ENVIRONMENT AND HEALTH

Influence of a Superactivated Charcoal on the Toxic Effects of Aflatoxin or T-2 Toxin in Growing Broilers[1]

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ABSTRACT To evaluate the effectiveness of a superactivated charcoal (SAC) in alleviating mycotoxicosis, two experiments were conducted in which 432 male broiler chicks (216 per experiment) were fed diets containing 4 mg aflatoxin (AF) or 6 mg T-2 toxin/kg of diet, with and without 0.5% SAC, from 1 to 21 d of age. Feeding AF and T-2 toxin significantly decreased BW gain over the 21-d experimental period. Inclusion of SAC in the diet containing AF resulted in BW gains that were intermediate between gains of chicks fed AF and those of controls. No benefits were seen in BW gain when SAC + T-2 toxin was fed. Feeding AF increased relative weights of liver, spleen, and kidney; however, only liver weight in Experiment 1 was similar to controls when SAC was included. Of the blood parameters altered by AF (decreased cholesterol, inorganic phosphorus, total protein, and urea nitrogen, and increased mean corpuscular volume and hematocrit in Experiment 1; decreased albumin and total protein, and increased creatine kinase in Experiment 2) only urea nitrogen, hematocrit, and inorganic phosphorus (Experiment 1) and hematocrit (Experiment 2) were comparable to controls when SAC was included in the diet. Feeding T-2 toxin decreased serum cholesterol, total protein, urea nitrogen, and mean corpuscular volume; however, only cholesterol and mean corpuscular volume were improved with the addition of SAC (Experiment 1). Oral lesions were observed in birds fed T-2 toxin with no difference in severity when SAC was added in Experiment 1, however in Experiment 2, birds fed SAC + T-2 had a significantly lower lesion scores than those fed T-2 alone. Mortality was noted in both experiments but was not influenced by SAC treatment. These findings suggest that the addition of dietary SAC is marginally effective in alleviating some of the toxic affects associated with AF, but was of little benefit when T-2 toxin was fed to growing broiler chicks.

(*Key words*: aflatoxin, T-2 toxin, superactivated charcoal, broiler, toxicity)

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INTRODUCTION

Aflatoxins (AF), a group of closely related, extremely toxic chemicals, are produced by strains of *Aspergillus flavus* and *Aspergillus parasiticus* and can occur as natural contaminants of poultry feeds (Edds and Bortell, 1983). Aflatoxins were responsible for "turkey X disease," which caused high mortality in turkey poults in England in 1960. Since then, the toxicity of AF to poultry has been well documented, as indicated by Huff *et al.* (1988). The T-2 toxin is a member of the tricothecene family of mycotoxins, produced by several species of *Fusarium* fungi. This toxin was responsible for the "moldy corn toxicosis" occurring in livestock in North America and alimentary toxic aleukia, a disease in humans that occurred when several thousand people in the U.S.S.R. consumed cereals that had over-wintered in the fields (Cheeke and Shull, 1985). Research in poultry has shown T-2 toxin causes reduced feed intake and weight gain, oral lesions, abnormal behavior, altered feathering, and coagulopathy (Wyatt *et al.*, 1972, 1973a,b, 1975; Doerr *et al.*, 1981; Hoerr *et al.*, 1982; Huff *et al.*, 1988). The frequency with which AF and T-2 toxin contaminate commodities used for poultry feeds and the detrimental effects of chronic exposure in animals consuming these feeds can mean the difference between profit or loss for the poultry producer (Jones *et al.*, 1982; Nichols, 1983; Hamilton, 1984).

Practical methods to detoxify mycotoxin-contaminated grain on a large scale and in a cost-effective manner are not currently available. A variety of physical, chemical, and biological techniques have been employed; however, they have met with only limited success (Goldblatt, 1971; Goldblatt and Dollear, 1979; Anderson, 1983). A recent approach has been the addition of non-nutritive sorptive materials to the diet in

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[1]Mention of trade mark, proprietary product, or specific equipment does not constitute a warranty by the USDA and does not imply its approval to the exclusion of other products that may be suitable.

