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Carcass Characteristics of Broiler Chicken Supplemented With Detoxifying Microbial Enzymes to Ameliorate Feed Toxins

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ABSTRACT

A feeding trial was conducted to find out the carcass characteristics of broiler chicken by supplementing the detoxifying microbial enzymes (DME) on feed toxins. 420 number of day-old male broiler chicks were divided into fourteen groups 30 birds in each (42 days). Treatment groups T1 and T2 were healthy control and positive control, respectively, T3 received naturally mycotoxin contaminated feed at field level, T4 received naturally mycotoxin contaminated feed at field level +DME at 250g/ton of feed, T5 received naturally contaminated feed with clostridium spp.,T6 received naturally contaminated feed with clostridium spp.+ DME at 250g/ ton of feed, T7 received naturally contaminated feed with E.coli, T8 received naturally contaminated feed with E.coli + DME at 250g/ton of feed, T9 infected with clostridium spp on day 8th, T10 infected with clostridium sp. on day 8th + DME at 250g/ton of feed, T11 infected with E.coli on day 8th, T12 infected with E.coli on day 8th + DME at 250g/ton of feed, T13 received mycotoxin contaminated feed inoculated with clostridium spp. and E.coli from day 8th, T14 received mycotoxin contaminated feed inoculated Clostridium spp. and E.coli from day 8th + DME at 250g/ton of feed. At the end of 42nd day, six birds per treatment group were selected randomly and slaughtered for slaughter studies such as carcass weight, dressing percentage, weight of organs such as liver, kidney, heart, gizzard, spleen, thymus, bursa of fabricious, lungs, tibia and length of intestine were measured. The dressing percentage, weight of heart, spleen and thymus do not differ significantly ($P \geq 0.05$), where as live body weight, weight of carcass, liver, kidney, gizzard, bursa of fabricious, lungs, tibia and intestinal length significantly differed ($P \leq 0.05$) between treatment groups when compared to control diet. It could be concluded that detoxifying microbial enzymes supplementation influenced the carcass characteristics and organ weight in broilers might be due to detoxifying effect of DME against feed and other toxins.

Keywords: *Broiler, Detoxifying microbial enzymes, Mycotoxin, Carcass characteristics, E.coli, Clostridium spp*

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INTRODUCTION

Mycotoxins are the toxic metabolites produced by certain fungi, mainly by the Aspergillus, Penicillium and Fusarium genera. They are always a hazard to human and domestic animals since the past 30 years. Aflatoxins constitute a great threat to the health of animals and humans due to their teratogenic, carcinogenic, mutagenic, and immunosuppressive effects (Guan et al., 2008; Yunus et al., 2011). Additionally, in terms of the livestock industry, aflatoxins cause huge economic loss by retarding animal growth, increasing feed consumption, and reducing meat production (Fan et al., 2013; Do and Choi, 2007). Due to its ubiquitous presence and harmful effect on consumption of contaminated feed, animal nutritionists focused their research to minimize the incidence of fungi in feed and toxicity from the toxin variety. In addition to fungal toxins, the poultry is also being exposed to bacterial toxins produced by Clostridium spp., and E.coli. Both these fungal and bacterial toxins known to affect the health of vital organs like liver, kidney and gut in poultry. Since the vital organs and gut health are affected, the absorption and utilization of nutrients will be impaired which results in sub-optimum productive performance in broilers.

The Food and Agriculture Organization (FAO) estimates that at least 25 per-cent of world cereal production is contaminated with mycotoxins (Dowling, 1997). Hence the research was carried out with detoxifying microbial enzymes (DME) which are capable of detoxifying the fungal and bacterial toxins and also contain toxin absorbents like MOS (Mannan Oligosaccharides), antifungal agents and biological antioxidants. Biological antioxidants have shown promising results in attenuation of heat stress (Pati et al., 2011). The quality of a toxin binder is expressed in four different parameters: binding capacity, absorption efficacy, activation time and inclusion rate (Van Kessel and Hiang Chek, 2004). Among mycotoxin binder, the use of biological methods, using microorganisms and their metabolites to eliminate aflatoxins, can be a highly promising approach owing to its specific, efficient, and environmentally sound detoxification (FAO, 2001). The present study was designed to find out the carcass characteristics of the broilers by supplementing with detoxifying microbial enzymes on toxins through feed.

MATERIALS AND METHODS

A biological trail was carried out with detoxifying microbial enzymes in broiler ration at Department of Animal Nutrition, Veterinary College and Research Institute, Namakkal with 420 numbers of day-old Vencobb male chicks. The design of experiment followed was completely randomised design. The chicks were randomly divided in to fourteen groups with three replicates with ten birds in each replicate.

