved by using vitamin C under feeding conditions of Mekong Delta in Vietnam.

MATERIALS AND METHODS

Animals and experimental design

The trial was carried out at the Experimental farm of Can Tho University in Can Tho City. Twenty crossbred (New Zealand White x local) rabbit does at 4 - 4.5 months of age were arranged in a Complete Randomized design with 5 treatments and 4 replications. The five treatments were different supplement levels of Vitamin C (mg vitamin C/kg DM diet) at 0 mg, 125 mg, 250 mg, 375 mg and 500 mg corresponding to C0, C125, C250, C375 and C500 treatments, respectively. Each animal was housed individually per wire mesh and woody cage (0.5m x 0.5m x 0.4m), as an experimental unit.

Feeds, feeding and management

Pennisetum purpureum cv.Mott was collected daily in the areas surrounding experimental farm. Soybean meal was bought at local feed store in one occasion during experiment. Soya waste was taken every day from tofu producer. Vitamin C (ascorbic acid, assay ≥99%) was imported from Ningxia Yuan Pharmaceutical Company. The animals were fed three times a day, at 8:00, 13:00 and 18:00h. The experimental rabbits were supplemented with 200g fresh soya waste, and 40g soybean meal per head per day while grass was offered *ad libitum.* Vitamin C was fed by mixing to a small amount of soya waste and soybean meal to ensure that does exactly consumed vitamin C as experimental design.

The feedstuffs were adjusted weekly by increasing 20, 30 and 40% in the second, third and fourth week of pregnancy, respectively. During lactation period allowances were increased by 40%. All animals had access to fresh water at all times.

Only one buck was used for mating. The breeding service was done at two weeks after birth. The new-born animals were weaned at the 30th day. Refusals and spillage were collected and weighed daily in the morning to calculate feed intake. Weights of rabbit at birth, at 21 days, at weaning, and daily milk yield were measured. Before entering experiment all does were vaccinated to prevent some diseases, especially rabbit Hemorrhagic diarrhea and also parasite diseases. Daily milk yield recorded by weighing the bunny before and after suckling. Ambient temperature (°C) was measured by Thermos recorder TR-73U at 6 am, 8 am, 10 am, 12 pm, 2pm, 4pm and 6pm during experiment.

Measurements

Reproduction criteria were recorded in 3 litters. Feeds and refusals were taken for analyses of DM, OM, CP, EE, CF following procedure of AOAC (1990). NDF and ADF were analyzedaccording to method of Van Soest et al. (1991) and Robertson and Van Soest (1981), respectively. Metabolism energy was estimated following a formula proposed by Maertens et al. (2002): ME (MJ/kg) = DE (MJ/kg) x ME/DE with ME/DE = 0,995-0,0048 x DP (g/kg)/DE (MJ/kg); DP = (%CPx CPD); DE=13,932-0,196*CF. The measurement taken included: daily feed and nutrient intakes for each litter, number of alive bunny at birth and weaning, fetal death, mean weight at birth, weight of litter at birth, mean weight at weaning, weight of litter at weaning, milk yield, viability of bunny.

Statistical analysis

The data were analyzed by analysis of variance using the ANOVA of General linear model of Minitab Reference Manual Release 16.0 (Minitab, 2016). For the comparison of the reproduction criteria between two litters the paired T test of Minitab Reference Manual was also used.

RESULTS AND DISCUSSION

Feed characteristics

Characteristics of feeds used in the trial are 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	CF	Ash	ME, MJ/kgDM
Elephant grass	13.2	89.2	11.3	3.87	63.5	40.9	30.6	10.8	7.90
Soybean meal	92.5	93.4	42.0	3.45	25.7	16.2	5.75	6.60	12.8
Soya waste	12.5	96.0	20.2	8.65	29.4	19.3	11.0	4.00	10.9

Note: DM: dry matter, OM: organic matter, CP: crude protein, EE: ether extraction, NDF: neutral detergent fiber, ADF: acid detergent fiber, CF: crude fiber, ME: metabolism energy

Elephant grass was high in the fiber content as NDF, ADF and CF (63.5%, 40.9% and 30.6%, respectively) and low in the CP value (11.3%). Soybean extraction meal had higher values of crude protein than that of soya waste. Soybean extraction meal was used to supply CP in the experimental diet while elephant grass gave fiber components.

