THE EFFECT OF PROBIOTICS SUPPLEMENTATION ON THE GROWTH PERFORMANCE OF TWO STRAINS OF COCKERELS

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ABSTRACT

In a 2 × 3 factorial design, two hundred and seven 3 weeks old black (Bovan Nera) and white (Gold line) cockerels were randomly assigned to three dietary treatments. The basal diet was based on maize, soybean meal, groundnut cake and wheat offal. Probiotics replaced the wheat offal in Diets I, II and III in proportion of 0, 0.05 and 0.1%. Probiotics contained Lactobacillus acidophilus, Saccharomyces cerevisae and Saccharomyces boulardii. Each diet was offered to 3 pens of 12 black cockerels each or 3 pens of 11 white cockerels each. Starting chicken of both strains responded non-significantly to increasing probiotics concentration in feed intake, body weight gain, and feed/gain ratio. A non-significant interaction occurred between strain and dietary probiotics concentration for all response criteria. The slope of regression of body weight changes depending on age was higher for white than black.

KEYWORDS: probiotics, cockerels, strain, performance, slope of regression

INTRODUCTION

The increased pressure on the livestock industry to phase out the use of prophylactic dosages of antibacterial growth promoter (AGP) in the European Union due to microbial resistance in animals and human and the potential to do the same in other parts of world has stimulated increased interest in alternative natural growth promoters. Similarly, the tendencies of consumers for 'chemical free' animal products further exacerbate the demand to lower the use of this feed additive. Antibiotic growth promoters has been used for over 50 years in the poultry industry with its attendant benefits such as improved growth rate, reduced mortality and morbidity and reduced feed conversion ratio.

In the review of the mode of action of in-feed antibacterial additives, Rosen [8] enumerated the roles that include microbiological (improves beneficial bacterial, E. coli, lactobacilli, debilitation of pathogens, reduces adverse bacteria etc.), physiological (reduces stress, faecal moisture, gut wall length and weight, feed transit time etc.), metabolic (reduces ammonia production, bacterial cell wall synthesis, bacteria protein synthesis etc.) and nutritional functions. Nutritional benefits included improvement in energy retention, nitrogen retention, vitamin absorption, trace element absorption, calcium absorption, plasma nutrients, limiting amino acid supply, fatty acid absorption and reduction in gut energy loss [8]. Potential "natural" alternatives to these AGP's include organic acids, probiotics, prebiotics and essential herbs and oil. The progressive reduction of the use of antibiotics in animal feed, as growth promoters, has raised renewed interest in the incorporation of microbial strains in animal feed, in order to maintain the beneficial effect obtained with antibiotics. Simon [9] defined probiotics as 'as viable micro-organisms, which after sufficient oral intake, lead to beneficial effects for the host by modifying the intestinal microbiota'. The microorganisms used in animal feed are mainly bacterial strains of Gram-positive bacteria belonging to the genera of Lactobacillus, Enterococcus, Streptococcus, Bifidobacterium, Pediococcus , Bacillus and microscopic fungi such as strains of yeasts belonging to the Saccharomyces cerevisiae species [10]. Probiotics is generally believed to improve performance in farm animal's vis-à-vis the improvement of intestinal health and maintenance of the microbial balance.

Cockerels are slow growing (male layer) birds usually raised for their meat, which female lines have been selected over many generations for high egg production while the males have been less selected. Different strains of these birds are generally assumed to have the same growth rate. It is well known that different sets of broiler have different requirement for nutrient e.g. the lysine requirement of fast growing broiler is higher than that of a slow growing strain [4] and different genotypes of chicken similarly differ in their requirement for the nutrients [3]. This relationship is well established for a wide range of nutrients. It is however not known whether this also apply to non-nutrient growth promoter fed to poultry species. It often assumed that the same dose or concentration of growth promoter would elicit similar performance in different strains of birds. It is also not known whether slow growing animals could benefit from the growth promoting effect of probiotics supplementation, if any. It is the objective of this study to compare the growth rate of white and black strain of cockerels with or without probiotics supplementation as well as examine the response of slow growing birds to probiotics supplementation using cockerel as a model animal.

