Effect of Quantum blue® enzyme supplementation on the growth parameters of weaner rabbits fed toasted castor seed (*Ricinus communis*) meal (TCSM)-based diets

[1]Alu, S.E., [1]Ari, M.M., [1]Egya, I.O. and Onazi[2], B.O.

[1]Department of Animal Science, Faculty of Agriculture, Nasarawa State University Keffi, Shabu- Lafia Campus, Nasarawa State, Nigeria.
[2]Dept. of Agricultural Education, School of Vocational Education, Federal College of Education (Tech), Gusau, Zamfara State, Nigeria.

ABSTRACT
Sixteen weaner rabbits weighing between 900 - 1000g liveweight were utilized in an experiment that lasted which lasted for 42days to investigate the effect of toasted castor seed (*Ricinus communis*) meal-based diets (TCSM) on growth performance supplemented with or without Quantum blue® enzyme. Four diets were compounded to be isonitrogenous (18% crude protein) and isocaloric (2800kcal/kg, ME). Treatments T1 and T2 contained 0% TCSM supplemented Quantum blue® at 0 and 100PPM while treatments T3 and T4 contained 30% TCSM and supplemented with the enzyme as in T1 and T2, respectively giving a 2x2 factorial. The rabbits were randomly allotted to the 4 treatments and each treatment was replicated 4 times. The results of the effect of enzyme supplementation or TCSM and that of their interactive effects on the growth performance of weaner rabbits shows that there was no significant variation (P>0.05) in all the parameters evaluated. Rabbit farmers can adopt toasting method of processing castor seeds and could include up to 30% TCSM especially when supplemented with Quantum blue® in the diets of grower rabbits without affecting their growth rate.
Key words: Castor seed meal, weaner rabbits, growth performance, enzyme supplementation, TCSM.

Introduction
Animal nutrition studies have shown that castor oil seed (*Ricinus communis,* L) meal can be used to a limited extent, as oil seed cake in feeds for ruminants (Rao *et al.,* 1988), rabbits (Adedeji *et al.,* 2006), pigs (Geary, 1950) and poultry birds (Okorie *et al.,* 1985). However, reports show that dietary inclusion at high levels in poultry rations suffered serious limitations due to the presence of residual ricin, ricinin and castor allergen (Puttaraj *et al.,* 1993; Ani and Okorie, 2002).
Deleterious factors present in feedstuffs have been reported to modify mucosal structure and function, affect nutrient mobility, digestion and absorption in poultry birds (Reid, 1987; Klopfenstein, 1988). Other anti-nutritive factors like tannins have been implicated in changes relating to intestinal absorption of nutrient, reduction in villi width and length of duodenum and jejunum (Johnston, 2005; Kim and Miller, 2005) while, non-starch polysaccharides concentration has been implicated in changes relating to weights and length of the gastrointestinal tract (Johnson *et al.,* 1984).
During the production of castor oil, undehulled seeds are normally used leaving behind a fibrous meal. The fibrous nature of the castor seed also constitutes a major constraint to its utilization in poultry nutrition. Fibrous ingredients have been reported to, negatively affect nutrient utilization by diluting macronutrients (Longe and Ogedengbe, 1989), modifying gut characteristics and intestinal morphology (Wu *et al.,* 2004) and modifying the upper and lower part of the digestive tract of poultry (Gabriel *et al.,* 2003; Hetland *et al.,* 2003).
Although several processing methods have been attempted in the past, studies on dietary inclusion of ethanol treated castor oil seed meal in feed for broilers are rare. The use of exogenous enzymes in alleviating these effects on animals has been documented (Alu *et al.,* 2011; Alu *et al.,* 2012) with positive results in poultry. The objective of this research is therefore, to investigate the effect of Quantum blue® enzyme supplementation on the growth parameters of weaner rabbits fed toasted castor seed (*Ricinus communis*) meal (TCSM)-based diets.

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

Source of test ingredients

Castor seeds were purchased from Masaka Market in Karu Local Government Area of Nasarawa State, Nigeria and were used alongside other ingredients to compound the experimental diets.

Experimental rabbits

Sixteen weaner rabbits were purchased from a commercial farm and reared in the open-side wire mesh rabbit hutches. Light was provided using electric bulb throughout the experimental period to enable the rabbits eat both day and night. The rabbits were fed and given water *ad-libitum*. All recommended routine medications were carried out and standard management practices were adopted as described by Aduku and Olukusi (1990).

Feed description and design of experiment

Four diets were compounded to be isonitrogenous (18% crude protein) and isocaloric (2800kcal/kg, ME) with two levels of TCSM, 0 and 30%. Treatments T1 and T2 contained 0% TCSM supplemented Quantum blue® at 0 and 100PPM, respectively while treatments T3 and T4 contained 30% TCSM and supplemented as in T1 and T2, respectively giving a 2x2 factorial; the experiment lasted for 42d. The chemical and energy compositions of the diets are shown in the Table 1.

