

## The Effects of *Saccharomyces Cerevisiae* on Performance and Biochemical Parameters in Broiler Chicks During Aflatoxicosis

<sup>1</sup>A. Safameher and <sup>2</sup>M. Shivazad

<sup>1</sup>Department of Animal Science, Islamic Azad University,  
Maragheh Branch, P. O. Box 345, Maragheh, Iran

<sup>2</sup>Department of Animal Science, Faculty of Agriculture,  
University of Tehran, Tehran, Iran

**Abstract:** The amelioration of aflatoxicosis in broiler chicks was examined by the dietary addition of *Saccharomyces Cerevisiae* (SCE). *Saccharomyces cerevisiae* incorporated into the diet at 1 g kg<sup>-1</sup> was evaluated for its ability to reduce the deleterious effects of 1 and 2 ppm Aflatoxins (AF) on Ross broiler chicks from 1 days to 42 days of age. The AF treatments significantly decreased feed consumption and body-weight gain and increased feed conversion ratio ( $p < 0.05$ ). Serum cholestrol, total protein and albumin decreased significantly ( $p < 0.05$ ) in diets contaminated with aflatoxin. Compared to controls, the addition of SCE to an AF-containing diet significantly reduced the deleterious effects of AF on body-weight gain, feed conversion ratio, cholestrol, albumin and total protein. The AF fed groups had higher serum activities of the enzymes LDH and AST and decreased activity of ALP. The addition of SCE to an AF-containing diet reversed the effect of the toxin on the activities of serum enzymes. These results suggest that SCE reduced the adverse effects of AF and should be helpful in a solution to the aflatoxicosis problem in poultry.

**Key words:** Effect of *saccharomyces cerevisiae*, performance, biochemical parameters, broiler chicks, aflatoxicosis

### INTRODUCTION

Afatoxins (AF) are toxic compounds produced in grains by the fungi *Aspergillus favus* and *A. parasiticus*. Afatoxicosis in poultry is characterized by weakness, anorexia with lower growth rate, poor feed utilization, decreased egg production, increased susceptibility to environmental and microbial stressors and increased mortality (Bailey *et al.*, 1998; Kubena *et al.*, 1998). Afatoxicosis is also associated with biochemical, haematological and pathological changes. The liver is the target organ of afatoxins and hepatobiliary damage is associated with alterations in liver enzyme functions. As aflatoxin often contaminates poultry feed, there is a need for a comprehensive tool to counter this problem. Recent biotechnological progress has opened new avenues for tackling this problem. *Saccharomyces cerevisiae* was found to have beneficial effects in poultry during mycotoxicosis (Stanley *et al.*, 1993). A study was conducted to determine the efficacy inclusion of *S. cerevisiae* in the decreasing the effects of aflatoxin on performance and biochemical parameters of broiler chickens.

### MATERIALS AND METHODS

In this study, 480 day-old male chicks (Ross 308) were randomly assigned to pens with 20 chicks in each. The study was a completely randomized design with four replications of each of the following. Birds were fed a balanced diet, based on corn and soybean meal, formulated according to the recommendations of the National Research Council (1994). Treatments: A: Control without aflatoxin, B: Contain 1g kg<sup>-1</sup> SCE, C: Contain 1 ppm Aflatoxins (AF), D: 1 ppm AF + SCE (1g kg<sup>-1</sup>), E: 2 ppm aflatoxins., F: Aflatoxins (2 ppm) plus SCE (1 g kg<sup>-1</sup>).

Aflatoxins were produced on rice following inoculation with fungal spores ( $6.5 \times 10^6$  -  $7.0 \times 10^6$ ) of a toxigenic *A. parasiticus* species as described by Shotwell *et al.* (1966). Aflatoxin content of the rice was determined by TLC and HPLC based on the procedure described by Wilson and Romer (1991). Birds were inspected daily and their body weight and feed consumption was recorded weekly and daily, respectively. Feed intake, mean body weight gain and feed conversion ratio were calculated. Blood samples were collected from the wing vein of birds at the age of 21 day (n = 240) and 42 day (n = 240) and

serum separated for total protein, albumin and cholesterol analysis. Serum enzymes, namely Lactate Dehydrogenase (LDH), aspartate Amino Transferase (AST) and Alkaline Phosphatase (ALP) were measured using commercial kits (Zist Chimi, IR) on an auto-analyzer (Technicon RA-1000). Data were analyzed by the General Linear models procedure of SAS Institute (1982). Means for treatments showing significant differences in the analysis of variance were compared using Duncan's multiple range tests. All statements of significance are based on the probability level of 0.05.

