Effect of quantum blue[®] supplementation of sugarcane peel meal-based diets on growth rate and nutrient digestibility by weaner rabbits

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Abstract

Sugarcane peels (SCP) is available in large quantities all year round especially in sugar industries where they are discarded as waste product. It contains high amount of carbohydrate and minerals which could be fed to animals especially when properly processed and supplemented with exogenous enzyme to aid the animal digest it. Fifty - four weaned 4-5 weeks old crosses of New Zealand white x Chinchilla male rabbits were utilized to evaluate the effect of feeding sugarcane peel meal-based diets supplemented with quantum blue[®] on the growth performance parameters (initial weight, final weight, weight gain, feed intake, FCR and feed cost per weight gain) and nutrient digestibility by weaner rabbits. Six diets were formulated to be iso-nitrogenous (18% crude protein) and isocaloric (2700kcal/kg, ME) with two levels of inclusion of sugarcane peel meal (SCPM) (low and high) and three levels of enzyme supplementation (0, 150 and 250 PPM) giving a 2x3 factorial arrangement fitted into Completely Randomized Design. The rabbits were weighed and allotted to the treatments at the rate of 3 rabbits per replicate and each treatment was replicated 3 times. Feeds were weighed and served to the animals individually and water was provided ad-libitum. Growth parameters and nutrient digestibility data were generated and evaluated. The results of the effect of enzyme on growth performance of weaner rabbits showed that average total weight gain significantly ($P<0.05$) improved as rabbits fed the 200PPM enzyme supplemented diets had the best value of 511.67g/rabbit. However, rabbits fed the 100PPM performed (410.83g/rabbit) the same as those fed the 200PPM. Similarly, rabbits fed the 200PPM enzyme supplemented diets gained more ($P<0.05$) daily weight of 10.40 g/rabbit/day followed by those fed the 100PPM (8.32 g/rabbit/day). The result of the effect of high SCPM showed that feed intake significantly ($P<0.05$) increased from 47.37 g/rabbit/day to 59.82 g/rabbit/day as the level of SCPM increased in the diets; rabbits fed the high SCPM had higher total weight gain of 484.44 g/rabbit as compared to those of low SCPM (362.78 g/rabbit). The interactive effects of SCPM and enzyme on growth performance of weaner rabbits showed that final live weight, feed intake and total weight gain were significantly ($P<0.05$) improved as the levels of SCPM and enzyme increased in the diets. In view of the findings, rabbit farmers can supplement 32% of SCPM in the diets of weaner rabbit with 200PPM of quantum blue[®] without negatively affecting the growth rate and suppressing the digestibility of nutrients by weaner rabbits.

Keywords: Enzyme supplementation, growth performance, nutrient digestibility, sugarcane peel meal and weaner rabbits

Introduction

There is a resultant increase in the demand for animal proteins due to the rapid growth of human population in developing countries like Nigeria. The demand for livestock products is expanding due to

growing populations and incomes along with changing preferences (FAO, 2009). Obeidat *et al.* (2009) reported that the main purpose of using alternative feed sources which are not in direct competition with human is to reduce total cost of production

and still arrive at a better result protein intake. Rabbits possess various attributes that are advantageous in comparison to other livestock. Rao *et al.* (1979) and Taylor *et al.* (1989) noted that rabbit meat is of excellent protein quality, low in saturated fat, cholesterol and sodium which make it safe for cardiac patients. Rabbit production is considered as a good source of meat in tropical developing countries because of the abundance of by-product feedstuff. Literature abound (Alu *et al.*, 2014; Tuleun *et al.*, 2014) indicating that sugarcane by-products such as scrappings, bagasse and molasses are suitable for rabbit feeding and other monogastric animals ranging from growth to nutrient digestibility if the ingredient is properly processed. The striking difference between the sugarcane scrappings and the peels is the presence of hard thick sclerenchyma tissues in the peels which renders it tougher and more fibrous than either the bagasse or the scrappings. This composition makes it unfit for feeding monogastric animals because they lack the enzyme that could attack it (Alu, 2015b; McDonald *et al.*, 1998). Pre-digestion and or supplementation of fibrous feeds with enzymes have been reported to improve feed digestion, absorption and utilization (Alu, 2013). It is therefore, important to consider the role of enzyme addition in rabbit nutrition. The enzyme used in this study was the granulated quantum blue® which is a product of the bacteria *Trichoderma reesei*. Previous findings (Alu *et al.*, 2012a; Alu *et al.*, 2012b) have shown that enzyme supplementation generally improves nutrient digestibility and increases growth rate of animals. The objective of this study therefore, was to investigate the response of weaner rabbits fed sugarcane peels meal-based diets supplemented with quantum blue® enzyme.

