

Growth indices, haematological and serum biochemical response of weaned rabbits fed growth promoters



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Abstract

The use of feed additives and plant extracts in rabbit husbandry offers an acceptable way to improve welfare, health and meat quality of rabbits as alternative to the use of antibiotics. In a six-week feeding trial, growth rate, nutrient digestibility, haematology and serum biochemical indices of weaned rabbits fed dietary prebiotics and probiotics as natural growth promoters were investigated. Thirty-two weaned crossbred rabbits of 6-week old with average weight of 446.75 ± 32.1 g were randomly allotted to 4 dietary treatments. Diet 1 served as the control without test ingredients while diets 2 (prebiotics-Biotronic[®] at 4kg/ton), 3 (probiotics- Biovet[®]-YC at 500g/ton) and 4 (symbiotics: Biotronic[®] SE and Biovet[®]-YC) were other treatments. Feed intake, weight gain, feed conversion ratio, feed efficiency, nutrient digestibility, haematological and serum biochemical variables were monitored. The design of the experiment was a completely randomized design. Feed intake was similar among dietary treatments while weight gain of rabbits fed diets 1, 2 and 3 was the same but significantly ($p < 0.05$) higher than rabbits fed diet 4. Feed conversion ratio was not significantly influenced by the treatments. Feed efficiency was significantly ($p < 0.05$) higher in rabbits fed symbiotic supplemented diets compared to others. The dry matter, crude protein, crude fibre, ash, nitrogen free extracts and ether extract digestibility were significantly ($p < 0.05$) higher in rabbits fed diets 2 and 3 than those on diets 4 and the control. Packed cell volume and haemoglobin were significantly ($p < 0.05$) higher in rabbits fed diets 3 and 4 than diets 1 and 2. Erythrocyte and leukocyte count were not significantly different among the treatments. Total protein, albumin and globulin examined revealed that they were not significantly influenced by the dietary treatments, however, alkaline phosphatase was significantly ($p < 0.05$) higher in rabbits fed test diets than the control. Biotronic[®] SE and Biovet[®]-YC in this study had a potential to enhance growth in rabbit when used as feed additive without any adverse effect on health status of the animal.

Key word: Biotronic[®] SE, Biovet[®]-YC, Growth response, Blood, Rabbits

Introduction

The increase in human population has led to increased demand for food. This led to a food crisis leaving us with a malnourished population especially in most developing African countries (Ademosun, 1976). This shortage of food is especially critical for those of animal origins. It is evident that there is dearth of animal protein in the diet

of Nigeria. FAO (1986) recommended total protein intake of 68g/day/caput out of which 35g (51.47%) should be of animal origin for normal growth and development in human beings. Ademosun (1976) also reported that the average protein intake in Nigeria is 52.7g of which only 9.2g (17.46%) is of animal origin while the remaining is obtained from plant protein

sourced.

Identification of supply deficit in meat and other animal products can be attributed to low productivity of livestock in Nigeria. Inconsistent national policies, poor climatic conditions, poor nutrition of animals, scarcity and expensive nature of animal feeds among others are limiting factors to livestock production (Adamu and Tewe, 1996). All these result in shortage of animal protein availability and therefore, lead to exorbitant cost, which is out of reach of majority of the populace. Efforts have been made by the researchers and institutions to explore the potential of other livestock species like rabbit other than the fast growing broiler and the large ruminant's production in closing up the gap in protein supply (Atsu, 2002).

One of these efforts is the manipulation of the scarce and expensive feed materials in such a manner that will make animal utilize them maximally for meat production (Onifade *et al.*, 1997). Besides, cost of feeding has been reported to be as high as 70% of total recurrent expenditure in livestock production (Adamu and Tewe, 1996). The high cost of feeding was attributed to high rise in the price of ingredients used in formulating feed most especially cereals and those of protein sources. Thus, the inclusion of growth promoters to the animal feeds becomes imperative in this context. The term "growth promoting agent" is not confining to chemicals which increase growth rate. It includes all agents that improve the efficiency with which healthy animals convert feed nutrients into desirable animal products (Lawrence, 1991).