**RESULTS**

The results show (Table 1) that inclusion of SCE to AF contaminated-rations were improved feed conversion ratio and body weight ( $p < 0.05$ ). Serum total protein and albumin decreased significantly ( $p < 0.05$ ) in diets contaminated with AF. The addition of SCE to the AF-containing diets decreased the effects of AF on feed intake ( $p < 0.05$ ).

The results of biochemical parameters presented in Table 2 show that the cholesterol level significantly reduced at the age of 21 days and the decrease was intensified in birds after 42 days ( $p < 0.05$ ) in groups C and E due to dietary aflatoxin. In chickens given SCE treated aflatoxin contaminated feed, the level of cholesterol was within the normal range. As shown in Table 2, plasma total protein together with albumin levels

was found to be significantly ( $p < 0.05$ ) decreased in chickens fed aflatoxin-containing diet. Chickens fed SCE in feed (B) showed no recovery in plasma total proteins as well as albumin levels. It was observed that in chickens of groups C and E given dietary aflatoxins, these changes were more significant in chickens fed diet with higher aflatoxin levels (diet E).

Effects of SCE on blood serum enzymes are shown in Table 3. Serum lactate dehydrogenase as well as aspartate amino transferase activities were found to be elevated ( $p < 0.05$ ) in chickens fed aflatoxin contaminated feed (Table 3). The addition of SCE to the AF-containing diets resulted in compensation of toxic effects of AF on these enzymes. Nevertheless, serum alkaline phosphatase was found to be inhibited in aflatoxin treated Chickens. The addition of SCE to the AF-containing diets significantly improved the decrease in activity of ALP caused by AF.

**Table 1: Comparison of performance parameters in chicks fed different rations**

Treatment	Body weight gain (g day <sup>-1</sup> )	Dietary feed intake (g day <sup>-1</sup> )	Feed conversion ratio
A	38.3 ± 0.6 <sup>a</sup>	75.4 ± 1.8 <sup>a</sup>	1.97 ± 0.05 <sup>a</sup>
B	38.6 ± 2.2 <sup>a</sup>	74.5 ± 2.2 <sup>a</sup>	1.93 ± 0.02 <sup>a</sup>
C	32.7 ± 1.2 <sup>b</sup>	70.3 ± 2.8 <sup>b</sup>	2.15 ± 0.05 <sup>b</sup>
D	37.9 ± 0.8 <sup>a</sup>	76.5 ± 2.4 <sup>a</sup>	2.02 ± 0.09 <sup>a</sup>
E	28.5 ± 1.1 <sup>b</sup>	65 ± 1.7 <sup>a</sup>	2.28 ± 0.07 <sup>b</sup>
F	36.2 ± 1 <sup>a</sup>	76 ± 1.3 <sup>a</sup>	2.1 ± 0.06 <sup>b</sup>

Experimental groups are as shown in Table 1. Feeding started from the first day of housing and parameters calculated on 42 days of age. Data presented as mean ± S.E.M. Mean values in same column without common letters (a-c) differ significantly ( $p < 0.05$ )

