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## Effect of *Prebiotics* and *Probiotics* as natural growth promoters in broiler chicks

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### Abstract

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Sixty day-old broiler chicks (Ross breed) were treated with or without prebiotics and probiotics (Natural growth promoters) containing immune extracts at the starter (1-5wks) and finisher (6-10wks) phases. The birds were allocated to two diets (one test and one control) in a completely randomized design. Each treatment had three replicates of ten birds per replicate. Energy and protein levels of the diets were 3000 Kcal ME/kg and crude protein (CP) of 20% and 3000 Kcal ME/kg and 17% CP at starter and finisher phases, respectively. The experiment lasted ten weeks. The daily metabolizable energy intake for body maintenance, 146.97 cal./day for birds on the test diet was significantly ( $P<0.05$ ) higher than those birds on the control diet, 113.04 cal./day at the starter phase. At the finisher phase, efficiency of feed utilization (0.38 as against 0.19), mean weights of live (1920g as against 1570g) and plucked (1740 as against 1380g) parts of the treated birds were significantly ( $P<0.05$ ) better than the untreated birds. Other parameters measured increased more for the treated birds but were not significant ( $P>0.05$ ). The immune status conferred on the birds ensured adequate protection from death for the treated birds. The untreated birds suffered 67% more mortality than the treated birds. Though mortality rate was within the acceptable limits for both treated and untreated birds. The results of the experiment showed that *Enterococcus faesium*, inulin together with cell-wall fragments and immune stimulant extracts as probiotics and prebiotics enhanced growth performance of broiler chicks. The trial was successful.

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**Keywords:** Natural growth promoters, immune extracts, enhanced performance, broiler chicks.

### Introduction

The advent of intensive system of management of poultry production has given rise to the use of many substances that have growth promoting ability. The use of growth promoter has become necessary in poultry production in Nigeria since optimum growth potentials of hybrid birds are better realized in temperate than in tropical environment (Oluyemi, 1978).

On the other hand, broiler chicks provide the needed animal protein in the diet of many

Nigerians. Therefore, there is the need for improved growth and quick attainment of market weight of the birds in Nigeria. This can be achieved by the use of the growth promoters. The earlier non-nutritive additives used in growth promotion often with therapeutic effect are mostly derived from antibiotics.

The level of inclusion of the antibiotics in the feed is usually below therapeutic dosage regimen that is capable of developing microbial resistance (Anonymous, 2002). Man is the final consumer

of eggs, meat, milk and their products and may be susceptible to pathogenic carry-overs emanating from animals fed antibiotics that have developed resistant strain that is not easily eliminated or destroyed by heat or other methods of food processing. The high temperature that is associated with tropical countries and poor storage facility prevalent in most of them do not ensure efficacy of antibiotics.

To avoid the risk involved in the use of antibiotics as growth promoters, the discovery and use of *prebiotics* and *probiotics* having no withdrawal time and no residual effect in this study have become necessary. The natural growth boosters can replace antibiotics in non-nutritive uses in poultry production. Direct fed microbial (DFM) or *probiotic* can be defined as 'a source of live (viable) naturally occurring microorganisms and this includes bacteria, fungi and yeast (Miles and Bootwalla, 1991). However, Vanbelle *et al.* (1990) pointed out that most researches considered *probiotics* to be selected and concentrated viable counts of lactic acid bacteria i.e., *Lactobacillus* and *Streptococcus*. Unlike antibiotics, *prebiotics* and *probiotics* have the ability to eliminate all the pathogens that are present in the gut of chicks. There is no risk of developing resistant strain of the pathogens. The natural *prebiotic* and *probiotic* are constituted by a fructo-oligosaccharide (Inulin), a stabilized strain of *Enterococcus faesium* together with cell-wall fragments and immune stimulant extracts will be used in this study.

*Enterococcus faesium* (*probiotic*) stabilizes the chick gut micro-flora and prevents pathogen colonization by its fast proliferation, colonization and acidification in the gut. *E. faesium* is a bacterium with proven enhanced effects on

animal performance (Anonymous, 2001). Fructo-oligosaccharide, inulin (*prebiotic*) selectively enhances the growth of beneficial bifid bacteria in the large intestine and complete the basic concept of beneficial bifid bacteria that out compete the pathogens (*Clostridia*). Inulin is the principal oligosaccharide that has been implicated in the stimulation of bifid bacteria growth, reduced faecal pH and decreased ammonia excretion. It also reduces the amount of toxic metabolites, suppresses growth of pathogens and enhances production of vitamins, stimulates mineral absorption and production of short chain fatty acids (Anonymous, 2001).