The growth promoters include antibiotics, enzymes and certain organic and inorganic salts and even vitamins. While the enzymes have hydrolytic effect on the hardly digested portion of feeds, others like antibiotics and some salts are suggested to either stimulate increased feed intake or act as growth promoter through their antimicrobial activities (Mckinnon, 1985). However, the use of antibiotics as growth promoters in animals' feed is becoming highly regulated because of the possible human health hazard due to the development of resistance and presence of residues in meat (Priyankarage *et al.*, 2003). The recent alternatives to antibiotics are the use of prebiotics and probiotics that improve feed efficiency through beneficial modification of microbial fermentation in the gastro intestinal tract (Mosenthin and Bauer, 2000). These were proposed as substitutes to antibiotics. Probiotics are living microbial food components which enhance the performance of the animal through microbial balance in the intestine (Gibson and Roberfroid, 1995). The genera of *Bifidobacterium* and *Lactobacillus* are most currently use probiotics and probiotics such as yeast, *lactobacilli* and *streptococci* function by enhancing resistance to pathogens (Duggan *et al.*, 2002). The indigestible feed ingredients that beneficially affect the host are called prebiotics. Their mode of action is by selectively stimulating the growth and activities of one or a number of health-promoting colon bacteria and thus improves host health (Gibson and Roberfroid, 1995). Symbiotics are combination of prebiotics and probiotics

and this combination improves the survival of probiotic organisms and the health status of the animals (Gibson and Roberfroid, 1995). The use of these growth promoting feed additives has been well documented in poultry but the available reports on the effect of such feed additives in rabbit production is scanty. Therefore, this study investigated the effect of prebiotic, probiotic and symbiotics on the performance, nutrient digestibility, haematological and serum biochemical indices of weaned rabbits.

Materials and Methods

Experimental plans

The experiment was carried out at the rabbitry unit of the Teaching and Research Farm, University of Ibadan, Ibadan, Nigeria. The site is located on the latitude 7° 20'N and 3° 50'E, 200m above the sea level. Four diets were formulated including the control (diet 1) as presented in Table 1. Diets 2, 3, and 4 containing Prebiotics (Biotronic® at 4 kg/tonne), Probiotics (Biovet®-YC at 500g/tonne), and Symbiotic (the combination of both pre- and probiotics at recommended rate indicated above) respectively as presented in Table 1. Biotronic® contained fructo-oligosaccharides and organic acids while BIOVET®-YC contained *Lactobacillus acidophilus* (45,000 million c.f.u), *Saccharomyces cerevisiae* (125,000 million c.f.u), and *Saccharomyces boulardii* (30,000 million c.f.u). A total of thirty-two weaned rabbits with average weight of 446.75±32.1g were randomly assigned to the four dietary treatments such that each treatment has 8 animals housed

individually. The experiment lasted six weeks. The animals were fed *ad libitum* twice daily at 8.00h and 16.00h. The daily feed intake and weight gain were monitored. Feed conversion ratio (FCR) was estimated by dividing the feed intake by weight gain. During the last week of the experiment, faecal samples were collected from five animals per treatment for 5 days. The proximate analyses of the feed and faeces were undertaken as described by AOAC (2001) to estimate nutrient digestibility.

Blood collection and evaluation

At the end of the experiment, blood was sampled from the ear vein of each animal for haematology and serum protein analysis. Blood samples for haematology were collected into sterile vacutainer tubes containing EDTA, while that for serum biochemical indices was without EDTA to allow blood clotting and serum decanted for the analysis. Packed cell volume (PCV) and erythrocyte counts were determined as described by Schalm (1975). Total leukocyte counts were determined using Neubauer haemocytometer after appropriate dilution. Blood constants (Mean corpuscular volume, MCV, Mean corpuscular haemoglobin, MCH and Mean corpuscular haemoglobin concentration, MCHC) were determined using appropriate formulae as described by Jain (1986). Serum total protein was determined using Biuret method as described by Kohn and Allen (1995). Albumin was determined using Bromocresol Green (BCG) method as described by Peter *et al.* (1982). The globulin concentration was obtained by subtracting albumin from the total protein

Table 1: Gross composition of the experimental diets

Ingredients (%)	Treatments			
	1(control)	2(prebiotics*)	3(probiotics**)	(symbiotics***)
Maize	30.0	30.0	30.0	30.0
Soybean meal	25.0	25.0	25.0	25.0
Wheat offal	9.0	9.0	9.0	9.0
Rice husk	30.0	30.0	30.0	30.0
Fish meal	3.0	3.0	3.0	3.0
DCP	2.0	2.0	2.0	2.0
Salt	0.5	0.5	0.5	0.5
Premix	0.45	0.45	0.45	0.45
Lysine	0.05	0.05	0.05	0.05
Total	100	100	100	100
Calculated Nutrients				
Digestible energy (Kcal/kg)	2744	2744	2744	2744
Crude Protein (%)	16.19	16.19	16.19	16.19
Crude fibre (%)	10.18	10.18	10.18	10.18

*Prebiotics (Biotronic®) inclusion rate at 4kg/tonne, **Probiotics (Biovet®-VT) inclusion rate at 500g/tonne, *** symbiotic: Prebiotics (Biotronic®) + Probiotics (Biovet®-VT) at normal inclusion rate. DCP: Dicalcium phosphate

while the albumin/globulin ratio was obtained by dividing the albumin value by the calculated globulin value.

