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308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorijps@gmail.com

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Low Performance of Broilers after the Inclusion of Celmanax Prebiotic into Starter and Finishing Poultry Feed

Aphzal Mohammed, Andell Edwards, Mario Baboolal and Puran Bridgemohan
University of Trinidad and Tobago, Eastern Caribbean Institute of Agriculture and Forestry,
Faculty of Biosciences, Agriculture and Food Technology,
Caroni North Bank Road, Centeno Arima, Trinidad

Abstract: This study aimed to assess the effects of including the prebiotic Celmanax in both a starter and finishing feed at rates of 2 kg and 1 kg/ton, respectively, as recommended for manufacturing purposes. A total of 240 one-day-old chicks (Aber Acres) were randomly divided into two groups of 120 chicks, including 60 chicks of mixed sexes per replicate (two replicates per group). The experiment was completely randomized with two experimental treatments (one control and one supplement; replicated twice). Chickens were vaccinated for Fowl pox, Tenosynovitis, Marek, Newcastle and Gumboro diseases. All birds received starter feed from one day to three weeks of age and finisher diets from four to six weeks of age. The average weight, feed intake, average daily gain (ADG) and feed conversion ratio (FCR) were determined at weekly intervals for each group. Data were analyzed using a completely randomized design with ANOVA utilizing Minitab software (Minitab 19). Significant differences among treatments were identified using Duncan's new multiple range test. Average weights for Celmanax added feed were higher at week one ($p<0.05$), whereas control diets showed higher weights at weeks 4, 5 and 6. The average daily gain was greater ($p<0.05$) for control diets at weeks 3, 4 and 5. There were no significant differences ($p>0.05$) in the feed conversion ratio (range 0.68-0.95 kg) across treatments for the 6 week study period. There were no differences ($p>0.05$) between the Celmanax and control diet regarding feed intakes and FCR during the overall six week period, while mortality was higher ($p<0.05$) in the Celmanax group. Present study did not identify the expected benefits in growth rates, feed intake rates and FCR, or reduced mortality, as expected based on other studies. This was likely a consequence of the presence of unconfirmed mycotoxins in the feeds and poor quality egg sources.

Key words: broiler, growth rates, FCR

INTRODUCTION

The poultry industry in Trinidad and Tobago includes more than 3000 traditional cottage or small-scale poultry processors, 4 conventional processing plants and over 500 contract farmers. The industry produces more than 40 million heads of finished broilers annually (equivalent to 80,000 tons), which have a value of approximately 1.4 billion Trinidad and Tobago dollars (Phillip *et al*., 2011). However, most of the raw materials for feed manufacture are imported, because the country does not produce corn in any competitive quantity for animal feed. Additionally, feed accounts for ~70% of the cost of production of a chicken at the farm gate. Any practice that reduces the cost of production will benefit the poultry producer.

Enteric diseases of poultry that are caused by bacterial infections pose major health, food safety and economic challenges to the poultry production industry. Bacterial diseases can result in impaired performance and increased mortality in flocks, which can potentially contaminate poultry products designated for human consumption. The use of antimicrobials in poultry feed to combat bacterial diseases can lead to the development of antibiotic resistance as well as the public health threat of antibacterial residues within poultry meat products. As an alternative to incorporating antibiotics in poultry feeds, the inclusion of both probiotics and prebiotics has been shown to improve gut health (Hajati and Rezaei, 2010). Probiotics, such as live yeast (*Saccharomyces cerevisiae*), incorporated into broiler feeds have also resulted in improvements in growth rate, feed conversion efficiency and nitrogen utilization (Gomez and Angeles, 2011). The prebiotic Celmanax is a combination of an enzymatically hydrolyzed yeast products and yeast culture that contains a unique blend of Refined Functional Carbohydrates (RFCs) of complex sugars, such as beta-glucans and galactosamines, including mannanoligosaccharide (MOS) (Stanley *et al*., 2004; Arce, 2014). The mannanoligosaccharide (MOS) contained in Celmanax

Corresponding Author: Aphzal Mohammed, University of Trinidad and Tobago, Eastern Caribbean Institute of Agriculture and Forestry, Faculty of Biosciences, Agriculture and Food Technology, Caroni North Bank Road, Centeno Arima, Trinidad

likely binds to potential pathogenic *Escherichia coli* bacteria that colonize dairy cattle, particularly those with type 1 fimbria on the surface, which blocks bacterial adhesion to and multiplication on intestinal cells (Mohamed *et al*., 2013). Evidence suggests that this oligosaccharide favors the growth of beneficial bacteria, such as *Lactobacillus* spp., which can nullify certain enterotoxins by inhibiting the growth of pathogenic bacteria (Spring *et al*., 2000). A similar type of change in enteric bacteria in the cecum of broilers that results from dietary MOS is improved gut morphology, gastrointestinal health and increased nutrient availability, which all contribute to enhancing the performance indices of poultry (Stanley *et al*., 2004; Arce, 2014; Ziki *et al*., 2011).