Table 2. Average ± SD of air temperature during the experimental period

Experimental periods	Average ± SD, ^oC	Max value, ^oC	Min value, ^oC
September 2019	28.7 ± 2.71	35.3	24.5
October 2019	29.9 ± 2.43	34.2	24.8
November 2019	29.2 ± 2.48	33.1	24.1
December 2019	27.6 ± 2.94	32.3	20.0
January 2020	28.9 ± 2.63	34.0	22.2
February 2020	28.3 ± 3.29	33.1	20.2
March 2020	29.9 ± 3.15	34.9	23.6
April 2020	31.1 ± 3.05	36.5	25.0

The average ambient temperature value was about 29.2°C, indicated experimental does exposure to sever heat stress during experiment period. A temperature of between 10-20°C is recommended as ideal for domestic rabbits. Environmental temperatures above 28^{o}C caused heat-induced physiological stress (Okab et al., 2008).

Table 3. Feed and nutrient intake of rabbit doeat three litters

Item, gDM		Treatments					±SE/P
		C0	***C125***	***C250***	***C375***	***C500***	
The first parity	Soya waste	29.1	28.9	28.9	29.3	29.2	0.21/0.474
	Soybean meal	42.2	43.2	42.6	41.7	43.8	0.61/0.192
	Elephant grass	40.1^{b}	39.9^{b}	41.4^{b}	46.0^{a}	45.9^{a}	0.92/0.001
	Vitamin C, mg	0.00^{e}	14.1^{d}	27.7^{c}	44.8^{b}	58.4^{a}	1.21/0.001
	DM	111^{c}	112^{bc}	113^{bc}	117^{ab}	119^{a}	1.13/0.002
	OM	103^{c}	104^{bc}	104^{bc}	108^{ab}	110^{a}	1.02/0.002
	CP	28.1^{b}	28.5^{ab}	28.3^{ab}	28.6^{ab}	29.5^{a}	0.28/0.042
	EE	8.63^{b}	8.71^{ab}	8.69^{b}	8.82^{ab}	9.04^{a}	0.07/0.018
	NDF	44.8^{b}	44.9^{b}	45.7^{b}	48.5^{a}	49.0^{a}	0.61/0.001
	ADF	28.8^{b}	28.9^{b}	29.4^{b}	31.2^{a}	31.5^{a}	0.39/0.001
	Ash	8.28^{c}	8.32^{c}	8.43^{bc}	8.89^{ab}	9.01^{a}	0.11/0.001
	ME, MJ/head/day	1.17^{b}	1.18^{b}	1.19^{b}	1.22^{ab}	1.24^{a}	0.01/0.006
The second parity	Soya waste	29.5	31.2	30.4	30.8	30.2	0.71/0.549
	Soybean meal	42.7	43.8	44.2	45.2	44.4	1.18/0.654
	Elephant grass	16.7^{b}	24.3^{ab}	29.5^{ab}	32.1^{a}	30.2^{ab}	3.07/0.026
	Vitamin C, mg	0.00^{e}	13.3^{d}	26.8^{c}	41.0^{b}	54.4^{a}	1.68/0.001
	DM	89.0^{b}	99.4^{ab}	104^{ab}	108^{ab}	105^{ab}	4.00/0.041
	OM	83.2^{b}	92.6^{ab}	96.8^{ab}	101^{a}	97.6^{ab}	3.64/0.043
	CP	25.7	27.4	28.0	28.8	28.1	0.78/0.133
	EE	78.1	8.38	8.55	8.80	8.59	0.24/0.114
	NDF	30.3^{b}	35.9^{ab}	39.0^{ab}	41.1^{a}	39.5^{ab}	2.15/0.028
	ADF	19.4^{b}	23.1^{ab}	25.1^{ab}	26.4^{a}	25.4^{ab}	1.38/0.029
	Ash	5.81^{b}	6.77^{ab}	7.32^{ab}	7.69^{a}	7.41^{ab}	0.37/0.029
	ME, MJ/head/day	1.03	1.12	1.15	1.19	1.16	0.03/0.074
The third parity	Soya waste	29.9	30.1	29.2	29.6	30.6	0.41/0.257
	Soybean meal	41.6	41.6	41.9	41.8	42.2	0.70/0.971
	Elephant grass	25.9^{b}	28.7^{ab}	30.6^{ab}	32.1^{a}	33.4^{a}	1.25/0.009
	Vitamin C, mg	0.00^{e}	13.5^{d}	26.3^{c}	39.8^{b}	54.1^{a}	0.90/0.001
	DM	97.4^{b}	100^{ab}	102^{ab}	104^{ab}	106^{a}	1.70/0.034
	OM	90.7^{b}	93.4^{ab}	94.6^{ab}	96.2^{ab}	98.6^{a}	1.55/0.036
	CP	26.4	26.8	27.0	27.1	27.6	0.37/0.251
	EE	8.08	8.21	8.25	8.32	8.50	0.11/0.165
	NDF	35.9^{b}	37.8^{ab}	38.8^{ab}	39.8^{ab}	41.0^{a}	0.89/0.015
	ADF	23.1^{b}	24.3^{ab}	24.9^{ab}	25.6^{ab}	26.4^{a}	0.57/0.015
	Ash	6.74^{b}	7.05^{ab}	7.25^{ab}	7.42^{ab}	7.62^{a}	0.16/0.017
	ME, MJ/head/day	1.09	1.11	1.12	1.13	1.16	0.02/0.086