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order to reduce the absorption of mycotoxins from the gastrointestinal tract. The dietary additions of zeolite, bentonite, or spent bleaching clay from canola refining have been shown to diminish the effects of T-2 toxin and zearalenone in rats and immature swine (Smith, 1980, 1984; Carson, 1982). A specific hydrated sodium calcium aluminosilicate has proven beneficial in alleviating the toxic effects of AF in growing poultry (Kubena *et al.*, 1987; Phillips *et al.*, 1988). The use of activated charcoal as an oral antidote for the treatment of poisonings is well established. Charcoal acts as an insoluble carrier that nonspecifically adsorbs molecules, thereby preventing their absorption. Several researchers have tested the efficacy of activated charcoal in binding AF (Dalvi and Ademoyero, 1984; Dalvi and McGowan, 1984; Kubena *et al.*, 1990; Edrington *et al.*, 1996), ochratoxin A (Rotter, 1988), and patulin (Sands *et al.*, 1976); however, in the case of AF, they have yielded conflicting results. Buck and Bratich (1986) and Galey *et al.* (1987) reported that a superactivated charcoal was effective in treating rats orally exposed to T-2 toxin, and Biehl *et al.* (1989) reported that a superactivated charcoal reduced the severity of skin lesions in swine topically exposed to T-2 toxin. Superactivated charcoal differs from activated charcoal in that the particle size is reduced, thereby increasing surface area, and the carrier base for the charcoal is chemically modified during the manufacturing process (Requa, Inc., Greenwich, CT, 06830, personal communication). Our objective was to evaluate the prophylactic effectiveness of a superactivated charcoal when included in a diet containing AF or T-2 toxin and fed to growing broiler chicks.

MATERIALS AND METHODS

In each of two experiments, 250 day-old male broiler chicks (Peterson × Hubbard) were purchased from a commercial hatchery, individually weighed, wing-banded, and housed in heated starter batteries[3] under continuous fluorescent lighting.

Chicks were fed a commercial corn-soybean meal starter ration formulated to meet or exceed the recommended nutrient requirements (National Research Council, 1984) and randomly assigned to the following treatment groups: 1) control diet only; 2) 0.5% superactivated charcoal (SAC); 3) 4 mg AF/kg of diet; 4) 6 mg T-2 toxin/kg of diet; 5) 0.5% SAC + 4 mg AF/kg of diet; and 6) 0.5% SAC + 6 mg T-2 toxin/kg of diet. Each treatment consisted of six pens of six birds per pen for a total of 216 birds, 36 birds per treatment. Experimental diets and water were provided for *ad libitum* consumption. Pen feed intake and individual BW were recorded weekly and pen feed efficiency calculated. At 21 d of age, the study was terminated and 18 birds (6 replicates of 3 birds each) per treatment were bled by cardiac puncture for individual serum biochemical analysis and hematological determinations (2 of the 3 above birds, 12 birds per treatment). Serum concentrations of albumin, total protein, urea nitrogen, glucose, cholesterol, triglycerides, creatinine, uric acid, calcium, inorganic phosphorus, and activities of alanine aminotransferase (ALT), aspartate aminotransferase (AST), γ-glutamyl transferase (GGT), lactate dehydrogenase (LDH), alkaline phosphatase (ALKP), and creatine kinase (CK) were determined using a clinical chemistry analyzer[4] according to the manufacturer's recommended procedure. Hemoglobin was measured as cyanomethemoglobin. Erythrocyte count and mean corpuscular volume (MCV) were determined with a Coulter Model ZM Counter[5] equipped with a Model C256 channelyzer and accucomp software. Hematocrits were measured by the microhematocrit centrifugation method. The mean corpuscular hemoglobin and mean corpuscular hemoglobin concentrations were calculated. After bleeding, birds were killed by cervical dislocation and the liver, left kidney, spleen, pancreas, proventriculus, gizzard, heart, and bursa of Fabricius removed and weighed. At this same time, birds were visually scored for oral lesions by an individual without knowledge of treatment groups. A four-point scoring system of 1 to 4 was used (1 = no visible lesions present, 4 = large lesions occurring at several sites within the mouth).

