

Nutritional effects of toasted castor seed meal based-diets on growth and blood parameters of grower rabbits supplemented with quantum blue® enzyme

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Abstract

Rabbits are known to be highly prolific animals with short gestation period and can thrive well on cheaper and available alternative feeds such as castor seeds especially when properly processed and supplemented with the right additive. Twenty weaner composite rabbits weighing approximately 660.45 ± 12.05 g/rabbit were utilized in an experiment to evaluate effect of toasted castor seed meal (TCSM) on growth and blood parameters of grower rabbits supplemented with quantum blue® enzyme. The rabbits were allotted to four isonitrogenous (15% crude protein) and isocaloric (2850kcal/kg, ME) diets with two levels (0 and 30%) of TCSM and two levels of enzymes (0 and 100PPM) in a 2X2 factorial arrangement of a Completely Randomized Design. Growth parameters and blood constituents were measured. The results obtained showed that all the growth parameters evaluated were not significantly ($P > 0.05$) influenced by enzyme supplementation except for initial weight which was significantly ($P < 0.05$) reduced (1818.75 vs. 1368.75 g/rabbit). Similarly, inclusion of TCSM significantly ($P < 0.05$) reduced initial (1862.50 vs. 1325.00 g/rabbit) and final (2112.50 vs. 1204.17 g/rabbit) weights of the rabbits. Also, there was significant improvement ($P < 0.05$) in serum calcium (3.00 mmol/L), creatinine (82.67mg/L) and albumin concentration (25.67 vs. 30.67 and 25.33 g/L) in rabbits fed high TCSM and enzyme supplementation. In conclusion, inclusion of 30% TCSM supplemented with quantum blue® enzyme at 100 ppm reduced the effect of TCSM on the animals and improves acceptance, absorption and utilization of feed by grower rabbits without compromising their health status.

Keywords: Castor seeds, grower rabbits, quantum blue® enzyme, ricin, serum biochemical constituents, toasting.

Introduction

Castor (*Ricinus communis*) seeds have remained the most important non-edible oilseed crop of the arid and semi-arid regions (Soetan and Oyewole, 2007). Reports on feeding of castor seed meal to livestock showed that it has huge potential as a tropical feed resource because of its high nutrient profile (Akande and Odunsi, 2012). The vast quantities of defatted meal generated from oil processing industries particularly in Asia and Africa are capable of reducing cost of feeding farm animals. However, its use as animal feed has been largely restricted because of inherent toxins (Nagalakshmi and Dhanalakshmi, 2015).

The use of exogenous enzymes as a means of alleviating the effect of these toxins as well as effective utilization of the inherent nutrients in the feeding stuff has been advocated. Some of the functions of exogenous enzyme include degrading the phytate found in plant-based ingredient, releasing phosphorus, increasing feed efficiency, unraveling intrinsic thermo stability and it releasing of calcium and other mineral ions that would typically chelate and be bound to the phytate by making it unavailable for absorption (Alu, 2012). The mechanisms of quantum blue enzyme are that it breaks down the phytate faster and gets to the site of action intact.

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This revolutionary product survives the rigors of feed processing trial conducted in commercial feed mills and has shown excellent recovering of quantum blue because the product is intrinsically thermo stable, which ensures that the enzyme is able to get to work quickly (Bio-ingredient Ltd, 2004). The rising cost of feeding farm animals occasioned by the rising cost of cereal grain, maize to be precise, have caused many farmers to resort to rabbit production to bridge the wide gap between demand and supply of animal protein (Cheeke, 1987). The choice of this species of livestock is basically for the fact that it has been known to be one of the major sources of animal protein (Amaefule *et al.*, 2004) because it is a cheap source of white meat that takes very little cost to produce (Luke Fahr and Cheeke, 1991). Rabbits are known to be highly prolific animals with short gestation period and can thrive well on cheaper and available alternative feeds such as castor seeds especially when properly processed and supplemented with the right additive. Again, there is a stiff competition between man and monogastric animals for available conventional feeds stuffs like cereal grains and other oilseeds (Agunbiade *et al.*, 2001). This has resulted in high cost and at times, poor quality of feed sold to farmers (Iheukwumere *et al.*, 2002). There is therefore need to source for alternative protein sources that have no direct use by man, and which also has no immediate industrial use. Castor seed fits into these qualities and has been found a good protein source. The study was therefore designed to evaluate the effect of utilization of toasted castor seed meal supplemented with or without blue enzyme on serum biochemistry of grower rabbits.

