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Full Length Research Paper

Growth response and nutrient digestibility of pre-pubertal rabbit bucks fed cottonseed cake-based diets supplemented with vitamin E

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A study was conducted to investigate the growth response and nutrient digestibility in rabbit bucks fed cottonseed cake (CSC)-based diets supplemented with vitamin E. 64 weanling rabbit bucks, aged five to six weeks and weighing averagely 511.28 g were involved in the study. The bucks were randomly allocated to eight treatment combinations comprising four levels (0, 5, 10 and 15%) of CSC and two levels (0 and 30 mg/kg diet) of vitamin E in a 2 × 4 factorial experiment. Eight (8) bucks were assigned to each dietary treatment and fed the experimental diets for eight weeks. The CSC level had no significant ($p > 0.05$) effect on feed intake, final body weight, weekly weight gain and feed efficiency. Also, vitamin E supplementation did not affect ($p > 0.05$) the growth parameters. All the growth parameters measured were not affected ($p > 0.05$) by the interaction between CSC and vitamin E supplementation. Digestibility of nutrients-dry matter, crude protein, crude fibre, ether extract and ash was not significantly ($p > 0.05$) affected by CSC level, vitamin E supplementation and their interaction. Mortality was high for the bucks that were fed CSC irrespective of vitamin E supplementation. It was concluded that, although rabbit bucks may be fed CSC up to 15% inclusion level in diet for meat production, it is deleterious for young bucks whose digestive tract is not mature enough to handle gossypol in the CSC.

Key words: Growth, digestibility, pre-pubertal bucks, cottonseed cake, vitamin E.

INTRODUCTION

Feed ingredients for livestock production, especially those that are sources of protein and energy, have witnessed astronomic price increases in the last two decades with the resultant increase in the price of animal products. This has led to frantic efforts by animal scientists in search of unconventional feed ingredients that can safely replace the often expensive conventional ones. One of the conventional feed resources that are used for limited classes of livestock (the ruminants) is cottonseed cake. Cottonseed cake (CSC) is available in large quantity in Nigeria and is relatively cheaper than the popular protein ingredients (soyabean meal and groundnut cake). However, the CSC contains gossypol, which is toxic to monogastric animals (Lindsey et al., 1980; Calhoun et al., 1990). As a result, its use in livestock feeding is restricted to ruminant species which have the capacity to detoxify the gossypol present in the cottonseed cake. Thus, cottonseed cake would be a very useful source of energy and protein for many livestock species if the gossypol contained in it is detoxified. One

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Abbreviations: SEM, Standard error of mean; **CSC,** cottonseed cake.

of the mechanisms by which gossypol affects physiological processes is by generation of free radicals, which are damaging by-products of body metabolism (Barhoumi and Burghardt, 1996).

It has been suggested by Bender et al. (1988), Lane and Stuart (1990) and Velasquez-Pereira et al. (1998) that antioxidants are important in the metabolism of gossypol. Antioxidants have been known to scavenge for free radicals in the body. One effective antioxidant that is not expensive and that is readily available is vitamin E (tocopherol). Vitamin E, a chain breaking antioxidant, has been reported to counter the deleterious effects of gossypol in rats (Bender et al., 1988) and cattle (Velasquez-Pereira et al., 1998). However, there is paucity of information on the effect of CSC and vitamin E supplementation on the growth performance and nutrient digestibility of rabbit bucks. This study was therefore conducted to evaluate the growth performance and nutrient utilization of pre-pubertal rabbit bucks fed dietary cottonseed cake. The present work was also aimed at determining the effect of vitamin E on the adverse effect (if any) of gossypol contained in the CSC on the growth response and digestibility by the bucks.

MATERIALS AND METHODS

Site of experiment

The study was conducted at the Rabbitry Unit of the Teaching and Research Farm of Ladoke Akintola University of Technology, Ogbomoso, Oyo State. Ogbomoso is an urban city located on latitude 8º 07' N and Longitude 4º 15' E with a mean annual rainfall of 1224.7 mm and a relative humidity of between 75 and 95%. The region has a mean annual temperature of about 26.2°C and it is about 600 mm above sea level (Adediran, 1977).

Sources of ingredients

Cottonseed cake was obtained from a commercial dealer in Kano who purchases it directly from oil extraction industries in Kano State and some other neighboring states. The vitamin E used for this study was of Evitol® brand containing dl-alpha tocopherol acetate. It was in tablet form, manufactured by Teva Pharmaceutical Industries Limited, Petah-Tikva. It was obtained from a reputable pharmaceutical store in Ibadan Nigeria. The product is available in most pharmacy shops. Other feed ingredients were obtained from SF Feed Ingredients Enterprises Nigeria Limited, Ogbomoso, Oyo State.

