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Efficacy of Mycosorb on Nutrient Retention in Aflatoxicated Broiler Chickens

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ABSTRACT

An experiment was conducted to study the effect of Mycosorb (esterified glucomannan-EGM) on nutrient retention in aflatoxicated broiler chickens. Day-old chicks (n=270, 50±5 g) were divided into 6 treatment groups, containing 45 numbers in each for 6 weeks. A control ration was prepared with conventional feedstuffs and an experimental diet was prepared from this after incorporating aflatoxin B_1 @ 300 ppb. From the experimental diet, 3 rations were prepared by mixing EGM at graded levels *i.e.*, 0.025, 0.05, or 0.10 per cent. The control ration was mixed with EGM, @ 0.05 per cent and maintained as a positive control. A balance trial of three days duration in the 6th week was conducted for determination of nutrient retention. There was a significant reduction in dry matter, ether extract, protein, calcium and phosphorus due to aflatoxicosis except on crude fibre. However, the improvement was noticed after the incorporation of Mycosorb. It could be concluded that the maximum benefit of nutrient retention was obtained at the high dose, *i.e.*, 0.10 per cent.

Key words: Aflatoxicosis, Broiler chicken, Esterified glucomannan, Mycosorb, Nutrient retention.

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Aflatoxins (AF) are a group of closely related biologically active mycotoxins produced by *Aspergillus flavus* and *Aspergillus parasiticus*. They commonly occur as natural contaminants of poultry feeds (Sapcota *et al*., 2006). Fungi or mould growth in feedstuff is associated with the utilization of nutrients from the host. Consequently, alterations in the nutritional content of the feedstuff are expected. The extent of mould growth determines the degree of depletion in the nutrient content of the feedstuff. Aflatoxins are highly hepatotoxic, neurotoxic, teratogenic and carcinogenic imparting various deleterious effects on vital organs such as the liver and kidney resulting in a reduction of body growth, poor feed utilization and lowering immunogenesis leading to mortality (Girish and Devegowda, 2006). The AFB1 decreased contents of Hb and C3bRR and ICR increased the number of RBCs and impaired the erythrocyte functions (Tingting *et al*., 2015). The significant changes in serum biochemical and haematological parameters are seen in aflatoxicated broiler chickens (Kumar *et al.,* 2016). Affected birds show poor vaccine response and low antibody titre, as both cellular and humoral immunities are affected (Corrier, 1991).

Certain studies have been performed for removing AF from contaminated feed and minimizing the toxicity of AF using Zeolites (Miazzo *et al.,* 2000), bentonites (Oguz and Kurtoglu, 2000), inorganic sorbents (Baily *et al*., 1998), esterified glucomannan (Girish and Devegowda, 2004) and diatomacious earth (Lakkawar *et al*., 2016) to reduce the AF absorption from the gastrointestinal tract in poultry. Mycosorb is a cell wall derivative of *Saccharomyces cerevisiae*, has shown considerable binding ability with several commonly occurring mycotoxins and is also found beneficial as a low-inclusion binder in minimizing the adverse effects of aflatoxins present in contaminated livestock and poultry feeds (Girish and Devegowda, 2006; Yildirim *et al*., 2011 and Maldhure *et al*., 2015). Studies regarding the effect of mycosorb on nutrient utilization in aflatoxicated broiler chickens received very little attention. Hence, this study has been designed to through some light on this aspect.

Aflatoxin B1 was produced in the laboratory through solid substrate fermentation in broken rice using a pure culture of *Aspergillus parasiticus*, NRRL 2999 strain (Shotwell *et al*., 1966). The fermented rice was autoclaved (15 lbs pressure for 15 min) to kill the fungi, dried, (55-60°C overnight), ground to powder form and its AFB1 content was measured by the method described by Romer (1975) using TLC. A standard basal diet was prepared with toxin-free conventional feedstuffs (Table 1) and the rice powder grown with a known amount of AFB1 was incorporated into it to provide the desired level of 300 ppb of toxin per kg of diet. Mycosorb *(Esterified glucomannan)* required for the

experiment was procured from M/s Alltech Biotechnology Pvt. Ltd, Bangalore and used in the experiment as per the following schedule:

Code	Aflatoxin (ppb)	Mycosorb (*Esterified glucomannan*) (per cent)
T_0	-	-
Tx	300	-
TxM_1	300	0.025
TxM_2	300	0.05
TxM_3	300	0.10
T_0M_2	-	0.05