Materials and methods

The experiment was carried out at the Teaching and Research Farm of the Faculty of Agriculture, Nasarawa State University.

The farm is located in Shabu, Lafia, in Nasarawa State, in the Guinea Savanna zone of North Central Nigeria. It is located on latitude 08° 35' N and longitude 08° 33' E; the mean monthly maximum and minimum temperatures are 35.06 and 20.16°C, respectively while the mean monthly relative humidity is 74%. Annual rainfall is about 168.90mm (NIMET, 2008). Quantum blue® was purchased from Bio-ingredients Ltd, Abuja. It is manufactured by Nutrex/NV (Belgium) and packaged in 1kg sachets. It is a powdery multi-enzyme compound containing β -glucanase, xylanase, phytase and arabinoxylanase. The rabbits were housed in cages. The cages which were located inside the rabbit building equipped with good ventilation through windows finished with wire gauze. Each hutch unit (100cmx40cmx40cm), accommodated one rabbit, partitioned with wood and wire mesh and fitted with aluminum drinkers and feeders (15cmx10cmx10cm).

Management of experimental animals

Twenty weaner composite rabbits weighing approximately 660.45±12.05g/rabbit of mixed breeds and sexes were used. Each rabbit was housed in a hutch unit and fed the experimental diets (Table 1) and water was given *ad libitum* during the experimental period. The rabbits were given coccidiostat and dewormed before the start of the experiment. Other routine management practices were adopted as outlined by Alu *et al.* (2009).

Experimental diets

Four diets were compounded to be isonitrogenous (15% crude protein) and isocaloric (2850kcal/kg, ME) with two levels (0 and 30%) of TCSM. Treatments T1 and T2 contained 0% TCSM with 0 and 100ppm of enzyme, treatments T3 and T4 contained 30% TCSM with 0 and 100ppm of enzyme, respectively. The nutrients were balanced to meet the nutrient requirements of grower rabbits (Table 1).

Experimental design

The experimental design was a 2x2 factorial setting fitted into Completely Randomized Design (CRD). The following statistical model was used: $Y_{ij} = \mu + A_i + B_j + (AB)_{ij} + \epsilon_{ijk}$, where, Y_{ij} = Individual observation, μ = general Mean, A_i = effect of Factor A, B_j = effect of Factor (AB) $_{ij}$ = effect of interaction AB and ϵ_{ijk} = experimental error.

Data collection

The rabbits were fed ad libitum and any left-over was recorded. The rabbits were weighed at the start of the experiment and subsequently on a weekly basis. Parameters measured were weight gain, feed intake, feed conversion ratio and protein efficiency ratio. Weight gain was calculated by subtracting initial live weight from final live weight, feed intake was determined by dividing the daily feed consumed by the rabbits. Weighing of rabbits was on individual basis and took place in the morning (8.00-9.00am) each week. Feed conversion ratio was determined by dividing feed intake by weight gain. Protein efficiency ratio was calculated as weight gain divided by protein intake while cost per kg weight gain was calculated as feed conversion ratio (FCR) x cost/1kg feed. At the end of the feeding trial of the grower phase, blood samples were collected for the evaluation of the haematological indices. The bloods were collected into sample bottles containing 1mg of dipotassium salts of ethylene diamine tetra acetic acid (EDTA-K²) to 1ml of blood. The haematological indices determined were packed cell volume (PCV), red blood cell count (RBC), white blood cell count (WBC) and haemoglobin concentration. PCV was determined using wintrobes micro haematocrit method (Margi, 1997); haemoglobin concentration was determined by the Cyanomethaemoglobin method as outlined by Kelly (1979). The improved Neubauerhaemocytometer method

as described by Jain (1986) was used to estimate the red and white blood cells. Mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) were computed according to Jain (1986).

Another blood samples were collected in another separate sample bottles without anti-coagulant to allow clotting for serum biochemical analysis. Constituents such as electrolytes (Na, Ca, and Cl), total protein, urea, creatinine, and albumin were analyzed using sigma kits according to Schalm *et al.* (1975).

Statistical analysis

Data obtained were subjected to Two Way Analysis of Variance and where significant differences ($P > 0.05$) were observed, means were separated using Duncan's Multiple Range Test (Duncan, 1955) as described by Steel and Torries (1980).