Regarding poultry performance, not all studies have reported consistent improvements in production criteria. Studies of the inclusion of the yeast *S. cerevisiae* have shown improvement in both weight gain and the feed conversion ratios (FCR) (Onifade *et al*., 1998; Kassem *et al*., 2012), whereas another study that used a dried yeast extract found increased weight gain, but not FCR (Kanat and Calialar, 1996). Other reports have shown improvement in FCR, but not the growth rate of broilers (Valdivie, 1975; Onifade *et al*., 1998). However, it is notable that Corrigan *et al*. (2011) found no weekly differences in feed intakes or the FCR between MOS and control diets that were fed to broilers over a six-week period.

The prebiotic Celmanax® (Vi-Cor, Mason City, IA, USA) has recently been introduced in its dry form as a feed additive in Trinidad. This feeding trial was designed to investigate the effects of supplementation with Celmanax on broiler performance at the recommended levels in starter and finishing feeds designed for poultry production. As such, this represents the first report on the inclusion of Celmanax in poultry feed in Trinidad.

MATERIALS AND METHODS

A total of 240 one-day-old chicks (Aber Acres) of uniform weight were randomly divided into two groups of 120 chicks with 60 chicks of each sex per group. The experiment was completely randomized with two experimental treatments (one control and one Celmanax supplementation; replicated twice), as follows: the control group received normal broiler feed (with no Celmanax) and the experimental group received Celmanax (dry form) incorporated in broiler feed. Birds were reared in an open-sided naturally ventilated broiler house and were contained in floor pens on wood shavings with rice husk litter. The litter was turned every five days to guard against ammonia production. Chickens were vaccinated against Marek's, Newcastle and Gumboro diseases. All birds received starter feed from one day to three weeks of age, followed by finisher diets from four to six weeks of age. Water was provided *ad libitum* throughout the experimental period. Celmanax was included in both the starter and finishing feeds at 2 kg and 1 kg/ton, respectively. The average weight, feed intake, average daily gain (ADG) and feed conversion ratio (FCR) were determined for each group. Average weights and feed intake were measured at weekly intervals. Weight gain was calculated as the difference between the final and initial body weight. Feed intake was calculated as the difference between the amount of feed supplied to the birds and the amount of feed that was refused. The feed conversion ratio was calculated as the ratio of feed intake to body weight gain.

Statistical analysis: Data were analyzed using a completely randomized design with ANOVA. The Minitab software package was used for statistical calculations **(Minitab 19, 2013)**. Significant differences among treatments were identified using Duncan's new multiple range test.

RESULTS AND DISCUSSION

We found no significant difference ($p>0.05$) among groups of birds for feed intake (range 0.55-6.79 kg) between the two diets (i.e., Celmanax treated and control) during the six-week period (Table 1). Moreover, was no difference ($p>0.05$) in the ADG (0.08 kg) across treatments for the first week (Table 1). However, ADG was greater ($p<0.05$) for birds given the control diet at week 3 (0.14 kg), week 4 (0.21 kg), week 5 (0.28) and week 6 (0.42 kg). There were no significant differences ($p>0.05$) in the FCR (range, 0.68-0.95 kg) across treatments during the six week period (Table 1).

However, the average weight was significantly greater ($p<0.05$) for birds administered Celmanax (0.11 kg) at week one compared with the controls (0.10 kg). Nevertheless, average weights were significantly greater for birds fed the control diet at week 4 (Celmanax (0.29 kg), control (0.34 kg), week 5 (Celmanax (0.42 kg), control (0.46 kg) and week 6 (Celmanax (0.61 kg), control (0.69 kg), Table 1.

There was no difference in mortality among birds fed either diets at weeks 1, 2 and 6. However, mortality was greatest ($p<0.05$) among birds fed the Celmanax diet (3.24%) at week 3.

Table 1 and 2 show that there were no significant differences ($p>0.05$) between treatments for the 6 week or 42 day overall feed intake (3.16 and 3.41 kg, respectively), average daily weight gain (0.19 and 0.20 kg), FCR (0.85 and 0.85 kg), or body weight (0.28 and 0.31 kg). Our findings agree with those of Corrigan *et al*. (2011) who reported no weekly differences in feed intake or FCR between broiler chicken fed the MOS or control diet over a 42-day period. Our study also agrees in part with the findings of Kanat and Calialar (1996), who evaluated a dried yeast extract and found increased weight gains, but not changes in the FCR. Other reports

have also shown improvements in the FCR, but not growth rates of broilers; the latter finding was confirmed by this present study (Valdivie, 1975; Onifade *et al*., 1998). Our present findings contrast with improvements in weight gains and FCR reported by other studies (Kanat and Calialar, 1996; Stanley *et al*., 2004). Mortality was greatest ($p<0.05$) among birds fed a Celmanax®-treated diet (1.07%; Table 2). This finding is in contrast to the reduced mortality that had been reported by other studies (Stanley *et al*., 2004; Arce, 2014).

Table 3 shows a commercial analysis of the starter and finisher diets. Table 4 shows an actual analysis solely of 4 sampled starter diets.