Note: DM: dry matter, OM: organic matter, CP: crude protein, EE: ether extraction, NDF: neutral detergent fiber, ADF: acid detergent fiber, CF: crude fiber, ME: metabolism energy. The numbers with different superscript letters in the same row were significantly different (P<0.05)

The DM intake of soya waste and soybean meal were similar (P>0.05) among treatments while DM intake of elephant grass increased significantly (P<0.05) by increasing vitamin C supplement levels in the diets during three litters. Thus, nutrient intakes were improved significantly (P<0.05) by using vitamin C in the experimental diets. The DM intakes of experimental rabbits ranged 111-119; 89.0-105; 97.4-106 g/doe/day corresponding to the first litter, the second litter and the third litter. Similarly, Dong and Thu (2013) reported that DM intakes of crossbred doe rabbits in the Mekong delta in Viet Nam were 118-135g/doe/day and 118-153g/doe/day for the first litter and the second litter, respectively. Additional, Latu et al. (2017) stated that DM intake of crossbred does (New Zealand White x California and California x Chinchilla breeds) in Nigeria ranged from 121 to 135 g/doe/day. However, Morsy et al. (2012) found that Egypt breed doe consumed about 133 to 161g/doe/day and 180 to 214g/doe/dayfor pregnant and lactating periods, respectively.

These results coincided with those obtained by Yousef et al. (2003) and Yassein et al. (2008) showed that the water supplement with ascorbic acid at 1 g/L increased daily feed consumption when compared with those of control group of New Zealand White doe rabbits. Feed and nutrient intakes in this study was in close agreement with those obtained by Abdel-Khalek et al. (2008) which results indicated that using vitamin C at 400mg/kg feed (C400) had the highest values for feed intake during pregnancy and lactation compare to E40, E80, E160, C200, E80C200 and E160C400 diets (E: vitamin E). The comfortable temperature for rabbits was 15 to 20°C, rabbits could with stand cold weather than warmer. The metabolic rate increased by about 20% in body when exposed to high air temperature ranged from 30 to 35°C (Gonzalez et al., 1971). Rising temperatures continues to be a barrier in rabbit production because of its adverse impacts on feed intake, live weight gain, feed efficiency, meat quality, mortality and health of rabbits (Maria et al., 2002; Hassan et al., 2016). Ascorbic acid supplementation helped to control the increase in body temperature and plasma corticosterone concentration. It also protected the immune system and it had an important role in bone formation through the growth rate (Pion et al., 2004; Asli et al., 2007).

Table 4. Reproductive performance of doe rabbits in three litters

	Item	**Treatments**					**±SE/P**
		C0	***C125***	***C250***	***C375***	***C500***	
The first parity	Gestation period, day	30.0	30.3	30.5	30.5	30.5	0.32/0.736
	Number of alive bunny at birth	5.00^{b}	5.75^{ab}	6.00^{ab}	6.25^{ab}	7.00^{a}	0.31/0.010
	Fetal death	1.00	0.00	0.30	0.00	1.00	0.27/0.035
	Mean weight at birth, g/bunny	50.5	49.4	56.5	53.6	51.6	4.16/0.754
	Weight of litter at birth, g	253^{b}	281^{ab}	337^{ab}	336^{ab}	361^{a}	22.0/0.023
	Number of bunny at weaning	4.75^{b}	5.50^{ab}	6.00^{ab}	6.00^{ab}	6.50^{a}	0.37/0.050
	Mean weight at weaning, g/bunny	353^{b}	357^{ab}	370^{ab}	389^{a}	388^{a}	7.37/0.011
	Weight of litter at weaning, g	1669^{b}	1964^{ab}	2216^{ab}	2334^{a}	2526^{a}	127/0.004
	Milk yield of doe, g/day	52.1^{b}	63.7^{ab}	65.9^{a}	68.0^{a}	72.3^{a}	3.06/0.006
	Milk suckling by bunny, g/bunny/day	11.1	11.8	11.1	11.6	11.2	0.96/0.976
	Meanweight gain of bunny, g/day	10.1^{b}	10.3^{ab}	10.5^{ab}	11.2^{a}	11.2^{a}	0.22/0.008
	Milk suckling/weight gain, g/g	1.10	1.15	1.06	1.04	1.00	0.09/0.777
	Viability (0-30day), %	95.0	95.8	100	96.4	92.9	4.15/0.810
	Mean weight of bunny at eyes open, g	107	123	128	130	132	6.50/0.114
	Bunny weight at 21 days, g	196	208	213	223	226	18.6/0.805