Animals and management

64 weanling rabbit bucks, aged five to six weeks were used for this experiment. The bucks, obtained from a reputable farm in Ibadan, Oyo State, were of mixed breeds (crosses of New Zealand White × Chinchilla breeds). The rabbits were balanced for weight and allocated to eight dietary treatment combinations comprising four CSC levels, (0, 5, 10 and 15%) and two vitamin E levels (0 and 30 mg/kg diet). One week prior to stocking, the cages were disinfected. Before the commencement of the experiment, animals were allowed to acclimatize for one week and were treated against endo- and ecto-parasites. Feed was supplied *ad libitum* with an allowance of 100 g/day. Clean, cool drinking water was available all the time. During the acclimatization period, animals were maintained on the control diet containing 16% crude protein and about 2500 kcal/kg metabolizing energy (ME). Hutches were cleaned daily and refusals from the previous feeding were measured daily to determine feed intake. Rabbits were housed individually in wooden metabolic cages, each unit measuring 44 × 44 × 34 cm, with screened floors raised to a height 45 cm from the concrete floor. The screened floor permitted faeces and urine to fall out of the reach of the rabbits and were retained in the collecting tray at the base of the cage. This allowed for easy emptying of the tray. Feeding was done twice a day, 08:00 h and 16:00 h (8:00 am and 4:00 pm). Eight rabbit bucks were allocated to each treatment, each rabbit constituting a replicate.

Diet preparation

Eight dietary treatments (T_1 to T_8) were compounded to contain four levels of cottonseed cake: 0, 5, 10 and 15%, corresponding to T_1, T_2, T_3 and T_4, and two levels of vitamin E supplementation. Treatments 1 to 4 were not given additional vitamin E supplementation apart from the one supplied by the premix, while treatments 5 to 8, containing the same levels of cottonseed cake as treatments 1 to 4, were further supplemented with vitamin E. Vitamin E was mixed with diets at a dose of 30 mg/kg diet (Amao et al., 2012). All diets were isonitrogenous and isocaloric, containing 16% crude protein (CP) and about 2500 kcal/kg ME. The gross composition and calculated nutrients of the experimental diets are shown in Table 1.

Data collection

Data were obtained for the following parameters: 1) feed intake (on daily basis), 2) weight gain (initial weight, weekly weight gain), 3) feed efficiency, and 4) mortality.

Feed intake

Daily feed intake was determined by subtracting the refusals from the amount of feed offered per animal per day.

Weight gain

Animals were weighed at the beginning of the experiment (initial weight) and subsequently once per week using a sensitive electronic weighing balance.

Feed efficiency

Feed efficiency was computed using the formula:

$$FE = \frac{\text{Weight gain (g)}}{\text{Feed intake (g)}}$$

Mortality

Mortality records were taken by recording the bucks that died and their corresponding dates. This allowed for the determination of length of tolerance of CSC in diets by different treatment groups.

Table 1. Gross composition and calculated nutrients of experimental diets for pre-pubertal rabbit bucks.

Parameter	-Vitamin E				+Vitamin E			
	T1	T2	T3	T4	T5	T6	T7	T8
Ingredient (%)	**0% (CSC)**	**5% (CSC)**	**10% (CSC)**	**15% (CSC)**	**0% (CSC)**	**5%**	**10%**	**15%**
Maize	44.04	42.37	40.66	40.15	44.04	42.37	40.66	40.15
Groundnut cake	20.21	17.90	15.59	13.10	20.21	17.90	15.59	13.10
Rice husk	30.00	29.00	28.00	26.00	30.00	29.00	28.00	26.00
Cottonseed cake	0.00	5.00	10.00	15.00	0.00	5.00	10.00	15.00
Fishmeal	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Bonemeal	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Oyster shell	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Vitamin/mineral premix*	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Salt	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Vitamin E	-	-	-	-	-	0.003	0.003	0.003
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Calculated nutrients								
Crude protein (%)	16.00	16.01	16.00	16.01	16.00	16.01	16.00	16.01
Metabolizable energy** (ME)(kcal/kg diet)	2523.07	2515.75	2507.04	2520.70	2523.07	2515.75	2507.04	2520.70
Crude fibre (%)	11.00	11.72	12.51	13.03	11.00	11.72	12.51	13.03
Lysine (%)	0.546	0.547	0.548	0.549	0.546	0.547	0.548	0.549
Methionine (%)	0.223	0.227	0.231	0.237	0.223	0.227	0.231	0.237
Free gossypol (ppm)	0.00	1.45	2.98	4.46	0.00	1.45	2.98	4.46