The cell-wall fragment is isolated from inactivated, non-pathogenic microorganisms. The positive effect of the *prebiotic* carrier and *probiotic* strain is multiplied by the cell-wall extracts. These extracts adhere to the gut wall and therefore block receptor-binding sites for pathogens (*Escherichia coli*, *Salmonella* spp. etc) in the mucous layer. Finally phycophytic substances together with the cell-wall extracts strengthen the innate as well as derived immune system of the animal by stimulation of the macrophage activity and lymphocyte proliferation (Anonymous, 2001).

In the young chick a fast establishment of a beneficial gut micro-flora and an optimized unspecific immune system are very important to withstand pathogen (Anonymous, 2001). The intestinal bacteria flora of domestic fowl has an important role in the digestion and absorption of feed ingested by the host. Nahashon *et al.* (1992, 1993, 1994b and 1996b) found that supplementation of non-pathogenic bacteria cultures in maize/soybean or maize/barley/soybean diets stimulated appetite and increased fat, nitrogen, calcium, phosphorus, copper and

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manganese retention in layers. However, maize/soybean meal formed the bulk of the ingredients in the ration formulated that was supplemented with the growth promoters in this study. But Awaad *et al.* (2001) working with the same growth promoters as used in the study with broilers (Hubbard breed) reported significant ( $P < 0.55$ ) increases in body weight, body weight gain and efficiency of feed utilization.

Immunity resulting from gut exposure to a variety of antigens, such as pathogenic bacteria and dietary protein is important in the defense of young animals against enteric infection (Perdigon *et al.*, 1995). Therefore immune extracts as used presently could be important in this aspect in bestowing immune to the young birds, particularly when protection must be derived against antigens likely to cause disease. Dunham *et al.* (1993) reported that birds treated with *Lactobacillus reuteri* exhibited longer ileal villi and deeper crypts, which are a response, associated with enhanced T-cell function, and increased production of antisalmonella IgM antibodies. However the current study will use *prebiotics* and *probiotics* together with cell-wall fragments and immune extracts to enhance growth of broilers at starter and finisher phases.

### Materials and Methods

Sixty day-old broilers (Ross breed) were tested with or without *prebiotics* and *probiotics* that have bio-competitive exclusion and enhance immune abilities were used as a natural growth promoter administered at starter (1-5wks) and finisher (6-10wks) phases. Each treatment had three replicates of ten birds per replicate. Energy and protein levels of the diets were 3000 kcalME/kg and 20% CP and, 3000 kcalME/kg and 17% CP for the starter and finisher phases, respectively. The experiment lasted for ten weeks.

The chicks were vaccinated against Newcastle and infectious bursal (Gumboro) diseases using Hitchner B 1 vaccine at day one. Gumboro vaccine was administered at days thirteen and twenty-three, and Ia Sota vaccine at day eighteen of establishing the birds in the brooder of the University of Ibadan, Teaching and Research Farm. Also the birds were administered with oral antistress multivitamin preparation for the first three days in the brooder. Coccidiostat (Improlium) was orally administered at the rate of 0.60 g/l of water for the first week then half of that initial strength for the second week according to the prescription.

Levels of inclusions of the growth promoters were at the rates of 20mg of a compound containing inulin, cell-wall extracts and immune extracts in drinking water per bird and 1g of a carrier containing a stabilized strain of *Enterococcus faecium* per kg of feed. The water supplement was administered for three days while that of feed supplement lasted for the entire feeding programme. Feed and water were given *ad libitum*. Starter diet was fed for the first five weeks and a finisher diet the remaining period of five weeks. The gross composition and calculated of the diet are as shown in Tables 1 and 2.

At the finisher phase, the birds were randomly chosen i.e. one per replicate for blood metabolites assay to determine the level of immune response of both treated and untreated birds with the natural growth promoters (Table 5). For the carcass analysis (Table 6), one bird per replicate was chosen at random starved for twelve hours then slaughtered. Severing of the jugular vein with a sharp knife then allowing blood to drain did the process of slaughtering. The birds were hand-plucked after scalding.