Data Analysis

Data obtained from this study were subjected to analysis of variance of completely randomized design using the Stastical Analysis software (SAS, 1999) package and the means separated using Duncan multiple range test of the same software.

Results and Discussion

The growth indices of the rabbits in terms of final live weight, weekly feed intake, weekly weight gain, feed conversion ratio and feed efficiency are shown in Table 2. The results showed that final live weight was significantly ($p<0.05$) higher in rabbits fed treatment 3 and the control than those fed treatments 2 and 4. The least final live

weight was recorded for animals fed diet 4. Weekly feed intake was not significantly influenced by the dietary treatments as this parameter was not statistically different among the treatments. Weekly weight gain of the experimental animals was significantly ($p<0.05$) influenced by the dietary treatments. Weight gain of the rabbit fed diets 2 and 3 were not significantly ($p<0.05$) different from control group. However, they were significantly ($p<0.05$) higher than those rabbits placed on diet 4 that recorded the least value.

Feed conversion ratio of the experimental animals was not significantly ($p>0.05$) influenced by the dietary treatments. The feed efficiency of rabbits fed diet 4 was significantly ($p<0.05$) higher than those rabbits fed diets 2, 3, and the control which were statistically similar. The result of the dry matter intake of rabbits obtained in this

Table 2: Growth rate of weaned rabbits fed prebiotic and probiotic diets

Parameters	1(Control)	2(Prebiotic)	3(Probiotic)	4(Symbiotic)	SEM
Initial Live weight (g)	442.00	447.00	450.00	448.00	
Final Live weight (g)	997.50 ^a	964.38 ^b	992.50 ^a	915.71 ^c	3.62
Weekly Feed Intake (g)	60.83	60.54	62.05	61.64	1.56
Weekly weight gain (g)	122.78 ^a	127.39 ^a	127.36 ^a	114.86 ^b	1.21
Feed conversion ratio	0.50	0.47	0.49	0.54	0.38
Feed efficiency (%)	61.80 ^b	61.07 ^b	56.73 ^b	76.69 ^a	4.21

abc: Means in the same row with different superscripts are significantly (P<0.05) different

study was at variance with the findings of Sanchez and Ayaya (1998) who reported that prebiotics increased feed intake. The lack of increased feed intake in rabbits fed prebiotic and probiotic diets could be attributed to short dietary exposure to the test ingredient.

The significantly lower weight gain observed in rabbits fed symbiotic diet (prebiotic + probiotic) may be attributed to negative synergistic effect of prebiotic and probiotic on the animal gut micro flora as also observed by Salminen *et al.* (1998) that the probiotics and prebiotics effect may be additives or synergistic. However, animals on diets 2 (prebiotics) and 3 (probiotics) recorded a higher weight gain which indicated that individual enhanced growth at early stage of rabbit as evidenced in this study compared to when they were fed together, probably because of the type of prebiotics and strains of probiotics that was involved in this study. Pond *et al.* (1995) reported poor response by animals to additive effects of different types of the growth promoting agents on livestock. Similar evidence of beneficial effect of prebiotic and probiotic on weight gain have been reported (Gibson and Roberfroid, 1995; Goldin and Salminen, 1998; Sanchez

and Ayaya, 1998).

The dry matter, crude protein, crude fibre, ether extract, ash and NFE (nitrogen free extract) digestibility of weaned rabbits fed control, prebiotic, probiotic and symbiotic diets are shown in Table 3. The dry matter digestibility of rabbits fed diets 2 and 3 were not significantly different from each other but both were significantly (p<0.05) higher than those fed diet 4 and the control. The same trend was also observed for crude protein, crude fibre, ash and NFE digestibility in the experimental animals. In all cases, nutrient digestibility was identical between animals on control diet and those that fed symbiotic diet which were significantly (p<0.05) lower than others. Ether extract digestibility of rabbits fed prebiotics (diet 2) and probiotics (diet 3) were not significantly (p>0.05) different from the control but were significantly (p<0.05) higher than rabbits fed symbiotic diet (diet 4) which recorded the least value.