**Calculated using Pauzenga (1985) formula (kcal/kg),*premix composition (per kg of diet): vitamin A, 12500 IU; vitamin D3, 2500 IU; vitamin E, 50.00 mg; vitamin K3, 2.50 mg; vitamin B1, 3.00 mg; vitamin B2, 6.00 mg; vitamin B6, 6.00 mg; niacin, 40 mg; calcium pantothenate, 10 mg; biotin, 0.08 mg; vitamin B12, 0.25 mg; folic acid, 1.00 mg; chlorine chloride, 300 mg; manganese, 100 mg; iron, 50 mg; zinc, 45 mg; copper, 2.00 mg; iodine, 1.55 mg; cobalt, 0.25 mg; selenium, 0.10 mg; and antioxidant, 200 mg.

Mortality was expressed as the percentage of the total number of bucks in a treatment at the beginning of the experiment.

Proximate analysis

Samples of feed and cottonseed cake were subjected to laboratory analysis for proximate composition. Analysis was done for dry matter, crude protein, crude fiber, ether extract and ash using the standard methods of the Association of Official Analytical Chemists (AOAC, 1990). Nitrogen free extract was then calculated.

Digestibility trial

At the end of the growth trial, four rabbits per treatments whose weights were close to the mean for the group were selected and housed individually in the metabolic cage. The cages were equipped with facilities for separate collection of faeces and urine. Each animal had access to separate feeding and water cups. Record of feed intake was taken daily. Total faeces voided were collected daily for six days. The faeces were weighed daily and oven-dried in a unitherm oven at 105°C for 24 h. The dried faeces were bulked and milled; and the representative samples for each group were stored in sealed bottles for laboratory analysis. Feed and faecal samples were analyzed for dry matter, crude protein, crude fibre, ether extract and ash using the conventional methods of AOAC (1990). Protein was determined by the Macro-Kjeldah technique and fat was determined using Soxhlet ether extractor apparatus. Minerals digested were determined by ashing the samples in a muffle furnace. Apparent nutrient digestibility was obtained by calculation using the formula:

$$\text{Nutrient digestibility (\%)} = \frac{\text{Nutrient intake (g DM) - Nutrient in faeces (g DM)} \times 100}{\text{Nutrient intake}}$$

Where nutrient, could be dry matter (DM), crude protein (CP), crude fibre or crude fat.

Statistical analysis

Data were subjected to statistical analysis of variance (ANOVA) using General Linear Model for a 2 × 4 factorial in a completely randomized design of SAS (1999). Means were separated by Duncan's option of the same statistical software.

RESULTS

The proximate composition of experimental diets and test ingredients for pre-pubertal rabbit bucks is presented in Table 2. The dry matter content was similar for diets containing 0, 5, 10 and 15% CSC. The values ranged from 89.58 for 5% CSC diet to 89.70 for 10% CSC diet. The crude protein values were similar among

Table 2. Proximate composition of experimental diets and test ingredient for pre-pubertal rabbit bucks.

Parameter (%)	T_1 (0% CSC)	T_2 (5% CSC)	T_3 (10% CSC)	T_4 (15% CSC)	SEM	CSC
Dry matters	89.67	89.58	89.70	89.59	0.12	93.72
Crude protein	16.27	16.59	16.10	16.35	0.26	40.72
Crude fibre	9.83	9.74	8.93	9.18	0.47	11.79
Ether extract	3.57	3.52	3.61	3.54	0.05	2.50
Ash	8.06	7.93	7.88	8.23	0.07	4.95
Nitrogen free extract	51.94	51.8	53.19	52.29	0.23	
Gross energy (kcal/g)	4.13	4.22	4.18	4.07	0.08	

Table 3. Effect of dietary cottonseed cake on the growth performance of pre-pubertal rabbit bucks.