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**Table 1:** Gross composition of experimental diets with or without prebiotics and probiotics.

Experimental	Diets	
	Starter	Finisher
<b>Ingredients</b>		<b>Percentages</b>
Maize	51.49	51.91
Soybean meal	16.11	16.24
Groundnut cake	13.99	2.98
Cassava meal	10.07	20.30
Fish meal	4.93	4.97
Bone meal	2.27	2.28
* Premix	0.90	0.91
Common salt	0.18	0.18
Methionine	0.01	0.13
Lysine	0.05	0.10
Total	100.00	100.00

Note: The variations observed in the values of the ingredients especially the fixed were as a result of adjustments in the formulated percentages to as-fed percentages.

\* Vitamin mineral premix contained per kilogram of diet. Vitamin A (1250 IU), vitamin D<sub>3</sub> (2750 IU), vitamin E (15 IU), vitamin K (2mg), riboflavin (6mg), pantothenic acid (10mg), niacin (35mg), vitamin B<sub>12</sub> (0.02mg), choline (300mg), biotin (0.05mg), folic acid (1mg), thiamine (1.50mg), pyridoxine (3.50mg), vitamin C (25mg), manganese (100mg), zinc (45mg), iron (50mg), copper (2mg), iodine (1.55mg), selenium (0.10mg), cobalt (25mg).

**Table 2:** Calculated analysis of the diet

Diets	DM%	CP %	MEkcal/kg	EE%	CF%	Ca%	P%
Starter phase	86.27	21.66	3035.71	3.72	3.15	1.221	1.079
Finisher phase	85.87	17.08	3091.48	3.15	2.98	1.229	0.647

### *Data analysis*

Using a scale to measure out what was fed to the birds and measuring the left over first thing in the morning the next day just before feeding did collection of data. Care was taken to minimize wastage of feed by using adjustable feeders. The birds were weighed every week for body weight gain. Metabolizable energy intake for body maintenance was calculated using the prediction model of  $W^{0.75}$  cal/day (Rose, 1997). Where W =

Body weight of the bird in grams. All data collected were subjected to analysis of variance while the least significant difference method (Gomez and Gomez, 1984) was used in assessing significant differences between paired means.

### **Results and Discussion**

The performance of the birds is as shown in Tables 3,4,5 and 6. The daily metabolizable energy intake (cal/day/bird) was significantly

( $P < 0.05$ ) increased with the *prebiotics* and *probiotics*, natural growth promoters. It was higher than the broiler chicks reared without the growth promoters at the starter phase. The efficiency of feed utilization (gain/feed/bird) was significantly ( $P < 0.05$ ) higher with the birds on the feed additives compared to those without them at the finisher phase of the experiment. Other parameters measured were increased but were not significant with the birds raised with the growth promoters.

Awaad, *et al.* (2001) working with the growth promoters on broilers (Hubbard breed) observed a significant ( $P < 0.05$ ) increase in efficiency of feed utilization body weight gain and mean body weight. This observation is similar to that obtained in the experiment.

The blood metabolites assay (Table 5) revealed better endowment of the birds treated with the growth booster than without it. All the parameters measured increased except the percentage of neutrophil though not significantly in the treated birds. Mortality rates in both treatments were within acceptable limits but 67% more of the

birds in the untreated died compared to the treated. Total mortality at starter and finisher phases was three birds for the untreated while for the treated it was one bird.

After slaughtering, the carcass analysis (Table 6) showed a significant ( $P < 0.05$ ) increase in the average weights of gall-bladder, live and plucked parts of the birds treated with the supplements compared to the untreated birds. The weights of other parts of the birds that were treated with the growth promoters were measured and were higher but not significant to those without the growth promoters.

The enhanced performance of the birds on the growth promoters could only be due to the bio-extracts that had the benefits of initiating a stabilized gut micro-flora improved utilization of feed leading to better conversion of nutrients to body weight. Also the supplement has an added advantage of reducing mortality, improving digestion and preventing diarrhea. These advantages culminated in a better performance of the birds on the growth promoters in the experiment.