The experiment was conducted in a shed having mangalore tile roofing and concrete flooring. The birds were housed in deep litter pens using coconut coir path as litter material and reared from day-old to 6 weeks following standard management practices. Feed and water were provided ad-libitum. All the birds were vaccinated against ranikhet disease on 7th day and IBD (infectious bursal disease) on 14th day of age. Mortality was recorded on occurrence. Post-mortem was done and the cause of death was recorded.

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Experimental design and feeding program: The chicks were weighed individually, wing banded and distributed randomly to fourteen treatment groups with three replicates with ten birds in each replicate. The broiler pre-starter, starter and finisher rations were fed from 0-14, 15-28 and 29-42 days of age respectively. The treatment of the biological experiment was presented in Table 1.

Table 1: dietary treatments of the biological experiment

Storage Group	Purpose	Particulars and Dosage
T1	**Healthy Control**	Non - contaminated and non – medicated
T2	**Positive Control**	Non - contaminated and non – medicated + DME @ 250 g/ ton feed.
T3	**Natural ontaminant***	Naturally mycotoxin contaminated feed at field level.
T4	**Prophylaxis***	Naturally mycotoxin contaminated feed at field level + DME @ 250 g/ ton feed.
	Infected Control	Naturally contaminated feed with Clostridium sp.
	Prophylaxis	Naturally contaminated feed with Clostridium sp. + Supplementation of DME @ 250 g/ ton feed.
	Infected Control	Naturally contaminated feed with E.coli.
	Prophylaxis	Naturally contaminated feed with E.coli. + Supplementation of DME @ 250 g/ ton feed.
	Challenge study	Infected with Clostridium sp. on day 8th.
T10	**Prophylaxis**	Infected with Clostridium sp. on day 8th + Supplementation of DME @ 250 g/ ton feed.
T11	**Challenge study**	Infected with E.coli on day 8th.
T12	**Prophylaxis**	Infected with E.coli on day 8th + Supplementation of DME @ 250 g/ ton feed.
T13	**Challenge study***	Mycotoxin contaminated feed inoculated with Clostridium sp. and E.coli from day 8th.
T14	**Prophylaxis***	Mycotoxin contaminated feed inoculated with Clostridium sp. and E.coli from day 8th + Supplementation of DME @ 250 g/ ton feed.

* Naturally Aflatoxin contaminated feed in the field level @ 50 ppb

Each bird in group 9, 10, 13 and 14 were infected orally with approx. 0.4 ml inoculum (bacterial count 1x106 CFU/ml) containing Clostridium spp. on 8th day of age. Each bird in group 11, 12, 13 and 14 were infected orally with approx. 0.4 ml inoculum (bacterial count 1x106 CFU/ml) containing E.coli on 8th day of age.

The broiler pre-starter, starter and finisher rations were fed from 0-14, 15-28 and 29-42 days of age, respectively. The experimental rations were formulated to contain the same level of protein, energy, lysine, methionine, calcium and phosphorus by using MS excel(R). The ingredient and proximate composition of the experimental prestarter, starter and finisher rations are presented in Table 2.

Table 2: dietary treatments of the biological experiment

Feed Ingredients (%)	Pre-starter	Starter	Finisher
Maize	55.10	56.30	61.80
Soyabean meal	39.50	37.20	30.70
Salt	0.30	0.30	0.30
Calcite	1.70	1.70	1.60
Di-Calcium Phosphate (DCP)	1.00	0.90	0.90
Rice bran Oil	1.80	3.10	4.20
Additives (%)			
NSP Degrading Enzyme	0.050	0.050	0.050
Phytase-2500	0.02	0.02	0.02
DL-Methionine	0.27	0.27	0.25
Lysine	0.16	0.16	0.18
Threonine	0.02	0.02	0.03
Sodium bicarbonate	0.14	0.07	0.05
Broiler Mineral Premix (Trouw)	0.20	0.20	0.20
Broiler Vitamin Premix	0.10	0.10	0.10
Salinomycin	0.05	0.05	0.05
Anti oxidant (Endoxdry)	0.01	0.01	0.01
Vitamin E 50 %	0.010	0.008	0.005
Lysoforte	0.05	0.05	0.05
Choline chloride (60%)	0.10	0.10	0.10
Hepatocare	0.10	0.10	0.10
Grand Total	100	100	100
Proximate composition and ME			
Dry matter (%)	91.30	90.93	91.74
Crude protein (%)	22.47	21.55	19.20
Crude fibre (%)	3.62	3.34	3.09
Ether extract (%)	4.18	5.67	6.89
Total ash (%)	7.96	7.85	7.49
Nitrogen free extract (%)	53.07	52.52	55.07
Metabolisable energy (kcal/ kg) calculated	3,000	3,100	3,200

Nutrient composition of the basal diet was more or less similar to the calculated values both during pre-starter, starter and finisher phases with regard to crude protein, ether extract, crude fiber, total ash and nitrogen free extractives on per-cent dry matter basis. With regard to the mycotoxin content, the basal diet was naturally contaminated with minimum 50 ppb of aflatoxin and maximum of 500 ppb.