**Table 2: Comparison of serum biochemical parameters in chicks fed different rations**

Treatment	Cholesterol (g L <sup>-1</sup> )		Total Protein (g dL <sup>-1</sup> )		Albumin (g dL <sup>-1</sup> )	
	Day 21	Day 42	Day 21	Day 42	Day 21	Day 42
A	132 ± 5.5 <sup>a</sup>	145.7 ± 8 <sup>a</sup>	2.58 ± 0.26 <sup>a</sup>	3.76 ± 0.23 <sup>a</sup>	0.77 ± 0.82 <sup>a</sup>	1.4 ± 0.20 <sup>a</sup>
B	128 ± 6.4 <sup>a</sup>	146.8 ± 7 <sup>a</sup>	2.7 ± 0.28 <sup>a</sup>	3.82 ± 0.29 <sup>a</sup>	0.82 ± 0.96 <sup>a</sup>	1.38 ± 0.21 <sup>a</sup>
C	89.5 ± 5.2 <sup>b</sup>	133.8 ± 6 <sup>b</sup>	1.78 ± 0.26 <sup>b</sup>	2.45 ± 0.37 <sup>b</sup>	0.54 ± 0.92 <sup>b</sup>	0.92 ± 0.20 <sup>b</sup>
D	127 ± 3.7 <sup>a</sup>	140.5 ± 8 <sup>a</sup>	2.47 ± 0.28 <sup>a</sup>	3.65 ± 0.28 <sup>a</sup>	0.72 ± 0.89 <sup>a</sup>	1.32 ± 0.18 <sup>a</sup>
E	85.5 ± 2.9 <sup>b</sup>	126.5 ± 12.7 <sup>b</sup>	1.65 ± 0.27 <sup>b</sup>	2.3 ± 0.22 <sup>b</sup>	0.43 ± 0.96 <sup>b</sup>	0.77 ± 0.14 <sup>b</sup>
F	124.5 ± 3.8 <sup>a</sup>	136 ± 11.2 <sup>ab</sup>	2.4 ± 0.23 <sup>a</sup>	3.57 ± 0.24 <sup>a</sup>	0.71 ± 0.86 <sup>a</sup>	1.29 ± 1.6 <sup>a</sup>

Data are mean ± S.E.M. of 10 analyses carried out on samples obtained from 10 individual birds. Chickens were examined at two stages of growth when they were either 21 or 42 days old. Means in the same column without common letters (a-c) differ significantly ( $p < 0.05$ )

**Table 3: Serum enzymes in chickens fed different dietary rations**

Treatments	LDH (U L <sup>-1</sup> )		AST (U L <sup>-1</sup> )		ALP (U L <sup>-1</sup> )	day 21
	Day 42	day 21	Day 42	day 21	Day 42	
A	227.5 ± 6.8 <sup>a</sup>	223 ± 15 <sup>a</sup>	223 ± 5 <sup>a</sup>	255.5 ± 20 <sup>a</sup>	4500 ± 200 <sup>a</sup>	4450 ± 225 <sup>a</sup>
B	226 ± 7.9 <sup>a</sup>	214 ± 6 <sup>a</sup>	219 ± 4 <sup>a</sup>	250 ± 21 <sup>a</sup>	4450 ± 280 <sup>a</sup>	4320 ± 220 <sup>a</sup>
C	272 ± 6.5 <sup>b</sup>	246 ± 11 <sup>b</sup>	260 ± 5 <sup>b</sup>	305.5 ± 36 <sup>b</sup>	3720 ± 450 <sup>ab</sup>	3400 ± 250 <sup>b</sup>
D	224.5 ± 6.5 <sup>a</sup>	213 ± 15 <sup>a</sup>	227.5 ± 7 <sup>a</sup>	265 ± 18 <sup>a</sup>	4200 ± 300 <sup>a</sup>	4160 ± 270 <sup>a</sup>
E	284.5 ± 12.5 <sup>b</sup>	261 ± 9 <sup>b</sup>	278 ± 6 <sup>c</sup>	325 ± 14 <sup>c</sup>	3220 ± 240 <sup>c</sup>	3150 ± 150 <sup>b</sup>
F	235.5 ± 8.5 <sup>a</sup>	217 ± 17 <sup>a</sup>	235.5 ± 7 <sup>a</sup>	280 ± 38 <sup>ab</sup>	4050 ± 280 <sup>ab</sup>	3860 ± 170 <sup>ab</sup>

Data are mean ± S.E.M. of separate analyses carried out on 10 samples obtained from individual chickens. Enzymes measured at two stages of growth, viz. 21 and 42 days after treatment. U, one unit is equivalent to 1 imole of lactate, oxaloacetate, pyruvate, or inorganic phosphate released per minute at 25°C for LDH, AST and ALP, respectively

## DISCUSSION

Aflatoxicosis is an important problem in poultry and livestock industry due to its profound effects on growth and the frequent contamination of feed by these mycotoxins. Mycotoxin producing fungi are responsible for significant financial losses encompassing a broad spectrum of crop and farm animals and extending through the food chain to the consumer (Shane, 1994). Every year a significant percentage of the world's grain and oilseed crops are contaminated with hazardous mycotoxins, such as aflatoxin. Unfortunately, discontinuing the feeding of aflatoxin contaminated grain is not always practical, especially when alternative feedstuffs are not readily available or affordable. Thus, these toxins frequently are detected in animal feed can cause significant production losses in animals. Dersjant-Li *et al.* (2003) reported that the rate of body weight gain in pigs and broilers is reduced as a function of the levels of aflatoxin in the diet. They suggested that with each mg kg<sup>-1</sup> increase of aflatoxin in broiler diets depresses growth rate by 5%. Our results showed that inclusion of *S. cerevisiae* in rations reduced the effects of aflatoxin in broilers.