Aflatoxin was produced via fermentation of rice by *Aspergillus parasiticus* NRRL 2999 as described by Shotwell *et al.* (1966) and modified by West *et al.* (1973). Fermented rice was autoclaved and ground and the AF content measured by spectrophotometric analysis (Nabney and Nesbitt, 1965; Wiseman *et al.*, 1967). Of the total AF content in the rice powder, 79% was AFB_1, 16% was AFG_1, 4% was AFB_2, and 1% was AFG_2. The rice powder was incorporated into the basal diet and confirmed by HPLC to provide the desired level of 4 mg AF/kg of diet. Aflatoxin concentration of diets was based on AFB_1 and not total AF. The rice powder did not exceed 1% of the basal diet. The T-2 toxin, provided by one of the authors (G.E.R.), was determined to be > 99% pure by results of nuclear magnetic resonance and mass spectrometry. The T-2 toxin was dissolved in 95% ethanol and the appropriate quantity applied to 1 kg of feed, which was dried and mixed with the remainder of the experimental diet. The basal diet was analyzed and was below detection limits (<10 μg/kg) for AF as established by methods described by Clement and Phillips (1985). For Experiment 1, the SAC (CharcoAid 2000 Emergency Poison Sorbent)[6] in a water solution, was placed in shallow pans and evaporated to dryness. The SAC was then ground in mortar and pestle, returned to the drying oven for 24 h, ground again, and incorporated into the respective experimental diets. The SAC used in Experiment 2 was supplied in a powder

[3]Petersime Incubator Co., Gettysburg, OH 45328.
[4]Gilford Impact 400E, Ciba Corning Diagnostics Corp., Gilford Systems, Oberlin, OH 44774.
[5]Coulter Electronics, Hialeah, FL 33012.
[6]Requa, Inc., Greenwich, CT 06830.

TABLE 1. Effects of feeding superactivated charcoal (SAC) on the performance of growing broiler chicks fed diets containing aflatoxin (AF) or T-2 toxin, Experiment 1

	Treatment						
Item	Control	SAC	AF	T-2	SAC+AF	SAC+T-2	SEM
Body weight gain, g							
1 to 7 d	98	106	102	94	103	97[a]	1.32
7 to 14 d	218[ab]	228[a]	182[c]	188[c]	202[abc]	197[abc]	3.85
14 to 21 d	346[ab]	361[a]	283[c]	304[bc]	315[bc]	315[bc]	5.69
1 to 21 d	666[ab]	695[a]	574[c]	595[c]	623[bc]	608[bc]	8.92
Feed consumption, g	1,034[ab]	1,048[a]	902[b]	927[ab]	914[ab]	990[ab]	29.55
Feed:gain, g:g	1.57[a]	1.51[a]	1.51[a]	1.57[a]	1.51[a]	1.62[a]	0.02
Lesion scores	1.00[a]	1.00[a]	1.00[a]	1.25[a]	1.00[a]	1.25[a]	0.04

[a–c]Means within a row with no common superscript differ significantly ($P < 0.05$).

form from the manufacturer and was incorporated directly into the diets. Care, use, and handling of experimental animals were preapproved by the Animal Care and Use Committee, Food Animal Protection Research Laboratory, USDA.

Data (pen means) for all response variables were subjected to ANOVA as a 2×2 factorial design using the General Linear Models (GLM) procedures of PCSAS® software (SAS Institute, 1988). If the ANOVA *F* test was significant ($P < 0.05$), means were separated by Bonferonni *t* statistics. All statements of significance are based on the 0.05 level of probability.