Altogether 270 Nos of day-old commercial chicks with uniform body weight were distributed randomly into 6 treatment groups. Each group had a total of 45 Nos of chicks in triplicates of 15 Nos, housed in an iron cage battery under optimal managemental conditions from day-old to 42 days. The birds were offered water and feed *ad libitum* throughout the experimental period of 6 weeks. A balance trial of three days duration at the 6th week of age was conducted for the determination of a dry matter, protein, calcium and phosphorus retentions. The study started with five-hour starvation at the beginning and the birds were given weighed experimental diets daily for 3 days at a fixed hour in the morning. The polythene sheets were spread on the faecal tray for the collection of excreta. The excreta were collected and weighed. The samples of faecal material after mixing it well were collected for further analysis. Feed and faecal samples were weighed and oven-dried in the laboratory. The samples were later analyzed for the proximate composition according to the methods of AOAC (2005). Calcium and phosphorus were separately analyzed using standard methods (Talapatra *et al.,* 1940; AOAC, 2005). The nutrient retention of dry matter, crude protein, ether extract, crude fibre, calcium and phosphorus were calculated by using the following formula:

$$\text{Retention (\%)} = \frac{\text{Amount of nutrient balance}}{\text{Amount of nutrient intake}} \times 100$$

The data obtained were subjected to statistical analysis as described by Snedecor and Cochran (1994).

Table 1: Ingredient and nutrient composition of the experimental diets.

	Starter (0-3 weeks)	Finisher (0-3 weeks)
Ingredient		
Maize	50.0	52.0
Rice Polish	6.0	12.5
Groundnut Cake	11.0	11.0
Soybean meal	20.75	12.0
Fish meal	6.0	6.0
Sunflower meal	4.0	4.0
Mineral Mixture§ and vitamin*	2.0	2.0
Salt	0.5	0.5
Nutrient		
ME (Kcal/Kg)*	2797.63	2842.48
Crude protein (%)	22.83	19.68
Lysine (%)*	1.0903	0.9328
Methionine (%)*	0.42005	0.4205

*Calculated value.

§Poultry min of M/s. Aries Agro-vet Industries Pvt. Ltd. Composition. Ca (32%), P (6%), Cu (100 ppm), Mn (2700 ppm), I (100 ppm), Zn (2600 ppm0, Mg (1000 ppm) and Fe (0.1%).

*Spectro mix (AB_2D_3K Feed premix) 20g/100kg was used in both starter and finisher rations. Composition: Each gm contains; Vitamin A (82,500 IU), VitaaminB2 (50mg), Vitamin D3 (12000 IU), Vitamin K (10 mg).

Dry matter, crude protein and crude fibre retentions

The dry matter (DM) retention was significantly (P<0.05) affected due to aflatoxicosis (Table 2). The reduction was 5.62 per cent as compared to the control group. However, improvement in DM retention was noticed after the dietary inclusion of Mycosorb in toxin-fed birds. The toxin binder with a dose of 0.10 per cent yielded significantly higher DM retention, making the value comparable to that of the control group. Similarly, the protein retention was also reduced due to aflatoxicosis to the extent of 7 per cent. Using Mycosorb in the diet of aflatoxin-fed birds the improvement in protein retention was noticed in a dose dependent-manner. The lower dose of Mycosorb was ineffective whereas, the medium or higher doses, *i.e.,* 0.05 or 0.10 per cent could significantly (P<0.05) improve protein retention.

Aflatoxicosis lowered the ether extract retention to the extent of 6.25 per cent in the toxin-alone fed group as compared to the normal birds of the control group. However, the incorporation of Mycosorb in the diets of aflatoxin-fed broilers significantly improved the ether extract retention. The lower and medium doses of Mycosorb yielded

Table 2: Mean per cent retentions of dry matter, crude protein, ether extract and crude fibre of broilers under different treatment groups.