	Item	C0	C125	C250	C375	C500	±SE/P
		Treatments					
The second parity	Gestation period, day	30.2	31.8	30.8	31.5	31.8	0.55/0.275
	Number of alive bunny at birth	5.50	5.75	6.00	6.25	5.50	0.43/0.696
	Fetal death	1.00^{ab}	0.25^{b}	0.00^{b}	0.00^{b}	2.00^{a}	0.23/0.001
	Mean weight at birth, g/bunny	45.2^{b}	56.5^{a}	57.9^{a}	55.6^{a}	56.8^{a}	1.80/0.002
	Weight of litter at birth, g	248	327	346	350	314	28.8/0.153
	Number of bunny at weaning	5.00	5.25	5.75	6.00	5.50	0.44/0.554
	Mean weight at weaning, g/bunny	301	296	290	334	290	24.0/0.679
	Weight of litter at weaning, g	1504	1511	1695	1981	1590	149/0.206
	Milk yield of doe, g/day	57.0^{b}	66.7^{ab}	70.2^{a}	73.9^{a}	64.4^{ab}	2.63/0.007
	Milk suckling by bunny, g/bunny/day	11.4	13.3	12.4	12.5	11.8	1.26/0.850
	Mean weight gain for bunny, g/day	8.52	7.95	7.77	9.28	7.79	0.81/0.642
	Milk suckling/weight gain, g/g	1.43	1.72	1.57	1.38	1.53	0.18/0.720
	Viability (0-30day), %	94.7	90.8	95.8	96.4	100	4.10/0.529
	Mean weight of bunny at eyes open, g	123^{b}	124^{b}	135^{ab}	144^{a}	124^{b}	5.04/0.047
	Bunny weight at 21 days, g	194	193	212	229	210	18.0/0.623
The third parity	Gestation period, day	30.8	31.3	31.3	30.8	31.5	0.461/0.132
	Number of alive bunny at birth	5.75	6.00	5.00	4.50	4.00	0.376/0.652
	Fetal death	0.50	0.50	0.75	1.00	2.00	0.403/0.698
	Mean weight at birth, g/bunny	63.9	61.0	55.2	55.9	56.1	2.803/0.138
	Weight of litter at birth, g	367	366	276	252	226	27.23/0.813
	Number of bunny at weaning	5.75	6.00	5.00	4.50	4.00	0.376/0.652
	Mean weight at weaning, g/bunny	316	318	302	277	296	14.29/0.051
	Weight of litter at weaning, g	1811	1905	1512	1247	1172	135.0/0.908
	Milk yield of doe, g/day	60.9	62.7	63.3	64.0	68.4	1.959/0.916
	Milk suckling by bunny, g/bunny/day	10.7	10.5	12.7	14.6	17.7	1.238/0.541
	Mean weight gain for bunny, g/day	8.40	8.59	8.24	7.37	8.01	0.490/0.085
	Milk suckling/weight gain, g/g	1.27	1.26	1.55	2.00	2.22	0.145/0.760
	Viability (0-30day), %	100	100	100	100	100	-
	Mean weight of bunny at eyes open, g	124^{b}	128^{b}	125^{b}	132^{ab}	143^{a}	4.102/0.005
	Bunny weight at 21 days, g	199	196	198	201	203	13.87/0.224

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

The effects of experimental diets on the productivity of rabbit does were shown in Table 4. In the first litter, it was clear that does fed vitamin C showed the higher (P<0.05) number of alive bunny at birth and weaning, and milk yield than those the C0 diet. The highest values were found for the C500 treatment. In the second litter, the number of alive bunny at birth and weaning tend to slightly increased (P>0.05) by increasing vitamin C supplement levels in the diets. The milk yield of doe was enhanced (P<0.05) by using ascorbic acid in the rabbit does. In the third litter, the fetal death increased (P>0.05) by increasing dietary vitamin C levels with the higher value for the C500 diet. Thus, the number of alive bunny at birth and weaning decreased (P>0.05) for the C250, C375 and C500 treatments (5.00, 4.50, 4.00 and 5.00, 4.50, 4.00, respectively).