The result simply implies that prebiotics and probiotics improved nutrient digestibility in rabbits when used singly than when mixed together as symbiotic at early stage of growth. This result was in agreement with the findings of Shane (2001) and Pelicano *et al.* (2004) that

Table 3: Nutrient digestibility of rabbits fed prebiotic and probiotic diets

Treatments	1(Control)	2(Prebiotic)	3(Probiotic)	4(Symbiotic)	SEM
Dry Matter (%)	48.61 ^b	74.53 ^a	72.86 ^a	57.38 ^b	2.81
Crude Protein (%)	53.61 ^b	75.98 ^a	73.98 ^a	65.98 ^b	2.17
Crude Fibre (%)	44.74 ^b	71.61 ^a	68.83 ^a	48.93 ^b	3.69
Ether Extract (%)	64.95 ^b	76.95 ^a	74.64 ^a	74.64 ^a	1.34
Ash (%)	37.14 ^b	72.02 ^a	69.19 ^a	38.40 ^b	2.60
NFE (%)	49.40 ^b	74.14 ^a	72.84 ^a	56.70 ^b	2.04

ab: Means in the same row with different superscripts are significantly ($P < 0.05$) different

NFE: Nitrogen Free Extract

improvement in performance traits of birds fed prebiotic diet was due to a better digestibility of nutrients by growth promoting agents. This improvement could also be due to beneficial modification of microbial fermentation in the gastrointestinal tract (Mosenthin and Bauer, 2000; Gibson and Roberfroid, 1995).

Haematological indices of weaned rabbits fed diets containing prebiotic (Biotronic[®]), probiotic (Biovet[®]-YC), symbiotic and the control is shown in Table 4. Some of the haematological indices examined were significantly ($p < 0.05$) influenced by dietary prebiotics and probiotics. The packed cell volume (PCV) of the rabbits fed diet 3 (which contained probiotic at the rate of 500g/tonne) and diet 4 (which contain both probiotics and prebotics at the rate of 500g/tonne and 4kg/tonne respectively) was not significantly different from each other but were significantly ($p < 0.05$) higher than those fed diet 2 (which contained Biotronic[®] at the rate of 4kg/tonne) and control diet. Haemoglobin concentration (Hb) of rabbits fed diets 3 and 4 was not significantly different from each other and from the control diet. However, these were significantly ($p < 0.05$) higher than those of

the rabbits fed diet 2. The erythrocytes of the rabbit were not significantly influenced by the dietary treatments. Similar trend was observed for the total leukocyte counts of the rabbits among the treatments. The blood constants were significantly ($p < 0.05$) affected by the dietary treatments. The mean corpuscular volume of rabbits on diet 4 was significantly ($p < 0.05$) higher than those fed control diet. The MCV of rabbits fed diets 1, 2 and 3 were not significantly different from one another, but MCV of rabbits fed diet 4 was significantly ($p < 0.05$) higher than those fed the control diet. Similar trend was observed for MCH in which the rabbits on control diet had a significantly ($p < 0.05$) lower value ($217.60 \pm 18.91 \mu\mu\text{g}$) compared to those on diet 4 ($292.52 \pm 18.50 \mu\mu\text{g}$).

The response of serum protein and alkaline phosphatase of weaned rabbits fed dietary prebiotics and probiotics is as shown in Table 5. The serum proteins of the weaned rabbits were not significantly influenced by the dietary treatments. There was no significant difference in the total protein, albumin and globulin among the treatments. However albumin/globulin ratio was significantly ($p < 0.05$) higher in

Table 4. Haematological indices of rabbits fed diets supplemented with prebiotics and probiotics (Mean±SEM)

Parameters	Treatments			
	1(control)	2(prebiotics*)	3(probiotics**)	4(symbiotics***)
Packed cell vol. (%)	38.75±1.31 ^{ab}	37.20±1.07 ^b	41.60±1.33 ^a	41.75±0.75 ^a
Haemoglobin (g/dl)	12.93±0.43 ^{ab}	12.38±0.35 ^b	13.86±0.45 ^a	13.83±0.31 ^a
Erythrocytes (x10 ⁶ /mm ³)	5.41±0.31	5.47±0.29	5.36±0.34	4.79±0.35
Leukocytes (x10 ³ /mm ³)	4.53±0.52	4.37±0.21	4.62±0.49	4.63±0.19
Mean cell volume (μ ³)	65.29±5.63 ^b	69.03±5.16 ^{ab}	78.41±7.65 ^{ab}	88.38±5.45 ^a
Mean cell haemoglobin (μg)	217.60±18.91 ^b	229.76±17.28 ^{ab}	264.58±24.03 ^{ab}	292.52±18.50 ^a

ab: Mean along the same row with different superscripts are significantly (P<0.05) different