This was achieved by comparing different parameters related to aflatoxicosis as well as the production efficiency of broilers. Data presented in this study showed that most of the plasma parameters were found to be affected by aflatoxin but remained within normal range in chickens given *Saccharomyces cerevisiae*. Unlike the non-enzymatic parameters, marker enzymes particularly lactate dehydrogenase and aspartate amino transferase showed more dependency on the concentration and duration of the exposure to aflatoxins. These data suggest that serum enzymes particularly AST and LDH can be used as indices for investigating the performance of chickens challenged with aflatoxins. Decreased serum ALP occurred because of aflatoxin intoxication whereas, it was unaffected in chickens fed diet containing SCE (Table 3). It has been suggested that the nutritional deficiency induced by aflatoxin can lead to disruption of the activities of digestive enzymes and absorption of essential nutrients (Bolden and Jensen, 1985). Impaired nutrient absorption and reduced pancreatic digestive enzyme production due to aflatoxin (Swamy and Devegowda, 1998) may play important role in alteration of the production parameters. At the end of rearing period (42 days) chickens fed normal diet (aflatoxin-free) exhibited normal dietary intake (g day<sup>-1</sup>), body weight gain (g day<sup>-1</sup>) and feed conversion ratio,

whereas in case of chickens fed two different dietary doses of aflatoxins the FCR was elevated significantly. These results suggest that SCE reduced the adverse effects of AF and should be helpful in a solution to the aflatoxicosis problem in poultry.

## REFERENCES

- Bailey, R.H., L.F. Kubena, R.B. Harvey, S.A. Buckley and G.E. Rottinghaus, 1998. Efficacy of various inorganic sorbents to reduce the toxicity of aflatoxin and T-2 toxin in broiler chickens. *Poult. Sci.*, 77: 1630-1632.
- Bolden, S. and L. Jensen, 1985. The effect of marginal levels of calcium, fish meal, torulas yeast and alfalfa meal on feed intake, hepatic lipid accumulation, plasma estradiol and egg shell quality among laying hens. *Poult. Sci.*, 64: 937-946.
- Dersjant-Li, Y., M.W.A. Verstegen and W.J.J. Gerrits, 2003. The impact of low concentrations of aflatoxin, deoxynivalenol or fumonisin in diets on growing pigs and poultry. *Nutr. Res. Rev.*, 16: 223-239.
- Kubena, L.F., R.B. Harvey, R.H. Bailey, S.A. Buckley and G.E. Rottinghaus, 1998. Effects of hydrated sodium calcium aluminosilicate (T-Bin™) on mycotoxicosis in young broiler chickens. *Poult. Sci.*, 77: 1502-1509.
- National Research Council. 1994. *Nutrient Requirements of Poultry*, (9th Edn.), (Washington DC, National Academy Press), pp: 44-45.
- SAS Institute, 1982. *SAS User's Guide: Statistics*. SAS institute Inc., Cary, NC.
- Shane, S.M., 1994. Economic Issues Associated with Aflatoxins. In: Eaton, D.L., Groopman, J.D. (Eds.), *The Toxicology of Aflatoxins*. Academic Press, Inc., New York, pp: 513-527.
- Shotwell, O.L., C.V. Hesseltine, R.D. Stubblefield and W.G. Sorenson, 1966. Production of aflatoxin on rice. *Applied Microbiol.*, 14: 425-428.
- Stanley, V.G., R. Ojo, S. Woldesenbet and D.H. Hutchinson, 1993. The use of *Saccharomyces cerevisiae* to suppress the effects of aflatoxicosis in broiler chicks. *Poult. Sci.*, 72: 1867-1872.
- Swamy, H.V.L.N. and G. Devegowda, 1998. Ability of mycosorb to counteract aflatoxicosis in commercial broilers. *Ind. J. Poul. Sci.*, 33: 273-278.
- Wilson, T.J. and T.R. Romer, 1991. Use of Mycosep multifunctional cleanup column for liquid chromatographic determination of aflatoxins in agricultural products. *J. Assoc. Off. Anal. Chem.* 74: 951-956.