MATERIALS AND METHODS

Two hundred and seven 3 weeks old black (Bovan Nera) and white (Gold line) cockerels with initial weights of 126 ± 2 g and 131 ± 2 g (Mean ± SEM) respectively were randomly assigned to three dietary treatments in a 2 × 3 factorial design. Treatments consisted of three dietary treatments and two strains of cockerels. Birds were allocated to floor pens on wood shavings with 12 or 11 birds per pen in the poultry house (approximately 0.17 m^2/bird). Before the commencement of the study, chickens were brooded under electric hoods and room temperature decreased from 35 to 25 ºC from day old to 21 days. Subsequently during the study, supplemental heating was provided only at night, because usual ambient temperature at this period of the year ranged between 25 to 30 ºC.

Birds were weighed and uniformly distributed to their respective pen on weight basis. Each diet was offered to 3 pens of 12 black cockerels each or 3 pens of 11 white cockerels each. Feed and water was also provided unrestrictedly. Birds were individually weighed on weekly basis with a precision scale until the end of the experiment. Daily voluntary feed intakes were monitored.

A basal diet was formulated. The basal diet was formulated to meet the nutrient requirement of starting chicks using the NRC [6] as a guide. The basal diet was based on maize, soybean meal, groundnut cake and wheat offal. The basal diet was fortified with synthetic amino acids to optimize amino acid balance. Amino acid and other nutrients composition of diets was calculated based on published values from NRC [6] and NRC [7]. Table 1 shows the ingredient composition of the

TABLE 1. Gross and chemical compositions of the experimental diets

Ingredients	Diet I	Diet II	Diet III		Chemical analyses (%)[1,2]
Maize	50.00	50.00	50.00	Crude protein	21.27 (21.26-21.28)
Groundnut cake	14.90	14.90	14.90	ME kcal/kg	2830.9 (2830.2-2831.5)
Palm kernel cake	5.80	5.80	5.80	Crude fibre	4.55 (4.54-4.55)
Soybean meal	12.00	12.00	12.00	Lysine	1.024
Wheat offals	10.00	9.95	9.90	Methionine	0.477
Bone meal	2.00	2.00	2.00	Threonine	0.702
Oyster shell	1.50	1.50	1.50	Valine	0.974
DL-Methionine	0.15	0.15	0.15	Isoleucine	0.811
L-Lysine.Hcl	0.15	0.15	0.15	Leucine	1.638
Salt	0.25	0.25	0.25	Phenylalanine	0.968
Vitamin-Premix	0.25	0.25	0.25	Histidine	0.525
Probiotics	-	0.05	0.10	Arginine	1.686
				Tryptophan	0.210

[1] Crude protein, crude fibre, metabolisable energy and amino acid values of the basal diet were calculated. Values in parenthesis are the calculated range for the three diets. Replacement of wheat offal with probiotics in Diets I to III have a negligible effect on the calculated values, therefore only values for Diet I was shown.

[2] Analysed proximate values for the basal diet (%) were: dry matter 90.92, crude protein 21.98, crude ash 6.18, ether extract 4.4 and crude fibre 3.82.

experimental diets. Probiotics replaced the wheat offal in Diets I, II and III in proportion of 0, 0.05 and 0.1% in the basal diet. Commercial probiotic preparation was declared to contain Lactobacillus acidophilus (4.5 x 10^9), Saccharomyces cerevisae sc-47 (1.25 x 10^{10}) and Saccharomyces boulardii (3 x 10^9) c.f.u. per kg by the manufacturer. Calculated values for proximate and amino acids on as fed basis are also presented in Table 1. All ingredients with the exception of the variable one (wheat offal) was mixed as a single lot and later divided into three equal parts. Wheat offal and the probiotics were added separately in their respective proportions. Each diet was then mixed again and bagged.