Materials and methods

Study area

The study was carried out at the University of Abuja Teaching and Research Farm, Animal Science section, along airport road, Federal Capital Territory Abuja, Nigeria. The project site lies between latitude 8°55'N and 9°N and longitude 7°00'E and 7°50'E. Annual rainfall ranges from 1,145-1,631mm. The temperature in the dry season is between 30.4-35.1°C and 25.8°-30.2°C during the dry season.

Sources and processing of test ingredient

Sugarcane peels were collected from retail sugarcane sellers, washed and sundried to about 6% moisture level and crushed into crumbs and used in compounding the experimental diets.

Quantum blue®

The active agent of all *quantum blue* products is 6-phytase produced by the strain *Trichoderma reesei*. *Quantum blue 5 L* and *10 L* are liquid preparations with a guaranteed minimum enzyme activity of 5000 and 10000 FTU/g, respectively, while *quantum blue 5 G* and *40 P* are a granulate (G) or powder (P) preparation with a guaranteed minimum enzyme activity of 5000 and 40000 FTU/g, respectively. *Quantum blue* preparations are intended to be used in *pre-mixtures* and/or complete *feedstuffs* to obtain minimum enzyme activities for 6-phytase of 150 and 250 FTU/kg *feedstuffs* depending on the target species. The dry products can be mixed with the final feed or with the mineral *pre-mixtures*, while the liquid product is to be sprayed onto feed pellets.

Chemical analysis

The crushed sample of sugarcane peels was analyzed for proximate constituents according to the methods outlined by AOAC (2002) while the metabolizable energy value was calculated using Pausenga formula (Pausenga, 1985).

Experimental animals and management

Fifty-four weaned 4-5 weeks old crossbred weaner rabbits were used for this study which lasted for 49 days. The rabbits were progenies obtained from mating between New Zealand white x Chinchilla breeds. The rabbits were individually housed in metal cages located in a well-ventilated house. The house is completely walled with wide, open windows covered with wire mesh and mosquito netting. The experimental animals were kept, maintained and treated in adherence to accepted standards for the humane treatment of animals.

The rabbits were randomly allocated to six dietary treatments and each treatment was replicated three times with three rabbits per replicate. Anti-stress and worming drugs were administered to the animals before the commencement of the experiment to reduce the stress that may arise from transportation and handling as well as possible presence of endo and ectoparasites. They were fed twice daily (7.00am and 4.00pm) and had access to drinking water at all times.

Experimental diets

Six diets were formulated to be iso-nitrogenous (18% crude protein) and isocaloric (2700kcal/kg, ME) with two levels of inclusion of sugarcane peel meal (SCPM) (low and high) and three levels of enzyme supplementation (0, 150 and 250 PPM). Treatments T1, T2 and T3 had low level of SCPM and had 0, 150 and 250PPM levels of enzyme supplementation such that treatment T1 served as the control for treatments T2 and T3. Similarly, treatments T4, T5 and T6 had high levels of SCPM and 0, 150 and 250PPM levels of enzyme supplementation such that T4 served as the control for treatments T5 and T6. Other micro-ingredients were added at the recommended rate to meet the nutrient requirements of weaner rabbits as earlier reported by Olomu *et al.* (2019) and NRC

(1994). The gross and energy composition of the experimental diets for weaner rabbits is presented on Table 1.