These results confirmed by Morsy et al. (2012) who reported that both size and weight of litters at birth, 21 days and weaning were improved by supplementing dietary ascorbic acid. The weight gain of bunny rabbits was affected by milk production, showing higher values of litter weight for diets supplemented with ascorbic acid than for control diet. The enhancement of reproductive performance obtained here in the vitamin C group is similar to that reported by Gadallah et al. (2004) in does fed a diet supplemented with 2 g of vitamin C/kg. Vitamin C supplementation significantly improved both overall mean receptivity and conception rate as compare to control. Compared to the control, vitamin C supplementation diets enhanced litter size at birth and weaning due to the potential benefit derived by modulating the neuroendocrine system during early development (Yassein et al., 2008). Moreover, the pre-weaning death percentage was lower in vitamin C group. It should be noted that vitamin C scavenges free O_2 radicals, so preventing the oxidative stress of the cell membrane of the digestive system and restoring efficient feed utilization (Abou-Zeid et al., 2000).

However, high intakes of vitamin C are considered to be of low toxicity. Leeson and Summers (2001) note that toxic levels of vitamin C interfere with oxidase systems in the liver. One sign is excess accumulation of iron in the liver.At higher amounts, Vitamin C may decrease the production of histamine, thereby reducing allergy potential. However, as demonstrated with several examples below, the effect of a regular, daily overdose of Vitamin C is not an acute event as experienced with a deadly, toxic substance, but a gradual change in mineral ratios and the progressive lowering of other essential elements, which over time can result in the development of moderate to serious medical problems. Daily overdose of vitamin C can lead to kidney stone in animal body due to a accumulation of oxalate and uric acid in urine. An excessive intake of vitamin C triggers acute gastrointestinal symptoms. Moreover, too much ascorbic acid results in acute deficiency symptoms of nutrients as B12 and copper (Ronald, 2016).

Table 5. Comparison the reproductive performance among three litters

Item	**Litter**			**±SE/P**		
	1	***2***	***3***	***Litter 1 vs 2***	***Litter 1 vs 3***	***Litter 2 vs 3***
Number of alive bunny at birth	6.00	5.80	5.05	0.26/0.447	0.36/0.016	0.29/0.018
Fetal death	0.45	0.65	0.95	0.20/0.330	0.24/0.047	0.18/0.110
Weight of litter at birth, g	314	317	297	15.4/0.828	25.8/0.536	23.6/0.414
Number of bunny at weaning	5.75	5.50	5.05	0.24/0.309	0.356/0.064	0.30/0.154
Weight of litter at weaning, g	2142	1656	1529	90.8/0.001	146/0.001	115/0.283
Milk yield of doe, g/day	64.4	66.5	63.9	1.84/0.272	1.77/0.758	1.75/0.147

A comparison of reproductive criteria of experimental does among three litter was showed in the Table 5. There was no significant difference ($P>0.05$) in number of bunny at weaning and milk yield of doe among three litters while number of alive bunny at birth in litter 1 and 2 was significantly higher ($P<0.05$) than that of litter 3. Beside, weight of litter at weaning in litter 1 (2142g) was higher ($P<0.05$) than that of litter 2 and 3.

Table 6. Analysis of economic returns of experimental doe rabbits of three litters (VND)

Item	Treatments				
	C0	***C125***	***C250***	***C375***	***C500***
Feed cost	135.124	140.220	142.136	145.495	147.216
Medicine cost	30.000	30.000	30.000	30.000	30.000
Total expense	165.124	170.220	172.136	175.495	177.216
Income from selling rabbits	1.162.500	1.256.250	1.256.250	1.237.500	1.200.000
Raw return	997.376	1.086.030	1.084.114	1.062005	1.022.784

Note: Cost were 75.000 VND/ weaned rabbit, 1.000 VND/kg soya waste, 10.000 VND/kg soybean meal, 500 VND/kg fresh elephant grass, 300.000 VND/kg ascorbic acid, 22.000VND=1USD

In Table 6 analysis of economic returns of experimental rabbits were supplemented ascorbic acid in the diets during three litters indicated that the lower total expense but higher income for the C125 treatment, resulting in giving more benefits.

CONCLUSIONS

Ascorbic acid could be used for rabbit doe diets at a level of 125mg/kgDM to improve feed and nutrient intakes, reproductive performance and profits. Long term study should be done to confirm its effects ondoe reproduction for an application.

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