Parameters studied: At the end of 42nd day, six birds per treatment group were selected randomly and slaughtered by restraining by hands without stuning and neck cutting. The birds are allowed to bleed completely with the help of bleeding cone. Then they are scalded in the hot water at the temperature of 58 - 62º C. Defeathering has to done by normal drum defeatherer. Then evisceration has done manually and finally the carcass was washed with clean water and stored in chiller. Slaughter parameters such as carcass weight, dressing percentage, weight of organs such as liver, kidney, heart, gizzard, spleen, thymus, bursa of fabricious, lungs, tibia and length of intestine were measured.

Statistical Analysis: The data were collected and subjected to one way ANOVA using SPSS soft ware as per the standard statistical methods given by Snedecor and Cochran (1994).

RESULTS AND DISCUSSION

The data on slaughter characteristics of broilers supplemented with detoxifying microbial enzymes in different treatment groups are presented in Table 3 and 4. The dressing percentage, weight of heart, spleen and thymus do not differ significantly (P≥0.05), where as live body weight, weight of carcass, liver, kidney, gizzard, bursa of fabricious, lungs, tibia and intestinal length significantly differed (P≤0.05) between treatment groups when compared to control diet. The per-cent live body weight (g), carcass weight (g), liver weight (g) and gizzard weight (g) was found to be high in T12 (2134 ± 121.87, 1629 ± 90.22, 50.16 ± 3.70 and 45.33 ± 3.39, respectively) and bursa (g) was high in T5 (3.50 ± 0.84) and T6 (3.50 ± 0.56) when compared to other treatment groups. Detoxifying microbial enzymes supplementation influenced the carcass characteristics and organ weight in broilers might be due to detoxifying effect of DME against feed toxins such as mycotoxin and also enterotoxins produced by E.coli and Clostridium spp. El-Katcha et al., (2017) revealed that chemical or biological mycotoxin supplementation significantly improved dressing percentage, increased spleen, bursa and thymus gland weight while, biological binder reduced spleen and bursa relative weight compared with broiler chicken fed without supplement. Significant increases in the relative spleen weight of broilers exposed to aflatoxin-contaminated diets have been reported by Bailey et al., (2006) and Shi et al., (2006).

Increase in the obsolete and relative weights of liver, kidney and gizzard of birds fed on ration containing aflatoxin indicating the hepato and nephrotoxicity of aflatoxins (Ortatali et al., 2005). Liver is considered the target organ for aflatoxin because it is the organ where most toxins are bioactivated to relative 8,9-epoxide form, which is known to bind DNA and proteins, damaging the liver structures and increasing liver weights (Miazzo et al., 2005; Bailey et al., 2006; Pasha et al., 2007). The increase in liver weight results in deposition of fat which affects the metabolism. Immuno-suppression can be observed in poultry ingesting aflatoxins at levels below those that cause over symptomatology and atrophy of the bursa of fabricius, thymus and spleen (Peir et al., 1972).

Biological mycotoxin with aflatoxin feed contamination alleviate the toxic effect and restore dressing percentage to the normal value, whereas significantly increased liver weight was observed when broilers supplemented aflatoxin contaminated feed without mycotoxin binder (El-Katcha et al., 2017). It is concluded that detoxifying microbial enzymes supplementation @ 250g/ton of feed influenced the carcass characteristics and organ weight in broilers.

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COMPETING INTERESTS: The authors declare that they have no competing interests.

ETHICS STATEMENT: Not Applicable

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Table 3: carcass characteristics of broilers fed with different treatment groups