Data collection

Growth parameters

The growth parameters evaluated included body weight gain which was measured as the difference between the final weight and the initial weight of the rabbit divided by the number of rabbits, feed intake was evaluated as the difference between weighed amount of feeds supplied daily and their corresponding left over weighed and recorded. Daily feed intake was therefore calculated as the difference between the amount of feed fed and the leftover. Feed conversion ratio was calculated as the rate of feed intake to live weight gain; protein consumed was calculated as the amount of protein in the diet multiplied by the quantity of feed consumed while protein efficiency ratio was determined as the gain in body weight to the protein consumed. The cost of feed per weight gain was calculated as the unit cost of each ingredient to unit weight gain.

Digestibility study

Digestibility study was conducted using six rabbits per treatment during the 6th week of the feeding trial. Faecal samples were collected daily for four days and stored at -20°C in a deep freezer immediately after collection. At the end of each collection period, the faecal samples were bulked for each animal for proximate analysis according to the methods outlined by AOAC (2002) procedures. Nutrient compositions of the experimental diets were determined according to the methods outlined by AOAC (2002). Feed and nutrient intake as well as digestibility coefficients of nutrients was determined. The following formula as earlier reported by Iyeghe – Erakpotobor *et al.* (2005) was adopted and used in the computation:

Apparent Digestible Nutrient =

$$\frac{\text{Nutrient in feed consumed} - \text{Nutrient in droppings voided}}{\text{X 100}}$$

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Nutrient in feed consumed

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 Torries (1980).

Table 1: Gross composition and calculated energy of experimental diets for weaner rabbits

Feed ingredients	T1	T2	T3	T4	T5	T6
*Premix	0.45	0.45	0.45	0.10	0.10	0.10
Salt	0.30	0.30	0.30	0.10	0.10	0.10
Soya bean (full fat)	19.00	19.00	19.00	30.45	30.45	30.45
Ground nut cake	11.00	11.00	11.00	4.00	4.00	4.00
Maize bran	26.25	26.25	26.25	10.00	10.00	10.00
Maize	25.50	25.50	25.50	21.00	21.00	21.00
Bone meal	1.00	1.00	1.00	1.00	1.00	1.00
Methionine	0.50	0.50	0.50	0.25	0.25	0.25
Lysine	0.50	0.50	0.50	0.25	0.25	0.25
Sugarcane peels	15.50	15.50	15.50	32.85	32.85	32.85
Enzyme (ppm)	0.00	150.00	250.00	0.00	150.00	250.00
Total	100.00	100.00	100.00	100.00	100.00	100.00
**ME (kcal/kg)	2716.27	2716.27	2716.27	2696.26	2696.26	2696.26
Crude protein (%)	18.08	18.08	18.08	17.92	17.92	17.92
Crude fibre (%)	10.08	10.08	10.08	14.45	14.45	14.45
Ether Extract (%)	6.06	6.06	6.06	7.20	7.20	7.20
Ash (%)	2.75	2.75	2.75	3.51	3.51	3.51
Calcium (%)	0.46	0.46	0.46	0.50	0.50	0.50
Phosphorus (%)	0.45	0.45	0.45	0.50	0.50	0.50
Lysine (%)	1.21	1.21	1.21	1.11	1.11	1.11
Methionine (%)	0.72	0.72	0.72	0.48	0.48	0.48

*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, Thiamine, (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. ** Calculated from Pauzenga (1985).

Results and discussion

Effect of quantum blue[®] supplementation on growth performance of weaner rabbits

The results of the effect of quantum blue[®] supplementation on growth performance of weaner rabbits is summarised on Table 2. The results showed that average total weight gain significantly ($P < 0.05$) improved as rabbits fed the 200PPM enzyme supplemented diets had the best value of 511.67g/rabbit. However, rabbits fed the 100PPM performed (410.83g/rabbit) similarly to those fed the

200PPM. Similarly, rabbits fed the 200PPM enzyme supplemented diets gained more ($P < 0.05$) daily weight of 10.40 g/rabbit/day followed by those fed the 100PPM (8.32 g/rabbit/day). The results of the present findings are in consonance with the earlier assertion of McDonald *et al.* (1998), Alu *et al.* (2012a) and Alu *et al.* (2009) who reported that enzyme supplementation improves growth rate of animals. The tissues are basically the deposition of nutrients released by the feeds which in turns are the direct function of the enzyme activity. The superior values

recorded for higher enzyme supplemented diet in the present study are somewhat a corroboration of the normal liver function test of the rabbits. The values obtained fell within the range for healthy weaner rabbits

as earlier reported by Alu (2015a) and Cheeke *et al.* (1987). However, Olomu *et al.* (2019) reported superior values of 13.62 g/rabbit/day and 72.24 g/rabbit/day for daily weight gain and daily feed intake.