Table 1. Percent ingredient, chemical and energy composition of experimental diets for weaner rabbits

Feedstuffs	**T1 (0%TCSM +0PPM)**	**T2 (0%CSM +100PPM)**	**T3 (30%CSM +0PPM)**	**T4 (30%CSM +100PPM)**
Maize	50.00	50.00	43.98	43.98
Soybeans(Fullfat)	25.00	25.00	18.10	18.10
Groundnut cake	7.68	7.68	14.20	14.20
TCSM	-	-	30.00	30.00
Bone meal	5.00	5.00	0.01	0.01
Fish meal	5.00	5.00	0.01	0.01
Palm oil	3.57	3.57	0.50	0.50
Lysine	0.25	0.25	0.01	0.01
Methionine	0.25	0.25	0.01	0.01
Salt	3.00	3.00	0.01	0.01
Premix	0.25	0.25	0.25	0.25
Enzyme (ppm)	-	100	-	100
Total	**100.00**	**100.00**	**100.00**	**100.00**
Calculated chemical and energy compositions				
*Energy (kcal/kg, ME)	2860.30	2860.30	2860.10	2860.10
Crude protein (%)	18.98	18.98	18.98	18.98
Crude fibre (%)	13.42	13.42	13.42	13.42
Calcium (%)	0.90	0.90	0.90	0.90
Phosphorus (%)	0.34	0.34	0.34	0.34

The vitamin – mineral premix supplied the following per 100kg of diet: Vitamin A 15,000 I.U, Vitamin D_3 300,000 I.U., Vitamin E 3,000 I.U., Vitamin K 2.50mg, Thiamin, (B_1) 200mg, Riboflavin (B_2) 600mg, Pyridoxine (B_6) 600mg, Niacin 40.0mg, Vitamin B_{12} 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. **TCSM**-Toasted castor seed meal, * Calculated from (Pauzenga (1985).

Experimental design

The experiment were designed as a factorial one and lasted for 12 weeks. Individual rabbits were weighed at the commencement of the experiment and were subsequently weighed weekly. Feed consumption was measured by calculating the difference in the quantity of feed offered daily and the quantity left.

Proximate analysis

The proximate analysis of TCSM and the experimental diets were carried out at the Institute of Tropical Agricultural Research (ITAR) Ibadan, using the procedure outlined by AOAC (1990).

Data collection

The growth performance parameters evaluated included initial weight, final weight, weight gain, feed intake, FCR, PER, feed cost per weight gain.

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 as described by Steel and Torrie (1980).

Results and Discussion

The results of the effect of enzyme supplementation or TCSM on the growth performance of weaner rabbits (Table 2) shows that there was no significant variation (P>0.05) in all the parameters evaluated. However, numerical differences existed which tended to improve most of the parameters.

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

Parameters	T1 (0PPM Enzyme)	T2 (100PPM Enzyme)	SEM	LOS	T1 (0%TCSM)	T2 (30%TCSM)	SEM	LOS
IW (g/rabbit)	1162.50	1062.5	126.53	NS	1175.00	1050.00	126.53	NS
FW (g/rabbit)	1543.75	1347.92	114.38	NS	1662.50	1229.17	114.38	NS
WG (g/rabbit)	381.25	385.42	86.82	NS	487.50	279.17	86.82	NS
FI (g/rabbit)	4411.21	4561.13	80.60	NS	4648.63	4323.72	80.60	NS
PER	2.09	2.31	0.57	NS	2.69	4.71	4.57	NS
FCR	2.99	1.80	0.94	NS	1.60	2.19	3.94	NS
Cost /WG (₦/kg)	120.38	120.62	12.63	NS	15.38	9.63	2.63	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 interactive effects of enzyme supplementation and TCSM on the growth performance of weaner rabbits is summarized in Table 3. The results show that there was no significant variation (P>0.05) in all the parameters evaluated but numerical differences existed which tended to improve most of the parameters.

Table 4.Interactive effect enzyme and TCSM on growth parameters of weaner rabbits.

Parameters	T1 (0%TCSM +0PPM)	T2 (0% TCSM +100PPM)	T3 (30% TCSM +0PPM)	T4 (30% TCSM +100PPM)	SEM	LOS
IW (g/rabbit)	1225.00	1125.00	1100.00	1000.00	171.59	NS
FW (g/rabbit)	1762.50	1562.50	1325.00	1133.30	109.15	NS
WG (g/rabbit)	537.50	437.50	225.00	333.33	97.26	NS
FI (g/rabbit)	4634.53	4662.73	4187.90	4459.53	77.62	NS
PER	28.32	23.05	11.86	17.56	5.13	NS
FCR	1.49	1.71	2.49	2.89	0.55	NS
Cost /WG (₦/kg)	128.25	128.93	145.94	146.10	10.97	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 observations recorded in the present studies show that the diets were adequate for this class of animals besides, enzyme effect are mostly noticed in diets that have crude fibre above the carrying capacity of the animal (Alu *et al.,* 2009; Alu *et al.,* 2011). The values recorded in the present studies tally with those previous reported by (Alu, 2015; Alu, 2018).

Conclusion and Recommendations

Rabbit farmers can adopt toasting method of processing castor seeds and could include up to 30% TCSM especially when supplemented with Quantum blue® in the diets of grower rabbits without affecting their growth rate.

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