**Table 3:** Performance of the broiler with (+) or without (-) prebiotics and probiotics (Table 3).  
Starter phase

<b>Experimental Diets</b>			
Parameters	1(-)	2(+)	S.E.M
Average body weights (g/bird/5wk)	985.00	1280.67 ± 199.20	
Average body weight gain (g/bird/d)	45.50	61.52 ± 9.20	
Average feed intake (g/bird/5wk)	123.57	129.12 ± 7.47	
Efficiency of feed utiliz (gain/feed)	0.35	0.50 ± 0.11	
Metabolizable energy intake (cal/d)	113.04 <sup>a</sup>	146.97 <sup>b</sup> ± 8.49	

Note: Values with different superscripts in a row are significantly ( $P < 0.05$ ) different  
SEM = Standard error of mean

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**Table 4:** Finisher phase Performance of the birds with (+) or without (-) *prebiotics* and *probiotics*

Parameters	Experimental Diets		S.E.M
	1(-)	2(+)	
Average body weights (g/bird/10wk)	1800.00	2290.00 ±	265.78
Average body weight gain (g/bird/d)	29.29	57.56 ±	11.00
Average feed intake (g/bird/5wk)	148.14	160.86 ±	10.97
Efficiency of feed utiliz (gain/feed)	0.19 <sup>a</sup>	0.38 <sup>b</sup> ±	0.05
Metabolizable energy intake (cal/d)	206.57	262.8 ±	30.50

*Note:* Values with different superscripts in a row are significantly (P<0.05) different  
SEM = Standard error of mean

**Table 5:** Blood metabolites of broilers with (+) or without (-) *prebiotics* and *probiotics*

Parameters	1(-)	Experimental Diets	2(+)
	Packed cell volume (%)	23.00±	0.58
Hemoglobin (mg/100ml)	7.47±0.29		8.70±0.17
Red blood cell (x 10 <sup>12</sup> /l)	3.92±0.05		4.19±0.06
White blood cell (x 10 <sup>9</sup> /l)	9.93±0.03		10.83±0.44
Lymphocyte (%)	33.33±6.01		38.33±4.41
Neutrophil (%)	66.67±6.01		61.33±4.10
Total protein (g/l)	4.97±0.22		6.00±0.06
Albumin (g/l)	1.77±0.03		2.43±0.18
Globulin (G/l)	3.20±0.21		3.70±0.06

Table 6: Average weight (g) of the different parts of bird

Experimental Diets	1(-)	2(+)	S.E.M
Parameters			
Live weight	1570.00 <sup>a</sup>	1920.00 <sup>b</sup> ±	120.00
Plucked weight	1380.00 <sup>a</sup>	1740.00 <sup>b</sup> ±	120.00
Eviscerated weight	990.00	1210.00 ±	210.00
<b>Cut-up parts</b>			
Back	260.00	310.00 ±	48.65
Breast	287.67	356.67 ±	40.60
Drum stick	146.67	193.33 ±	17.95
Head	53.33	57.67 ±	7.45
Neck	60.00	81.67 ±	10.93
Shank	53.33	80.00 ±	12.00
Thigh	49.00	31.33 ±	19.44
Wing	136.67	160.00 ±	8.82
<b>Organ Weights</b>			
Crop	10.00	10.00 ±	0.00
Gizzard	43.33	50.00 ±	4.71
Gall bladder	2.83 <sup>a</sup>	3.30 <sup>b</sup> ±	0.16
Heart	15.00	10.33 ±	3.00
Intestine	111.33	100.33 ±	13.33
Kidney	5.00	6.67 ±	0.84
Liver	50.00	53.33 ±	3.33
Lung	11.92	18.33 ±	2.54
Proventriculus	10.00	10.00 ±	0.00

Note: values with different superscripts in a row are significantly ( $P < 0.05$ ) different.  
S.E.M = Standard Error of Mean.

## Conclusions

Results of the experiment showed that:

- i. *Prebiotics* and *probiotics* supplements enhanced performance of the broiler birds.
- ii. The growth booster is useful for the improvement of performance within a relatively short time.
- iii. The evidence of increased level of immunity was attested for by higher levels of white

blood cells, lymphocytes, total serum protein etc. in the blood assay of treated birds that result in their having a lower mortality.

The use of the growth promoters will eliminate risk involved in the use of antibiotics for the purpose of growth promotion. Therefore, farmers instead of using antibiotics in growth promotion can use *prebiotics* and *probiotics*. It is cost effective, risk free and an efficient way of raising birds.

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