Results and discussion

The result of the effect of Quantum blue[®] enzyme supplementation or TCSM on the growth parameters of grower rabbit is presented in Table 2. All the growth parameters evaluated were not significantly ($P > 0.05$) influenced by enzyme supplementation except for initial weight (1818.75 vs. 1368.75 g/rabbit) which was significantly ($P < 0.05$) reduced. Similarly, inclusion of TCSM significantly ($P < 0.05$) reduced initial (1862.50 vs. 1325.00 g/rabbit) and final (2112.50 vs. 1204.17 g/rabbit) weights of the rabbits. The values recorded in the present study fell within the normal range as earlier reported by Alu (2018) who investigated the response of rabbits fed toasted kidney bean seed (*Phaseolus vulgaris*) meal (TKBSM) as a replacement for soybean meal and observed non-significant variation in most of the growth parameters evaluated. The author noted that the processing method being thermal, naturally denatures the

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Table 1: Percent gross composition of experimental diets for grower rabbits

Feedstuffs	DIETS			
	T1-	T2+	T3-	T4+
Maize	51.95	51.95	40.00	40.00
Soybeans(Fullfat)	15.00	15.00	17.00	17.00
Groundnut cake	12.00	12.00	6.00	6.00
Castor seed toasted	-	-	30.00	30.00
Bone meal	0.70	0.70	0.70	0.70
Fishmeal	5.00	5.00	4.00	4.00
Palm oil	5.00	5.00	0.55	0.55
Lysine	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25
Salt	9.60	9.60	1.00	1.00
Premix	0.25	0.25	0.25	0.25
Enzyme (ppm)	-	100	-	100
Total	100:00	100.00	100.00	100.00
Calculated nutrients and energy composition				
Energy (kcal/kg, ME)	2851.52	2851.52	2851.30	2851.30
Crude protein (%)	15.72	15.72	15.00	15.00
Crude fibre (%)	2.61	2.61	3.57	3.57
Calcium (%)	1.87	1.87	0.11	0.11
Phosphorus (%)	1.15	1.15	0.40	0.40

The vitamin – mineral premix supplied the following per 100kg of diet: Vitamin A 15,000 I.U., Vitamin D₃ 300,000 I.U., Vitamin E 3,000 I.U., Vitamin K 2.50mg, Thiamin, (B₁) 200mg, Riboflavin (B₂) 600mg, Pyridoxine (B₆) 600mg, Niacin 40.0mg, Vitamin B₁₂ 2mg, Pantothenic acid 10.0mg, Folic acid, 100mg, Biotin 8mg, Choline chloride 50g, Anti-oxidant 12.5g, Manganese 96g, Zinc 6g, Iron 24g, Copper 0.6g, Iodine 0.14g, Selenium 24mg, Cobalt 214mg.

Table 2. Effect of enzyme supplementation or TCSM on growth parameters of grower rabbits

Parameters	ENZYME		SEM	LO S	TCSM			LO S
	0PPM	100PPM			0%	30%	SEM	
Initial weight (g/rabbit)	1818.75 ^a	1368.75 ^b	117.88	**	1862.50 ^a	1325.00 ^b	117.88	***
Final weight (g/rabbit)	1737.5	1579.17	141.52	NS	2112.50 ^a	1204.17 ^b	141.52	***
Weight gain (g/rabbit)	293.75	210.42	42.68	NS	250.00	254.17	42.68	NS
Feed intake (g/rabbit)	5571	3980.61	485.25	NS	4263.51	5288.10	485.25	NS
Protein efficiency ratio	1.69	1.38	0.72	NS	1.90	1.17	0.72	NS
Feed conversion ratio	2.71	2.11	0.39	NS	3.68	3.03	0.39	NS
Feed cost/weight gain (₦/kg)	121.07	121.13	13.09	NS	123.62	133.11	12.39	NS

NS = Not significant (P>0.05), LOS= Level of significant, SEM = Standard error of mean,

phytochemical constituents in oilseeds thereby rendering the test ingredient suitable for rabbit feeding. Similarly, enzyme addition further levels the performance of the animals as the anti-nutritional factors are easily broken down by the actions of both the endogenous and exogenous enzymes (Alu *et al.*, 2014).

Table 3 summarizes the interactive effects of quantum blue[®] enzyme supplementation and TCSM on growth parameters of rabbits.