Parameter (%)	T_1 (0% CSC)	T_2 (5% CSC)	T_3 (10% CSC)	T_4 (15% CSC)	SEM
Initial weight (g)	498.75	552.50	494.17	502.50	32.55
Final weight (g)	907.21	925.23	825.75	877.94	57.04
Total weight gain (g)	408.27	372.73	331.58	375.44	39.26
Weekly weight gain (g)	51.03	46.59	41.45	46.93	4.91
Weekly feed Intake (g)	205.56	211.55	202.96	201.24	13.94
Feed efficiency	0.25	0.22	0.20	0.23	0.35

Table 4. Effect of vitamin E supplementation on the growth characteristics of pre-pubertal rabbit bucks fed cottonseed-based diets.

Parameter	-Vitamin E	+Vitamin E	SEM
Average initial weight (g)	531.46	492.50	23.15
Average final weight (g)	897.92	870.05	40.57
Average total weight gain (g)	366.46	377.55	27.93
Average weekly weight gain (g)	45.86	47.19	3.49
Average weekly feed intake (g)	205.63	205.02	9.86
Feed efficiency	0.22	0.23	0.35

experimental diets and were consistent with the calculated value (16.0%). The values ranged between 16.10 (10% CSC) to 16.59 (5% CSC). The crude fibre content tended to decline up to 10% CSC and then increased. The proximate composition of test ingredient showed that the CSC used in this study contained 93.72% dry matter, 40.72% crude protein, 11.79% crude fibre, 2.50% ether extract and 4.95% ash.

Pre-pubertal growth performance

Table 3 shows the effect of dietary cottonseed cake on the growth performance of pre-pubertal rabbit bucks. Cottonseed cake level had no significant ($P > 0.05$) effect on the final weight, total weight gain, weekly weight gain, weekly feed intake and feed efficiency. Table 4 shows the effect of vitamin E supplementation on the growth characteristics of pre-pubertal rabbit bucks fed cottonseed-based diets. The effect of vitamin E supplementation on the growth characteristics was not significant ($P > 0.05$). Although rabbits that were supplemented with vitamin E tended to have higher weekly weight gain than those that were not supplemented, the difference was not significant ($P > 0.05$). The interaction effect of cottonseed cake and vitamin E supplementation on the growth characteristics of pre-pubertal rabbit bucks is presented in Table 5. Average total weight gain, average weekly weight gain and average weekly feed intake for rabbit bucks fed 0, 5, 10 and 15% CSC without vitamin E supplementation were not significantly ($P > 0.05$) different from each other and from their counterparts supplemented with vitamin E. However, vitamin E supplemented group at 5% CSC

Table 5. Interaction effect of cottonseed cake and vitamin E supplementation on the growth performance of pre-pubertal rabbit bucks.

Parameter	Vitamin E	CSC level (%)				SEM
		0	5	10	15	
Average initial weight(g)	-Vitamin E	512.50	525.00	533.33	555.00	25.30
	+Vitamin E	485.00	580.00	455.00	450.00	18.57
	SEM	28.04	30.96	35.30	31.15	
Average final weight (g)	-Vitamin E	909.63	835.25	876.67	970.13^{x}	40.30
	+Vitamin E	904.42^{ab}	1015.20^{a}	774.83^{b}	785.75^{by}	39.51
	SEM	46.11	61.01	63.24	53.23	
Average total weight gain (g)	-Vitamin E	397.13	310.25	343.33	415.13	24.25
	+Vitamin E	419.42	435.20	319.83	335.35	29.66
	SEM	34.20	37.74	40.82	35.35	
Average weekly weight gain (g)	-Vitamin E	49.64	38.78	42.92	51.89	3.03
	+Vitamin E	52.43	54.40	39.98	41.97	3.71
	SEM	4.28	4.72	5.10	4.42	
Average weekly feed intake (g)	-Vitamin E	203.92	220.77	189.83	208.00	9.48
	+Vitamin E	207.19	202.33	216.10	194.47	10.10
	SEM	14.04	14.23	13.22	14.04	
Feed efficiency	-Vitamin E	0.24	0.18	0.23	0.25	
	+Vitamin E	0.25	0.27	0.19	0.22	
	SEM					
Mortality %	-Vitamin	0.00	37.50	37.50	50.00	
	+Vitamin	0.00	25.00	37.50	37.50	
Days of mortality	-Vitamin	-	15-53	10.49	8-45	
	+Vitamin	-	24-52	15-50	11-54	

[a, b]Means along the same row with different superscripts differ significantly ($p<0.05$), [x, y]Means within the same column with different superscripts differ significantly ($p < 0.05$).

tended to gain more weight per week than their counterparts that were not supplemented with vitamin E. Mortality supplementation (37.50 and 50.00%, respectively) than for those that was higher for rabbit bucks fed 5 and 15% CSC without vitamin E were supplemented with vitamin E (25.00 and 37.50%, respectively); whereas no mortality was recorded for the control group with and without vitamin E supplementation.