Our random analysis of the starter diet revealed a trend to have reduced crude protein and crude fat levels (Table 4) compared with the commercial analysis. Mycotoxins, though not confirmed, might account for the variable levels of these key nutrients. The presence of mycotoxins in poultry trials have been found to result in reduced crude fat/ether extract, feed intake and

Table 1: Effects of Celmanax on the performance parameters of broilers over time

Treatment	Week	Feed intake (kg)	ADG (kg)	FCR (kg)	Body wt (kg)	Mortality (%)
Celmanax®	1	0.57[a]	0.08[a]	0.91[a]	0.04[a]	0
Control	1	0.55[a]	0.08[a]	0.87[a]	0.04[a]	0
SEM		0.04	0.00	0.07	0.001	-
Celmanax®	2	1.35[a]	0.10[a]	0.88[a]	0.11[a]	0
Control	2	1.55[a]	0.09[b]	1.05[a]	0.10[b]	0
SEM		0.18	0.000	0.118	0.001	-
Celmanax®	3	2.81[a]	0.13[a]	0.95[a]	0.21[a]	3.24[a]
Control	3	2.99[a]	0.14[b]	0.92[a]	0.23[a]	0.23[b]
SEM		0.19	0.001	0.06	0.01	0.86
Celmanax®	4	3.53[a]	0.18[a]	0.88[a]	0.29[a]	2.74[a]
Control	4	3.82[a]	0.21[b]	0.82[a]	0.34[b]	0.46[a]
SEM		0.131	0.000	0.031	0.001	0.613
Celmanax®	5	4.27[a]	0.26[a]	0.73[a]	0.42[a]	0.41[a]
Control	5	4.74[a]	0.28[b]	0.74[a]	0.46[b]	0.00[a]
SEM		0.162	0.000	0.027	0.003	0.146
Celmanax®	6	5.83[a]	0.38[a]	0.68[a]	0.61[a]	0.00
Control	6	6.79[a]	0.42[b]	0.71[a]	0.69[b]	0.00
SEM		0.360	0.000	0.041	0.004	-

[ab]Superscript letters in the same column for a parameter denote significant differences, $p<0.05$

SEM: Standard Error of the Mean, ADG: Average Daily Gain, FCR: Feed Conversion Ratio

Table 2: Overall effects of Celmanax on the performance parameters of broilers

Treatment	Feed intake (kg)	ADG (kg)	FCR (kg)	Body wt (kg)	Mortality (%)
Celmanax	3.16[a]	0.19[a]	0.85[a]	0.28[a]	1.07[a]
Control	3.41[a]	0.20[a]	0.85[a]	0.31[a]	0.12[b]
SEM	0.174	0.008	0.021	0.016	0.161

[ab]Superscript letters in the same column for a parameter denote significant differences, $p<0.05$

SEM: Standard Error of the Mean, ADG: Average Daily Gain, FCR: Feed Conversion Ratio

Table 3: Manufacturer feed analysis and basal feed additives of starter and finisher diets

Feed ingredients	Starter feed ratio (%)	Finisher feed ratio (%)
Crude protein	20	19
Crude fat	4.5	4.5
Crude fiber	3.50	3.50
Sodium monensin	0.10	-
Amprolium hydrochloride	-	0.0125
Celmanac	2 kg/ton	1 kg/ton

Table 4: Chemical composition of Celmanax in selected samples of starter feed (g/kg DM)

Sample ID	Reps	DM	MC	CP	EE	CF	Ash	*NFE
Celmanax®	1	986	14	154	44.5	20.7	53.9	726
Celmanax®	2	987	12.9	135	40	28.6	50.6	715
Mean		986	13.5	13.7	42.2	15.7	52.3	721
SD		0.82	0.84	0.862	11.0	1.21	2.36	7.57
Control	1	982	18	121	19	24.7	54.5	799
Control	2	982	17.5	118	17.8	21.9	52.8	789
Mean		982	17.9	11.83	19.5	20.9	53.7	794
SD		0.53	0.55	0.57	0.60	0.64	1.16	7.51

*Calculated according to AOAC (2005)

performance and can also cause greater mortality compared with controls (Danicke *et al*., 2003; Akande *et al*., 2006). The higher mortality at week 3 for the Celmanax diet might also have been caused by mycotoxin-induced mortality. In Guyana, chickens often only reach an average weight of 1 kg by 16 weeks of age, perhaps because hatcheries in Guyana import eggs of a poor quality (Starbroek News, 2010). Our broiler chicken attained an average market weight of approximately 2.5 kg at 12 weeks, but they were fed a different finisher feed source (18% CP; Warner Grains Ltd.).

Conclusions: This present study was conducted to study the effects of including the prebiotic Celmanax in both starter and finishing feed at 2 kg and 1 kg/ton, respectively, as recommended for manufacturing purposes. We found no differences between the chickens fed the Celmanax or control diet in feed intakes or the FCR during the six-week period, while mortality was greater ($p<0.05$) among the Celmanax group. This present study did not reveal benefits in the growth rates, feed intake, or FCR and showed reduced mortality compared with other studies, potentially because of the potential presence of mycotoxins and/or poor quality eggs.

Conflicts of interest: There were no conflict of interest related to the conduct of this study.

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