The results show that there was no significant variation (P>0.05) in all the parameters evaluated. The values recorded in the present study are in consonance with those earlier reported by Kpanja *et al.* (2016) who fed soaked castor seed meal to rabbits and observed non-significant variation in the growth parameters. However, Akande *et al.* (2013) reported significant improvement in most of the growth parameters when fed to broilers.

Table 3. Interactive effects of TCSM and Quantum blue enzyme supplementation on growth parameters of grower rabbits

Parameters	T1	T2	T3	T4	SEM	LOS
	(0%TCSM +0PPM)	(0% TCSM +100PPM)	(30% TCSM +0PPM)	(30% TCSM +100PPM)		
Initial weight (g/rabbit)	1987.50	1650.00	1737.50	1000.00	62.27	NS
Final weight (g/rabbit)	2200.00	1275.00	2025.00	1133.33	62.39	NS
Weight gain (g/rabbit)	212.50	375.00	287.50	133.33	43.21	NS
Feed intake (g/rabbit)	5308.60	5833.40	3218.43	4742.80	471.30	NS
Protein efficiency ratio	3.52	3.86	3.29	3.48	0.75	NS
Feed conversion ratio	1.28	2.14	2.07	3.92	0.15	NS
Feed cost /weight gain (₦/kg)	112.42	112.60	123.40	123.750	10.29	NS

NS = Not significant (P>0.05), LOS= Level of significant, SEM = Standard error of mean, PER =Protein efficiency ratio, FCR=Feed conversion ratio, TCSM=Toasted castor seed meal, IW=Initial weight, FW=Final weight. WG=Weight gain, FI=Feed intake

The results of the effect of quantum blue enzyme supplementation or TCSM on the haematological parameters of grower rabbits are presented in Table 4. There was no significant variation (P>0.05) across the treatment groups due to either enzyme supplementation or inclusion of TCSM in the diets of the rabbits. Similarly, the interactive effects (Table 5) of enzyme supplementation and TCSM did not affect

(P>0.05) the haematological indices. The non-significant variation observed in the present study is an indication of the safety of the processed test ingredient especially with the supplementation of the enzyme. The values reported in this study fell within the range for normal mature rabbits (Dalikeh *et al.*, 2012). This is therefore, a confirmation of the nutritional safety, acceptability and healthy nature of the experimental diets in general.

Table 4. Effect of enzyme supplementation or TCSM on haematological parameters of grower rabbits

Parameters	ENZYME				TCSM		SEM	LOS
	0PPM	100PPM	SEM	LOS	0%	30%		
PCV (%)	27.67	33.33	2.96	NS	34.83	26.17	2.96	NS
Hb (g/dl)	29.05	32.45	14.86	NS	32.78	28.72	14.86	NS
WBC (x10 ⁷ /mm ³)	7.01	5.60	0.52	NS	5.58	7.03	0.52	NS
RBC (x10 ⁶ /mm ³)	2.42	3.18	0.29	NS	3.16	2.44	0.29	NS
Neutrophil (%)	42.75	34.67	3.07	NS	37.42	40.00	3.07	NS
Lymphocytes (%)	57.25	65.33	3.07	NS	62.58	60.00	3.07	NS

NS = Not significant (P>0.05), LOS= Level of significant, SEM = Standard error of mean.

Table 5. Interactive effect of enzyme supplementation and TCSM on haematological parameters of grower rabbits

Parameters	T1	T2	T3	T4	SEM	LOS
	(0%TCSM +0PPM)	(0% TCSM +100PPM)	(30%TCSM +0PPM)	(30% TCSM +100PPM)		
PCV (%)	33.00	33.00	36.67	32.33	2.88	NS
Hb (g/dl)	10.67	10.67	10.90	10.433	17.78	NS
WBC (x10 ⁷ /mm ³)	6.15	6.150	5.00	7.87	0.43	NS
RBC (x10 ⁶ /mm ³)	2.75	2.75	3.57	2.10	0.28	NS
Neutrophil (%)	41.50	41.50	43.33	44.00	3.63	NS
Lymphocytes (%)	58.50	58.50	66.67	56.00	3.63	NS

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Table 6 summarizes the effect of quantum blue[®] enzyme supplementation or TCSM on serum biochemical constituents of grower rabbits. All the parameters evaluated did not show significant variation (P>0.05) with or without TCSM. The non-significant variation is an indication of the effectiveness of the processing method on the chief anti-nutritional factor, *ricin*. The results of the present findings are in consonance with the earlier report of Nagalakshmi and Dhanalakshmi (2015) who reported no adverse effect of feeding castor seed cake as sole protein supplement in diet on body weights, DM intake and nutrient efficiency in lambs.