*Prebiotics (Biotronic®) inclusion rate at 4kg/tonne, **Probiotics (Biovet®-VT) inclusion rate at 500g/tonne, *** symbiotic: Prebiotics (Biotronic®) + Probiotics (Biovet®-VT) at normal inclusion rate.

rabbits fed the symbiotic diet compared to those fed prebiotic diet while those fed the control and probiotics diet were statistically the same. The Alkaline Phosphatase activity of the animals fed control diet was significantly (p<0.05) lower (5.92±0.61 i.u/L) than those fed diets 3 and 4 with 8.32±0.23 and 8.38±0.20 i.u/L respectively. The haematological indices are reflection of the effect of dietary treatments on the animals in terms of the type and amount of feed ingested and available for the animal to meet its physiological, biochemical and metabolic necessities (Ewuola *et al.*, 2004). In this study, in which prebiotic (Biotronic®) and probiotics (BIOVET®-YC) were added to the diets of rabbits at the recommended rate, the PCV, Hb and the

blood constants (except MCHC) were significantly (P<0.05) influenced. The PCV and Hb were significantly (P<0.05) higher in rabbits fed only the probiotics and its combination with prebiotics i.e. symbiotic diet though all the values across diets were within the normal range reported by Mitruka and Rawnsley (1977). A significantly high PCV and MCH were recorded by rabbits fed symbiotics compared to the control. However, the values of MCV and the MCH were outside the normal physiological values of 58.8 – 66.5 μm³ and 18.7 – 22.7 μg respectively Mitruka and Rawnsley (1977). The high MCH value could also be attributed to the tender age of the rabbits used for the experiment (Coles, 1986) The erythrocytes

Table 5: Serum proteins and alkaline phosphatase of rabbits fed diets supplemented with prebiotics and probiotics (Mean±SEM)

Parameters	Treatments			
	1 (control)	2 (prebiotics*)	3 (probiotics**)	4(symbiotics***)
Total protein (g/dL)	5.18±0.19	5.00±0.18	4.72±0.21	5.08±0.34
Globulin (g/dL)	1.41±0.13	1.41±0.014	1.02±0.10	1.19±0.09
Albumin (g/dL)	3.78±0.04	3.58±0.17	3.70±0.06	3.95±0.21
Albumin/globulin ratio	3.06±0.11 ^{ab}	2.88±0.19 ^b	3.26±0.41 ^{ab}	3.74±0.19 ^a
Alkaline phosphatase (i.u/L)	5.92±0.61 ^b	7.20±0.58 ^{ab}	8.32±0.23 ^a	8.38± 0.20 ^a

ab: Mean along the same row with different superscripts are significantly (P<0.05) different

*Prebiotics (Biotronic®) inclusion rate at 4kg/tonne, **Probiotics (Biovet®-VT) inclusion rate at 500g/tonne, *** symbiotic: Prebiotics (Biotronic®) + Probiotics (Biovet®-VT) at normal inclusion rate.

and leukocytes were not affected by the dietary treatments but were also below the normal physiological range reported by Mitruka and Rawnsley (1977). The result partially agreed with the report of Mateova *et al.* (2008) who fed chicken with prebiotics, probiotics and herb oil for 42 days and the haematological parameters such as RBC, PCV, WBC and Hb were not significantly affected by the dietary treatments. The total protein, albumin and globulin were adversely affected across the treatments. However, the globulin values, which ranged from 1.02 – 1.41g/dL among the treatments were lower than the normal physiological range reported by CCAC (1980) for rabbits. The result however contradicted the findings of some researchers that prebiotics and probiotics improve protein utilisation in animals. A significant increase in the serum protein of chickens fed prebiotic additives for 39 days was reported by Sirvydis *et al.* (2006). Mateova *et al.* (2008) also reported a significant increase in the total protein of chicken fed combination of lactobacillus and oligosaccharide. The significantly high albumin/globulin ratio observed for rabbits on diet 4 indicated that the rabbits did not suffer from any toxin (antigen) or pathogenic infection which could have resulted in low albumin/globulin ratio. However, a significantly low albumin/globulin ratio of rabbits on diet 2 may be due to inability of the prebiotic diet to enhance albumin production. However, this could not be regarded as adverse effect since the albumin; globulin and total protein assessed in this study were identical among the dietary treatments including the

control.

Conclusion

This study demonstrated that Biotronic® and Biovet®-VT used as prebiotics and probiotics respectively possessed potential beneficial effect on the health and nutrient utilization in rabbits. The combination of the two could give a better result as regards the prevention of diseases and utilization of nutrients on long term exposure.

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Received: 16th March, 2013

Accepted: 4th July, 2014