Dry matter, crude protein, crude fibre and crude ash of the basal diet were performed according to the AOAC [1] procedure. Data were subjected to routine ANOVA from General Linear Model procedures using the software package SPSS 13.0 for windows. A linear regression on growth of chicken (y, kg/bird) depending on age – in weeks (x, growth over time) was calculated.

$y = bx + a$

where a =constant and b=slope of the regression line.

Treatment averages was considered as one data point in the regression analysis. Parameters of goodness of fit were r^2 and Sy.x. The sy.x values are the standard deviations of the residuals, which are the distances between the individual points from the calculated line. Linear regression was calculated using GraphPad Prism 4.02 (GraphPad Software Inc., San Diego, California). This experiment was conducted at the Poultry Unit of the Teaching and Research Farm, Obafemi Awolowo University, Ile-Ife.

RESULTS AND DISCUSSIONS

The calculated chemical analysis of the basal diet was confirmed by proximate analysis (Table 1). The concentration of probiotics and viable spores fed in this experiment are those generally considered high enough to elicit response in pigs and poultry [5, 10]. Starting chicken of both strains responded non-significantly to increasing probiotics concentration in feed intake, body weight gain, and feed/gain ratio. For all response criteria a non-significant interaction occurred between strain and dietary probiotics concentration (Table 2). The parameter estimates of the linear regression of body weight changes depending on age (weeks) are shown in Table 3. The final body weight gain, body weight gain and feed intake was significantly influenced by strain but was unaffected by probiotics supplementation. Arslan [2] fed Lactobacillus bulgaricus to two groups of rock partridges (a control and a treatment group containing 0.15% probiotics) for 12 weeks and observed no difference in live weight, feed intake and feed conversion between the two groups. Reports on the use probiotics and its attendant benefits in poultry have been generally inconclusive. In review of published results on the use of probiotics in poultry diet or water, Stavric and Kornegay [10] concluded that results were generally inconsistent, while a few result indicated a beneficial effect in terms of weight gain, egg production and feed efficiency in broiler, layers

TABLE 2. Effect of probiotics (Pro) concentration on growth, intakes, and feed conversion of cockerel chickens from a black (B) or a white (W) strain (Str) during 3 to 9 weeks of age (n = 3 pens of 12 (B) or 11 (W) birds per treatment)

		Diet I	Diet II	Diet III	Pooled SEM	Probiotics	P (ANOVA) Strain	Pro×Str
Initial body weight, g/bird								
	B	125.0	130.6	122.2	1.67	0.353	0.066	0.068
	W	136.4	127.3	130.3	2.20			
Final body weight, g/bird								
	B	643.0	626.7	661.6	12.1	0.905	0.002	0.161
	W	698.7	732.3	688.5	10.4			
Body weight gain, g/bird/week								
	B	86.3	82.7	89.9	2.11	0.849	0.004	0.096
	W	93.7	100.8	93.0	1.85			
Feed intake, g/bird/week								
	B	352.8	333.6	339.5	4.27	0.050	<0.0001	0.437
	W	368.9	362.6	357.7	24.3			
Feed/gain, g/g								
	B	4.1295	4.0810	3.8270	0.07	0.152	0.078	0.113
	W	3.9882	3.6457	3.8887	0.07			