The result of the effect of quantum blue[®] enzyme supplementation on serum biochemical constituents of grower rabbits fed toasted castor seed TCSM shows that enzyme supplementation significantly (P<0.05) improved serum albumin from 22.83 to 28.00mmol/L but reduced phosphorus from 5.30 to 4.43 mmol/L. However, there was no variation (P>0.05) in the Na, Ca, Cl, urea, creatinine and total

protein. These results support the earlier findings of Alu (2012) who fed sugarcane scrapping meal-based diets supplemented with exogenous enzyme to quails and observed significant improvement in some of the serum biochemical constituents.

Table 7 shows the results of the interactive effects of quantum blue[®] enzyme supplementation and TCSM on serum biochemistry of grower rabbits. Serum calcium (3.00 mmol/L), creatinine (82.67mg/L) and albumin concentration (25.67 vs. 30.67 and 25.33 g/L) were improved significantly (P<0.05) with high TCSM and enzyme supplementation. Literature (Alu, 2012) has shown that the interactive effects of enzyme and other ingredients do not differ significantly. This is because the exogenous enzyme levels the performance of the animals as against the either phytochemical constituents or arabinoxylanases in the feed. The values recorded in the present study fell within the normal range for healthy and matured rabbits as earlier reported by Adedeji *et al.* (2006).

Table 6. Effect of quantum blue[®] enzyme supplementation or TCSM on serum biochemistry of grower rabbits

Parameters	ENZYME				TCSM		SEM	LOS
	0PPM	100PPM	SEM	LOS	0%	30%		
Na (mmol/L)	148.5	145.83	1.90	NS	148.00	146.33	1.90	NS
Calcium (mmol/L)	2.27	2.67	0.18	NS	2.42	2.52	0.18	NS
Phosphorus (mmol/L)	5.30 ^a	4.43 ^b	0.25	*	5.20	4.53	0.25	NS
Chloride (mmol/L)	99.17	97.33	1.67	NS	100.17	96.33	1.67	NS
Urea (mmol/L)	3.92	3.95	0.50	NS	4.18	3.68	0.50	NS
Creatinine (mmol/L)	67.00	66.67	6.48	NS	66.67	67.00	6.48	NS
Total protein (g/L)	61.67	62.33	1.98	NS	60.83	63.17	1.98	NS
Albumin (g/L)	22.83 ^b	28.00 ^a	1.24	*	25.33	25.50	1.24	NS

SEM-Standard error of means, LOS -Level of significance, NS -Not significant (P>0.05), *= Significant variation (P<0.05), a,b = Means on the same row carrying different superscript differ significantly

Table 7. Interactive effects of Quantum blue® enzyme supplementation on serum biochemistry of grower rabbits fed castor seeds meal-based diets

Parameters	T1	T2	T3	T4	SEM	LOS
	0%CSM +0ppm	0%CSM +100ppm	30%CSM +0ppm	30%CSM +100ppm		
Na (mmol/L)	151.00	146.00	145.00	146.67	2.68	NS
Calcium (mmol/L)	2.50 ^b	2.03 ^b	2.33 ^b	3.00 ^a	0.25	*
Phosphorus (mmol/L)	5.53	5.07	4.87	4.00	0.35	NS
Chloride (mmol/L)	100.67	97.67	99.67	95.00	2.36	NS
Urea (mmol/L)	4.07	3.77	4.30	3.60	0.71	NS
Creatinine (mmol/L)	82.67 ^a	51.33 ^b	50.67 ^b	82.67 ^a	9.17	*
Protein (g/L)	61.00	62.33	60.67	64.00	2.79	NS
Albumin (g/L)	20.00 ^b	25.67 ^a	30.67 ^a	25.33 ^a	1.76	*

SEM-Standard error of means, LOS -Level of significance, * -Significant (P<0.05), a ,b-means carrying different superscript differ significantly (P<0.05), NS-Not significant (P>0.05).

Conclusion and recommendation

Inclusion of 30% toasted castor seeds supplemented with quantum blue® enzyme at 100 ppm alleviates the presence of ricin and improves acceptance, absorption and utilization of feed by grower rabbits without affecting their health status.

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