Nutrient	Group					
	T_0 (Control)	T_x	T_xM_1	T_xM_2	T_xM_3	T_0M_2
Dry matter	61.06^{cd}±0.34	57.63^{a}±0.36	58.45^{ab}±0.37	59.38^{b}±0.34	60.39^{c}±0.24	62.03^{d}±0.15
Crude protein	62.39^{cd}±0.50	58.02^{a}±0.55	59.23^{a}±0.46	60.17^{ab}±0.63	61.17^{bc}±0.61	63.12^{d}±0.05
Ether extract	72.62^{d}± 0.85	60.82^{a}±0.75	63.47^{b}±0.40	65.22±0.44	67.31^{c}±0.41	72.84^{d}±1.10
Crude fibre	29.67±0.10	29.37±0.03	29.58±0.02	29.47±0.04	29.57 ±0.05	29.64±0.03
Calcium	51.81^{d}± 0.33	48.68^{a}±0.48	50.08^{b}±0.30	51.21^{c}±0.20	51.57^{cd}±0.14	51.90^{d}±0.02
Phosphorus	50.95^{bc}±0.25	47.86^{a}±0.16	48.42^{a}±0.18	49.90^{b}±0.20	50.21^{b}±0.10	51.17^{c}±0.25

Means with at least one common superscript in a row do not differ significantly (P<0.05).

comparable results whereas; significantly more retention was noticed with the higher dose (0.01 per cent). Nevertheless, even with the highest dose of Mycosorb the counteraction of aflatoxicosis was not complete since the ether extract retention values remained significantly lower than that of the control group. Using dietary aflatoxin (300ppb) in commercial broiler chickens Ahmed *et al*. (2007) and Gogoi (2003) noted significantly (P<0.05) lower retention of dry matter, crude protein and ether extract in their 6-week-old trials. Similar findings were observed by Shamsudeen and Shrivastava (2013).

It is a fact that the liver is the main organ where various digestive enzymes are synthesized. Further, aflatoxin is reported to be a hepatotoxic and cytotoxic agent as it directly affects the liver resulting in various pathological conditions depending upon its doses and severity of stress. Thus, the decline in the digestibility of dry matter, crude protein and ether extract might be due to the pathological conditions of the liver. The aflatoxin might have caused alteration in intestinal physiology and intestinal mucosal damage due to chronic inflammation which might have led to decreased absorption of nutrients. This is supported by earlier findings of Kelly and Arora (1976) who observed hemorrhage on intestinal organs due to AF and Balachandran and Ramakrishnan (1987) who observed catarrhal inflammation in intestinal mucosa Addition of Mycosorb might have helped the liver to revitalize its digestive function at varying degrees in proportion to its doses. Among the three graded dietary doses of Mycosorb (0.025, 0.05, or 0.10 per cent) the highest one showed significantly (P<0.05) better results in retention of dry matter, crude protein and ether extract. No significant difference was observed in CF retention among all the six groups. This might be because the CF digestion takes place in the caeca, which might not have been affected due to aflatoxicosis. However, the available literature is limited to elucidating the matter.

Calcium and phosphorus retentions

The dietary inclusion of aflatoxin in broilers significantly reduced (P<0.05) calcium retention to the extent of 6.04 per cent as compared to the control group. The result is in agreement with the observations of Ahmed *et al.* (2007) and Shamsudeen and Shrivastava (2013). This might be due to the action of aflatoxin hampering the process of calcium digestion and absorption resulting in lower calcium retention. Reduced feed intake by the birds consuming dietary aflatoxin might have contributed to lower calcium retention. However, when toxin-fed broilers were treated with Mycosorb the calcium retention was improved significantly in a dose dependent-manner. Among three doses of Mycosorb the highest dose (0.10 per cent) gave significantly (P<0.05) more calcium retention and the value was found to be comparable with that of the control group.

The phosphorus retention was lowered (P<0.05) to the extent of 6.06 per cent in aflatoxin-alone fed broilers as compared to control birds (Table 2). Similar observations were noted by Ahmed *et al*. (2007) and Shamsudeen and Shrivastava (2013). This might be due to lower feed intake and poor absorption of nutrients in the aflatoxin-treated birds. However, the incorporation of Mycosorb in the aflatoxin-containing diets improved phosphorus retention. It could be noted that a lower dose (0.25 per cent) could not significantly improve the phosphorus retention, whereas medium and higher doses significantly improved the condition with comparable results. Mycosorb, with medium or high doses, gave complete counteraction since the phosphorus retention value was found to be at par with that of the control group.

CONCLUSION

Aflatoxin B_1 @ 300 ppb in feed significantly decreased the retention of dry matter, ether extract, protein, calcium and phosphorus of commercial broiler chickens; whereas, the addition of Mycosorb in the contaminated diet, improved the nutrient retention of aflatoxicated birds in a dose-dependent manner. The results suggest that Mycosorb (@ 0.10 per cent might be sufficient to ameliorate the adverse effects of AF.

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