Table 2: Effect of quantum blue® supplementation on growth performance of weaner rabbits fed high SCPM-based diets

Parameters	0PPM Enzyme	100PPM enzyme	200PPM Enzyme	SEM	LOS
Av. Initial live weight (g/rabbit)	885.00	890.00	853.33	29.56	NS
Av. Final live weight (g/rabbit)	1071.67	1300.83	1365.50	122.04	NS
Av. Total weight gain (g/rabbit)	348.33 ^b	410.83 ^{ab}	511.67 ^a	42.25	**
Av. Daily weight gain (g/rabbit/day)	7.07 ^b	8.32 ^{ab}	10.40 ^a	0.86	**
Av. Feed intake (g/rabbit/day)	38.00	37.00	40.17	1.19	NS
Feed conversion ratio	3.92	4.53	3.93	0.65	NS
Feed cost/weight gain (₦/kg)	466.13	560.10	500.13	84.63	NS

ab= means on the same row having different superscript differs significantly(P<0.05); SEM= standard error of means; LOS= level of significance; NS= not significantly different (P>0.05)

Effect of high SCPM-based diets on growth performance of weaner rabbits

The result of the effect of high SCPM in the diets of weaner rabbits on growth performance is summarized on Table 3. Average feed intake significantly (P<0.05) increased from 47.37 g/rabbit/day to 59.82 g/rabbit/day as the level of SCPM increased in the diets. A similar trend was observed on total weight gain as rabbits fed the high SCPM based diets had higher total weight gain of 484.44 g/rabbit as compared to those fed the low SCPM-based diets (362.78 g/rabbit). The high degree of lignification of the test ingredient due to the

sclerenchyma tissues naturally makes it fibrous and fibres are known to be indigestible by monogastric animals (Alu, 2015; McDonald *et al.*, 1998). This implies that the utilization of the feed will be poor, thus reducing the growth rate of the animal. This assertion is supported by the increased feed intake observed in the present study as an attempt by the animals to meet the calorie requirement. The values recorded in the present study are in close to those earlier published by Enyenihi *et al.* (2019) for weight gain (23.00-68.00 g/rabbit/day), FCR (4.65-14.85) and final live weight (980.00-1500.00g/rabbit).

Table 3: Effect of high SCPM- based diets on growth performance of weaner rabbits

Parameters	Low SCPM	High SCPM	SEM	LOS
Av. Initial live weight (g/rabbit)	882.22	870.00	24.14	NS
Av. Final live weight (g/rabbit)	1137.56	1354.44	99.64	NS
Av. Feed intake (g/rabbit/day)	47.37 ^b	59.82 ^a	0.70	**
Av. Daily weight gain (g/rabbit/day)	37.67	39.11	0.97	NS
Feed conversion ratio	4.26	4.00	0.53	NS
Av. Total weight gain (g/rabbit)	362.78 ^b	484.44 ^a	34.50	**
Feed cost/weight gain (₦/kg)	569.19	448.39	69.10	NS

ab= means on the same row having different superscript differs significantly(P<0.05); SEM= standard error of means; LOS= level of significance; NS= not significantly different (P>0.05)

Interactive effects of high SCPM-based diets and quantum blue[®] on growth performance of weaner rabbits

The result of the interactive effects of SCPM and quantum blue[®] supplementation on growth performance of weaner rabbits (Table 4) showed that average final live weight (840.00 vs. 1258.33 vs. 1314.33 vs. 1303.33 vs. 1343.33 and 1416.67 g/rabbit), feed intake (64.60 vs. 67.80 vs. 69.70 vs. 69.53 vs. 73.83 and 75.10 g/rabbit) and total weight gain (226.67 vs. 385.00 vs. 476.67 vs. 470.00 vs. 436.67 and 546.67 g/rabbit) were significantly ($P<0.05$) improved as the levels of SCPM and enzyme increased in the diets. Rabbits fed the high SCPM and