RESULTS

Experiment 1

The effects of SAC on performance of chicks fed AF or T-2 toxin are presented in Table 1. Body weight gain was not different among treatment groups during the 1st wk on experimental diets. During the 2nd and 3rd wk, and when examined over the entire 21-d feeding period, birds fed AF and T-2 toxin had significantly lower BW gains. When SAC was included in diets containing AF or T-2 toxin, the observed decrease in BW gain for the 21-d feeding period was not significantly different from control values, but was significantly decreased relative to SAC values. Feed consumption and efficiency of feed utilization were not different among treatments. Although lesion score numerically increased in both the T-2 and SAC + T-2 treatments, no statistical differences were observed between treatment groups. No lesions were observed in any other treatments. Four chicks each died in the control and AF treatments, 3 each in the T-2 and SAC + AF treatments, and 1 chick died in the SAC + T-2 treatment.

Table 2 presents the effects of the experimental diets on relative organ weights (grams per 100 g of BW). Relative liver, kidney, and spleen weights were increased by dietary AF, and the addition of SAC did not offer total protection as evidenced by relative organ weights that were intermediate between those of controls and AF. Feeding SAC + T-2 toxin increased relative gizzard weight compared to controls. No differences in relative weights of bursas of Fabricius, pancreas, proventriculus, and heart were observed (data not shown).

Data for selected serum constituents and hematological values are presented in Table 3. Serum cholesterol was decreased in AF, T-2 toxin, and SAC + AF treatments, but was not different from controls in the SAC + T-2 toxin treatment. Feeding AF, T-2 toxin, SAC + AF, and SAC + T-2 toxin decreased total protein compared with the control treatment. Serum urea nitrogen was significantly lower in all treatments except SAC + AF when compared with controls. Inorganic phosphorus was decreased by AF alone treatment. When compared to controls, MCV was significantly lower in all treatments except SAC + T-2 toxin. Hematocrit was significantly decreased by AF, but returned to values comparable to controls when SAC + AF was fed. No differences were noted for concentrations of

TABLE 2. Effect of feeding superactivated charcoal (SAC) on relative organ weights of growing broiler chicks fed diets containing aflatoxin (AF) or T-2 toxin, Experiment 1

	Treatment						
Item	Control	SAC	AF	T-2	SAC+AF	SAC+T-2	SEM
	(g/100 g BW)						
Liver	3.14[b]	3.01[b]	3.76[a]	3.05[b]	3.43[ab]	3.07[b]	0.06
Kidney	0.49[b]	0.49[b]	0.70[a]	0.51[b]	0.69[a]	0.56[b]	0.02
Spleen	0.13[bc]	0.12[bc]	0.18[a]	0.11[bc]	0.15[a]	0.11[bc]	0.006
Gizzard	2.51[b]	2.46[b]	2.64[ab]	2.70[ab]	2.59[ab]	2.82[a]	0.03

[a–c]Means within a row with no common superscript differ significantly ($P < 0.05$).

TABLE 3. Effect of feeding superactivated charcoal (SAC) on selected serum constituents and hematological parameters in growing broiler chicks fed diets containing aflatoxin (AF) or T-2 toxin, Experiment 1

	Treatment						
Item	Control	SAC	AF	T-2	SAC+AF	SAC+T-2	SEM
Cholesterol, mg/dL	139[a]	143[a]	83[b]	125[b]	98[b]	133[a]	4.23
Total protein, g/dL	2.75[a]	2.72[ab]	1.56[d]	2.31[c]	1.78[d]	2.37[bc]	0.08
Urea nitrogen, mg/dL	1.91[a]	1.36[b]	1.58[b]	1.33[b]	2.05[a]	1.51[b]	0.08
Inorganic phosphorus, mg/dL	6.25[a]	6.69[a]	5.15[b]	5.87[ab]	6.24[ab]	6.08[ab]	0.14
Mean corpuscular volume, μm	141[a]	134[b]	134[b]	134[b]	134[b]	138[ab]	0.73
Hematocrit, %	27.5[a]	27.6[a]	24.3[b]	26.2[ab]	27.5[a]	26.9[a]	0.35

[a–d]Means within a row with no common superscript differ significantly ($P < 0.05$).

albumin, calcium, creatinine, glucose, hemoglobin, MCHC, triglycerides, uric acid, or activities of ALT, AST, CK, LDH, GGT, or ALKP (data not shown).