Nutrient digestibility

Effect of cottonseed cake level on apparent digestibility in pre-pubertal rabbit bucks is presented in Table 6. Dry matter, crude protein, ether extract and ash digestibilities were not significantly affected ($P > 0.05$) by cottonseed cake level. Only crude fibre digestibility was significantly affected ($P < 0.05$) by the CSC level. Crude fibre digestibility for 5% CSC did not differ from that of the control. However, it was significantly higher than that of 10% CSC. At 15% CSC, crude fibre digestibility was not significantly different ($P > 0.05$) from that of other levels. The main effect of vitamin E supplementation on the apparent digestibility in pre-pubertal rabbit bucks is presented in Table 7.

All parameters, except ether extract, were not significantly ($P > 0.05$) affected by vitamin E supplementation. Vitamin E supplementation lowered ether extract digestibility significantly ($P < 0.05$). Table 8 shows the interaction effect of CSC and vitamin E supplementation on the apparent digestibility in pre-pubertal rabbit bucks. The interaction between CSC and vitamin E supplementation had no significant ($P > 0.05$)

Table 6. Effect of cottonseed cake level on apparent digestibility of nutrients by pre-pubertal rabbit bucks.

Parameter (%)	T_1 (0% CSC)	T_2 (5% CSC)	T_3 (10% CSC)	T_4 (15% CSC)	SEM
Dry matter	72.59	75.92	69.92	71.92	2.80
Crude protein	83.87	86.30	83.52	84.67	2.80
Ether extract	90.24	67.96	84.24	85.00	3.02
Crude fibre	90.71	91.82	87.25	89.62	1.07
Ash	78.62	81.05	76.87	79.40	2.23

Table 7. Effect of vitamin E supplementation on the apparent nutrient digestibility by pre-pubertal rabbit bucks fed cottonseed cake-based diets.

Parameter (%)	-Vitamin E	+Vitamin E	SEM
Dry matter	73.16	72.01	1.98
Crude protein	85.39	83.79	1.19
Ether extract	89.69[a]	82.52[b]	2.13
Crude fibre	79.49	78.47	1.58
Ash	79.49	78.47	1.58

[a,b]Means along the same row with different superscripts are significantly different ($p < 0.05$).

Table 8. Interaction effect of cottonseed cake and vitamin E supplementation on the apparent digestibility of nutrients by pre-pubertal rabbit bucks.

Parameter	Vitamin E	CSC level				SEM
		0%	5%	10%	15%	
Dry matter	-Vitamin E	78.98	72.93	73.61	70.11	1.22
	+Vitamin E	69.2	78.91	66.22	73.72	2.55
	SEM	3.67	2.11	3.55	1.16	
Crude protein	-Vitamin E	85.75	84.62	87.03	84.17	0.72
	+Vitamin E	82.00	87.97	80.01	85.18	1.54
	SEM	2.15	1.19	2.29	0.78	
Ether extract	-Vitamin E	90.59	89.3	90.13	88.73	0.46
	+Vitamin E	89.86	86.62	72.3	81.27	3.11
	SEM	1.67	2.62	4.99	2.7	
Crude fibre	-Vitamin E	91.76	90.73	88.76	89.01	0.50
	+Vitamin E	89.66	92.91	85.74	90.22	1.05
	SEM	1.27	0.74	1.51	0.42	
Ash	-Vitamin E	82.29	78.59	75.59	77.50	0.96
	+Vitamin E	74.94	83.50	74.14	84.14	2.06
	SEM	3.07	1.67	2.79	0.96	

effect on digestibility of any of the parameters namely dry matter, crude protein, ether extract, crude fibre and ash, that is, nutrient digestibility with or without vitamin E supplementation across the CSC levels did not differ significantly ($P > 0.05$).

DISCUSSION

Proximate composition

The similarities observed in CP, DM, CF, ether extract

(EE) and nitrogen free extract (NFE) in this study indicate the isonitrogenous and isocaloric nature of the diets. The observation also suggests that all animals were given fair treatment in terms of nutritional adequacy.