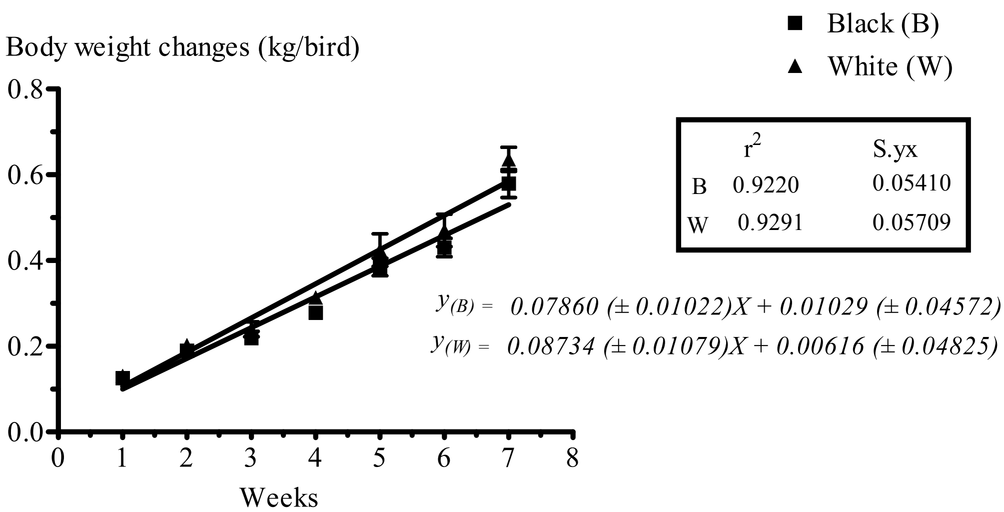

FIGURE 1: Body weight changes depending on weeks of starting chicken fed incremental probiotics concentrations (n = 9 pens of 12 (B) or 11 (W) birds per treatment)

TABLE 3. Estimated parameters for weekly body weight changes of Black (B) or a white (W) strains of during 3 to 9 weeks of age (n = 3 pens of 12 (B) or 11 (W) birds per treatment)

	Diet I (B)	Diet II (B)	Diet III (B)	Diet I (W)	Diet II (W)	Diet III (W)
a	0.09021 ± 0.0172	0.09333 ± 0.0202	0.08314 ± 0.0228	0.09873 ± 0.0218	0.08838 ± 0.0214	0.09339 ± 0.0216
b	0.08008 ± 0.0048	0.07495 ± 0.0056	0.08078 ± 0.0063	0.08644 ± 0.0061	0.09242 ± 0.0059	0.08315 ± 0.0060
95% CI of Slope						
Upper	0.09004	0.08670	0.09401	0.09909	0.1048	0.09571
Lower	0.07013	0.06320	0.06755	0.07378	0.08000	0.07059
Goodness of Fit						
r^2	0.9372	0.9037	0.8958	0.9149	0.9274	0.9100
Sy.x	0.0436	0.05145	0.05793	0.05542	0.05439	0.05498

and turkey, most of the results generally had no effect. They adduced the observed response to differences in concentration of probiotics added to feed (reported range in literature was 0.002 to 0.2), duration of treatment, diet type, age of birds and other experimental protocols. L. acidophilus was the strain of probiotics used in most of these experiments. A similar observation has also been made in piglets [9]. In the review of 22 publications on the intake of probiotics by piglets, only in 3 of the studies was significant improvement in daily gain observed and improvement in feed conversion was only observed in a study. Probiotics generally reduced the incidence of diarrhoea in young piglets and this is independent of the strain of microbe used [9]. The initial body weight and feed conversion ratio was neither influenced by strain nor the added probiotics. The slope of regression of the white strain was higher than that of black strain with or without probiotics supplementation on the various diets and all slopes were significantly different from zero (Table 3). Probiotics exhibited no influence on all the performance criteria for the within strain variations observed, however there was a significant strain difference in body weight gain and feed intake. White cockerels had significant higher feed intake ($p < 0.0001$) and weight gain ($p = 0.004$) than black cockerels. Therefore a pooled data for both strains was used for further calculation (Figure 1). The slope of regression of body weight changes depending on age was higher for white than black (87.34 vs. 78.60 g). Comparing the pooled data for body weight changes for each strain using independent two tailed t-test revealed that the overall growth rate was generally higher for white than black strains of cockerels ($p = 0.0043$).

It was concluded that probiotics generally have no effect on the growth performance of cockerels and this observation is independent of strain of cockerel. White cockerels have higher growth rate than the black strain based on the slope of regression of body weight changes depending on age.

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