Experiment 2

The SAC + T-2 toxin treatment statistically decreased BW gain during Weeks 2 and 3, and when examined over the entire 21-d feeding period compared to controls, whereas T-2 toxin alone had no affect on BW (Table 4). Feeding AF, with and without SAC, decreased BW gains during Week 3. However, when examined over the 21-d experimental period, BW gains were decreased by AF, and the addition of SAC induced BW gains that were not statistically different from control values, but were significantly decreased compared to SAC values. Feed intake was decreased by the AF, SAC + AF, and SAC + T-2 treatments. No differences were observed in efficiency of feed utilization. The incidence of oral lesions increased when T-2 toxin was included; however, it was lessened with the inclusion of SAC. Four chicks died in the T-2 toxin treatment, three each in the AF and SAC + T-2 toxin treatments, and one chick each in SAC and SAC + AF treatments.

Relative kidney weight increased in AF and SAC + AF treatments, and relative spleen and pancreas weights were elevated only in the SAC + AF treatments (Table 5). Relative weights of the liver, heart, proventriculus, gizzard, and bursa of Fabricius were not different among treatments (data not shown).

Table 6 presents the effects of the experimental diets on selected serum constituents. Serum cholesterol and triglycerides were significantly lower in birds fed SAC + AF. Concentrations of albumin and total protein were decreased in AF and SAC + AF treatments and serum activity of CK was increased by feeding AF alone. No other differences were noted in serum constituents or hematological variables examined (data not shown).

DISCUSSION

The most prevalent indicator of chronic aflatoxicosis is reduced growth rate. In the present study, feeding 4 mg of AF/kg of diet significantly decreased BW gain in growing broiler chicks. When SAC was included in the diet with AF, BW gain was not significantly different from controls or the AF group when examined over the 21-d experimental period for Experiments 1 and 2. Feed intake was depressed by AF-alone in Experiment 2, and was not improved by the addition of SAC. The authors are at a loss to explain the variance of feed intake from Experiment 1 to Experiment 2. Dalvi and Ademoyero (1984), Dalvi and McGowan (1984), and Jindal *et al.* (1994) reported a trend in improvement in BW gains and feed intake of chickens when activated charcoal was added to AF-contaminated diets. Kubena *et al.* (1990)

TABLE 4. Effects of feeding superactivated charcoal (SAC) on the performance of growing broiler chicks fed diets containing aflatoxin (AF) or T-2 toxin, Experiment 2

	Treatment						
Item	Control	SAC	AF	T-2	SAC+AF	SAC+T-2	SEM
Body weight gain, g							
1 to 7 d	109[ab]	113[a]	105[ab]	99[ab]	113[a]	95[b]	1.64
7 to 14 d	225[ab]	229[a]	194[bc]	202[abc]	210[abc]	188[c]	3.65
14 to 21 d	332[a]	334[a]	269[b]	296[ab]	275[b]	265[b]	5.94
1 to 21 d	665[ab]	676[a]	567[c]	599[bc]	598[bc]	549[c]	9.98
Feed consumption, g	1,028[ab]	1,047[a]	872[c]	932[bc]	889[c]	890[c]	24.23
Feed:gain, g:g	1.55[a]	1.55[a]	1.56[a]	1.58[a]	1.49[a]	1.60[a]	0.01
Lesion score	1.05[bc]	1.00[c]	1.00[c]	1.85[a]	1.00[c]	1.40[b]	0.03

[a–c]Means within a row with no common superscript differ significantly ($P < 0.05$).