Growth performance

The growth performance of the pre-pubertal rabbit bucks as indicated by final live weight, total weight gain, weekly weight gain, weekly feed intake and feed efficiency were not significantly ($P > 0.05$) affected by CSC level. This suggests that the diets contained adequate amount of protein and other nutrients and that the rabbit bucks were able to utilize them very well for body building. This also indicates that cottonseed cake supported the growth of the pre-pubertal bucks at the levels of inclusion used in this study. This result disagrees with the report of Taha et al. (2006) who reported that body weight of rabbits that were given high dose of gossypol was significantly reduced compared with the control, while the low dose of gossypol (4 mg/kg LW) had no effect. However, the observation that feed intake was not significantly affected from this study by dietary CSC, is in agreement with the report of Taha et al. (2006). Earlier workers, Chase et al. (1994), observed that bulls fed whole cottonseed for 196 days gained less body weight and exhibited lower gain/feed than bulls fed cottonseed meal or soyabean meal. Other workers had reported decreased feed intake and digestibility when whole cottonseed was greater than 30% of the diet (Coppock et al., 1985; Warren et al., 1988). In this study, the non-significant variations observed for performance parameters could be due to the main effect of CSC which was regardless of the vitamin E supplementation. The result from this study also supports the observation of Gray et al. (1993) and Velasquez-Pereira et al. (1998) that average daily gain, total gain and final body weights were not affected by cottonseed meal in diets of beef heifers and bulls, respectively.

The effect of vitamin E supplementation on the pre-pubertal bucks fed cottonseed cake based diets did not have significant effect on final weight, average total weight gain, or weekly weight gain and feed intake. These data indicate that irrespective of CSC level, supplementation with vitamin E did not influence feed intake and weight gain. The interaction effect of CSC level and vitamin E supplementation did not significantly ($P > 0.05$) influence weekly feed intake, weekly weight gain and total weight gain in this study. This observation is in contrast to the report of Calhoun et al. (1990) who reported that vitamin E supplementation increased average daily gain in lambs fed a diet containing 20% cottonseed meal, a response that was attributed to the effect of vitamin E. The variation observed in this work is probably due to the species and sex variation, as well as short duration (eight weeks) of exposure of the pre-pubertal bucks to the experimental diets. The result of this study however agrees with the report of Velasquez-Pereira et al. (1998) that vitamin E supplementation did not affect average daily gain, total gain and final body weight of bulls fed cottonseed meal based diets.

Nutrient digestibility

The findings from this study revealed that CSC level did not significantly ($P > 0.05$) affect digestibility of dry matter, crude protein, ether extract and ash. However, crude fibre digestibility was significantly ($P < 0.05$) affected. Similar observation has been reported for Angora rabbits (Singh and Negi, 1987). Probably, the level of gossypol in the CSC did not affect the availability of nutrients in the diets. It has been suggested that free gossypol could bind to soluble protein in diets, thereby impairing its utilization. In this study, the observation that there was no significant difference among treatment means for crude protein digestibility suggests that the gossypol in CSC used in this study did not bind to the protein as to impair its availability and utilization. This observation also suggests that other possible anti-nutritional factors that might be contained in the CSC were in negligible amounts. The observation that crude fibre digestibility was significantly ($P < 0.05$) affected by CSC level was a reflection of the fact that varying levels of CSC in diet could cause appreciable alteration in the fibre component of a diet, and hence its utilization.

The observation that vitamin E supplementation did not affect the digestibility of any nutrient except ether extract indicated that vitamin E did not play any significant role to make the nutrient more utilizable. It also establishes the relationship that vitamin E has with fats and fat related substances, being a fat soluble vitamin. One of the functions of vitamin E is to unclog the blood vessels by clearing the fats that could have otherwise obliterated the blood vessels, thereby making room for absorption and utilization of other fat related vitamins such as vitamins A, D and K. It could also be suggested that, since the diets used in this study were cottonseed cake-based and the CSC is an oil seed by-product, probably vitamin E has a way of making diets that contain fat-related products more digestible. The high mortality rate observed in this study for the bucks that were fed CSC-based diets with or without vitamin E supplementation could be due to the age of the bucks. Probably the gut of the bucks was not yet mature to handle the gossypol in the CSC-based diets.

Conclusion

Although rabbit bucks may be fed diets containing cottonseed cake up to 15% inclusion level for meat production, the CSC appears to be deleterious to weanling rabbit bucks whose digestive tract is not yet

mature enough to handle the gossypol in the CSC. Supplementation of CSC-based diets with vitamin E, in this study, was not potent enough to counter the deleterious effect at this stage. Thus, feeding of CSC to weanling rabbit bucks should be discouraged.

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