	Carcass characteristics						
Treatment	Live body wt (g)	Carcass wt (g)	Dressing %	Liver wt (g)	Heart Wt (g)	Gizzard wt (g)	Intestinal length (cm)
T1	2053.00±113.95^{bc}	1486.50±75.97^{abc}	72.91±3.17	46.83±2.83^{abcd}	13.50±0.92	45.83±2.19c	207.66±3.75b
T2	1742.33±114.90^{ab}	1325.00±141.71^{abc}	75.70±5.18	44.66±1.30^{abcd}	13.16±0.87	38.33±1.58abc	198.66±10.44ab
T3	1866.16±111.39^{abc}	1394.66±66.79^{abc}	74.99±1.00	41.66±2.31^{abc}	11.83±0.54	36.16±3.43ab	208.66±7.70b
T4	1816.50±92.53^{abc}	1391.33±66.37^{abc}	76.67±0.58	40.33±0.42^{ab}	12.33±1.62	36.83±2.02ab	179.16±6.17a
T5	1629.50±82.18^{a}	1190.50±57.17^{a}	73.12±1.10	40.33±2.92^{ab}	13.00±1.00	33.66±1.52ab	192.50±5.50ab
T6	1986.00±87.47^{abc}	1527.16±83.67^{bc}	76.84±2.25	48.83±1.85^{cd}	13.33±0.42	39.66±2.24bc	199.16±10.12ab
T7	1780.16±179.87^{abc}	1385.50±166.70^{abc}	77.27±1.73	40.66±1.81^{abc}	11.66±2.60	36.66±4.20ab	191.33±4.27ab
T8	1977.50±116.15^{abc}	1506.50±91.56^{abc}	76.13±0.74	47.16±1.62^{bcd}	14.00±2.08	36.00±3.30ab	195.83±2.10ab
T9	1727.00±68.23^{ab}	1299.50±63.44^{ab}	75.12±1.04	38.83±2.58^{a}	11.66±1.17	33.50±1.02ab	184.33±3.83a
T10	1886.33±97.59^{abc}	1453.66±81.39^{abc}	76.97±0.85	45.66±3.87^{abcd}	12.66±0.98	36.00±1.29ab	199.66±3.94ab
T11	1857.33±52.12^{abc}	1383.50±44.59^{abc}	74.60±2.21	43.83±2.16^{abcd}	12.50±0.56	38.00±3.39abc	184.66±4.84a
T12	2134.00±121.87^{c}	1629.50±90.22^{c}	76.43±1.29	50.16±3.70^{d}	16.16±2.71	45.33±3.39c	195.16±8.45ab
T13	1902.83±95.33^{abc}	1362.33±107.62^{abc}	71.29±3.02	45.16±1.62^{abcd}	15±10.46	38.00±2.75abc	179.50±11.38a
T14	1798.33±135.30^{abc}	1402.66±117.72^{abc}	77.91±2.77	43.00±3.1^{abcd}	12.33±1.28	30.00±2.20a	190.16±5.36ab

Means with different superscript within the same column differ significantly (P<0.05)

Table 4: organ weight of broilers fed with different treatment groups

	Organ weight					
Treatment	Spleen (g)	Thymus (g)	Bursa (g)	Kidney (g)	Lungs (g)	Tibia (g)
T1	3.16±0.16	6.00±1.54	2.66±0.42abc	7.50±1.62ab	11.66±0.76ab	28.00±1.57c
T2	3.00±0.36	6.00±1.36	1.66±0.21ab	6.00±1.23ab	7.00±1.00a	19.33±2.44abc
T3	2.00±0.36	5.50±1.43	1.50±0.22a	6.16±1.16b	7.50±0.84a	22.83±2.82bc
T4	2.50±0.22	4.50±1.40	1.83±0.30ab	5.33±0.95ab	8.33±0.66a	20.33±1.30abc
T5	2.33±0.33	5.00±1.36	3.50±0.84c	5.33±0.61ab	7.16±0.54a	20.00±2.14abc
T6	3.33±0.42	4.83±0.94	3.50±0.56c	7.16±0.74ab	9.50±1.02ab	27.66±1.32c
T7	2.83±0.47	5.16±0.70	1.33±0.21a	4.83±0.47a	9.16±1.32ab	22.33±2.70bc
T8	2.50±0.22	5.83±1.27	1.66±0.33ab	7.83±0.74ab	8.66±0.42ab	19.83±1.87abc
T9	2.83±0.40	5.16±0.74	1.50±0.22a	6.66±1.25ab	7.00±1.06a	12.16±2.62a
T10	2.33±0.61	6.50±1.14	1.50±0.22a	8.33±0.88ab	7.50±0.84a	28.50±3.93c
T11	3.80±0.57	3.00±0.57	3.00±0.89bc	5.33±0.61ab	13.66±1.08b	16.50±2.40ab
T12	4.00±1.09	5.16±1.13	1.83±0.30ab	9.66±1.92ab	10.16±1.30ab	25.66±1.15bc
T13	2.16±0.47	7.16±1.77	2.00±0.24ab	5.16±1.07ab	10.33±0.61ab	19.66±2.48abc
T14	2.16±0.47	5.66±1.42	1.83±0.30ab	5.16±1.37ab	10.33±0.80ab	19.66±1.66abc

Means with different superscript within the same column differ significantly (P<0.05)

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