200PPM enzyme generally performed better than the other treatment groups. The effect of enzyme supplementation ameliorated the negative effect of high SCPM in the diets except for final live weight, feed intake and total weight gain where the effect of enzyme supplementation was more pronounced. This observation is probably because enzyme effects are noticeable when dietary fibre level goes beyond the tolerable level in the diet. In this study, dietary fibre was raised from 10% in treatments T1, T2 and T3 to 14% for treatments T4, T5 and T6. The values recorded in the present research support the earlier findings of Dalikeh *et al.* (2012) and Alu (2015a).

Table 4: Interactive effects of SCPM and quantum blue[®] supplementation on growth parameters of weaner rabbits

Parameters	T1	T2	T3	T4	T5	T6	SEM	LO S
Av. ILW (g/rabbit)	936.67	873.33	836.67	833.33	906.67	870.00	41.81	NS
Av. FLW (g/rabbit)	840.00 ^c	1258.33 ^b	1314.33 ^b	1303.33 ^b	1343.33 ^b	1416.67 ^a	172.58	**
Av. FI (g/rabbit/day)	64.60 ^b	67.80 ^{ab}	69.70 ^a	69.53 ^a	73.83 ^a	75.10 ^a	1.22	**
Av. DWG (g/rabbit/day)	37.33	35.67	40.00	38.67	38.33	40.33	1.68	NS
Feed conversion ratio	3.77	4.80	4.20	4.07	4.27	3.67	0.91	NS
Av. TWG (g/rabbit)	226.67 ^b	385.00 ^{ab}	476.67 ^a	470.00 ^a	436.67 ^a	546.67 ^a	59.75	**
FC/WG (N/kg)	490.17	641.43	575.97	442.10	478.77	424.30	119.69	NS

ab= means on the same row having different superscript differs significantly ($P<0.05$); SEM= standard error of means; LOS= level of significance; NS= not significantly different ($P>0.05$), ILW= Initial live weight, FLW= Final live weight, DWG= Daily weight gain, TWG= Total weight gain, FC/WG= Feed cost/weight gain.

Effect of quantum blue[®] supplementation on coefficient of nutrient digestibility by weaner rabbits

The result of the effect of quantum blue[®] supplementation on coefficient of nutrient digestibility by weaner rabbits (Table 5) indicated that the entire nutrient evaluated were significantly ($P<0.05$) improved as the level of enzyme supplementation increased in the diets. The digestibility was best for rabbits fed the 200PPM, recording 68.85, 95.61, 87.65, 81.08 and 59.58% for dry matter, crude protein, crude fibre, ether extract and nitrogen-free extract, respectively. According to Alu (2015), Alu (2012) and McDonald *et al.* (1998),

enzyme addition in the diet of animals improves digestibility of nutrient. The trend observed in the present study tallies with the earlier findings of Alu (2012) who supplemented Maxigrain[®] to sugarcane scrapping meal in the diets of laying quails and observed significantly improvement in all the proximate components of the feed. The activity of enzyme is that it simply attacks the NSP thereby releasing more nutrients to the host animal. Similarly, Alu *et al.* (2009) supplemented Nutrase xyla[®] to rice offal meal-based diets of weaner pigs and observed significant improvement in the digestibility of some fibre fractions components of the dietary fibre.

Table 5: Effect of quantum blue® supplementation on coefficient of nutrient digestibility by weaner rabbits

Parameters (%)	0PPM Enzyme	100PPM Enzyme	200PPM Enzyme	SEM	LOS
Dry matter	65.87 ^b	65.04 ^b	68.85 ^a	4.22	**
Crude protein	94.51 ^b	93.33 ^c	95.61 ^a	8.25	**
Crude fibre	82.45 ^c	83.29 ^b	87.65 ^a	7.29	**
Ether extract	77.17 ^b	74.59 ^c	81.08 ^a	7.21	**
Nitrogen-free extract	55.78 ^c	56.99 ^b	59.58 ^a	3.24	**

ab= means on the same row having different superscript differs significantly (P<0.05); SEM= standard error of means; LOS= level of significance; NS= not significantly different (P>0.05)

Effect of high SCPM-based diets on coefficient of nutrient digestibility by weaner rabbits

Table 6 summarizes the effect of high SCPM-based diets on coefficient of nutrient digestibility by weaner rabbits. The result shows that SCPM significantly (P<0.05) depressed the digestibility of crude fibre, ether extract, and nitrogen-free extract from 80.20% to 68.76%, 75.78% to 59.44% and 56.93% to 47.96%, respectively. The

significant depression in the digestibility of crude fibre, ether extract and NFE tallies with the earlier findings of Alu (2012). According to McDonald *et al.* (1998) and Alu (2015b), high dietary fibre above handling capability of monogastric animals which should not be more than 5-7%, impairs digestibility of nutrients. This is because; they form complexes with other macro-nutrients in the digesta thus, preventing the nutrient absorption and utilization by the animal.

Table 6: Effect of high SCPM on coefficient of nutrient digestibility by weaner rabbits

Parameters (%)	Low SCPM	High SCPM	SEM	LOS
Dry matter	66.44	66.73	7.22	NS
Crude protein	94.49	94.47	8.02	NS
Crude fibre	80.20 ^a	68.73 ^b	6.24	**
Ether extract	75.78 ^a	59.44 ^b	7.62	**
Nitrogen-free extract	56.93 ^a	47.96 ^b	5.10	**

ab= means on the same row having different superscript differs significantly (P<0.05); SEM= standard error of means; LOS= level of significance; NS= not significantly different (P>0.05)

Interactive effects of high SCPM-based diets and quantum blue® on coefficient of nutrient digestibility by weaner rabbits

Table 7 shows the results of the interactive effects of high SCPM-based diets and quantum blue® on coefficient of nutrient digestibility by weaner rabbits. Dry matter digestibility was significantly (P<0.05) improved where rabbits fed the T3 diet gave the best result of 69.31% as compared to the other treatment groups. However, crude fibre digestibility was best by rabbits fed the

T6 diet (90.81%) whereas that of ether extract was best (84.33%) in treatment T4. The digestibility of nitrogen-free extract was best (60.79%) in rabbits fed the T3 diet as compared to the other treatment groups. Generally, the effects of supplementation of enzyme in the diets are much more pronounced when the fibre level is above the tolerable level. This is noticed in the results recorded in the present study as the numerical values are higher between treatments T4 to T6 being diets containing

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the high fibre. Oladipo *et al.* (2019) studied the effect of inclusion of enzymes and eubiotics in sorghum based diet for broiler chickens and observed non-significant

improvement in the digestibility of nutrient, probably because the dietary crude fibre of the experimental diets was within the handling ability of the birds.

Table 7: Interactive effects of SCPM and quantum blue® supplementation on coefficient of nutrient digestibility by weaner rabbits

Parameters (%)	T1	T2	T3	T4	T5	T6	SEM	LOS
Dry matter	67.20 ^b	62.80 ^d	69.31 ^a	64.53 ^c	67.27 ^b	68.38 ^{ab}	3.08	**
Crude protein	94.10	93.16	96.22	94.92	93.50	95.00	0.38	NS
Crude fibre	78.50 ^e	77.60 ^e	84.50 ^d	86.39 ^c	88.98 ^c	90.81 ^a	6.31	**
Ether extract	70.00 ^d	78.18 ^c	79.16 ^c	84.33 ^a	71.00 ^d	83.00 ^b	4.12	**
Nitrogen-free extract	58.00 ^b	52.00 ^d	60.79 ^a	53.56 ^c	61.97 ^a	58.36 ^b	3.19	**

ab= means on the same row having different superscript differs significantly(P<0.05); SEM= standard error of means; LOS= level of significance; NS= not significantly different (P>0.05)

Conclusion

The study indicated that rabbit farmers can supplement 32% of SCPM in the diets of weaner rabbit with 200PPM of quantum blue® without negatively affecting the growth rate and digestibility of nutrients.

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