TABLE 5. Effect of feeding superactivated charcoal (SAC) on relative organ weights of growing broiler chicks fed diets containing aflatoxin (AF) or T-2 toxin, Experiment 2

Item	Treatment						
	Control	SAC	AF	T-2	SAC+AF	SAC+T-2	SEM
	(g/100 g BW)						
Kidney	0.49[c]	0.48[c]	0.67[ab]	0.52[c]	0.72[a]	0.58[bc]	0.02
Spleen	0.10[b]	0.10[b]	0.12[ab]	0.09[b]	0.14[a]	0.09[b]	0.004
Pancreas	0.36[b]	0.38[ab]	0.39[ab]	0.38[ab]	0.43[a]	0.37[ab]	0.006

[a–c]Means within a row with no common superscript differ significantly ($P < 0.05$).

and Edrington *et al.* (1996) also examined activated charcoal for the ability to alleviate chronic aflatoxicosis in growing broilers and turkey poults and reported no improvement in chick or poult performance. The reason for these conflicting results is unknown, but may be due to differences in type or physical characteristics of the activated charcoal, duration of feeding, composition of the basal diet, concentration of AF fed, poultry species or strain, or other factors.

The liver is considered to be the primary target organ of AF. Feeding AF significantly increased relative liver weight in Experiment 1, but not in Experiment 2. Relative kidney weight was elevated in both experiments and an increase in spleen weight was observed in Experiment 1. The addition of SAC to the diet resulted in liver weights similar to those of controls in Experiment 1, however, no improvements were noted in kidney or spleen weight (Experiments 1 and 2). Kubena *et al.* (1990) reported increased liver and kidney weights in broiler chicks fed AF and Edrington *et al.* (1996) reported decreased liver and increased kidney and spleen weights in turkey poults fed AF. However, neither author reported any benefit from feeding activated charcoal on these organ weights.

Of the serum constituents altered by AF (decreased cholesterol, inorganic phosphorus, total protein, and urea nitrogen in Experiment 1; decreased albumin and total protein, increased CK in Experiment 2) only urea nitrogen concentration or hematocrit (Experiment 1) and CK activity (Experiment 2) were similar to controls when SAC was included in the diet (CK activity was also the same as that of AF fed birds). A significant decrease was noted in urea nitrogen concentrations in Experiment 1 when SAC was fed alone, but not when SAC + AF was fed. The reasons for these variations are unknown, but in the case of Experiment 1, they did not appear to have a detrimental effect on these birds. Edrington *et al.* (1996) reported a therapeutic effect of activated charcoal on urea nitrogen and glucose concentrations in turkey poults fed AF. Similarly, improvements in serum total protein concentration and ALKP activity (Jindal *et al.*, 1994; Edrington *et al.*, 1996), calcium and phosphorus concentrations (Jindal *et al.*, 1994), and AST activity (Dalvi and Ademoyero, 1984; Dalvi and McGowan, 1984; Jindal *et al.*, 1994) have been reported when activated charcoal was added to the diet. Kubena *et al.* (1990) reported no benefit in altered serum concentrations of total protein, albumin, cholesterol, or GGT activity when activated charcoal was included in AF-contaminated diets. Aspartate aminotransferase, often elevated in chronic aflatoxicosis, was not improved by the addition of activated charcoal, nor were serum concentrations or activities of triglycerides, cholesterol, ALT, LDH, or CK when charcoal was added to AF-contaminated diets (Edrington *et al.*, 1996).

The tricothecenes are also known to decrease performance in growing broilers (Cheeke and Shull, 1985). In Experiment 1 of the present study, when compared to controls, T-2 toxin decreased BW gain over the 21-d experimental period. The addition of SAC resulted in BW gains intermediate between controls and T-2 toxin treated birds. However, the difference in BW gain for the two treatments (T-2 and SAC + T-2) was only 13 g and coupled with the fact birds fed SAC + T-2 in Experiment 2 performed the poorest of any treatment, indicates the apparent benefits provided by SAC on BW

TABLE 6. Effect of feeding superactivated charcoal (SAC) on selected serum constituents in growing broiler chicks fed diets containing aflatoxin (AF) or T-2 toxin, Experiment 2

Item	Treatment						
	Control	SAC	AF	T-2	SAC+AF	SAC+T-2	SEM
Cholesterol, mg/dL	145[ab]	137[ab]	117[bc]	152[a]	93[c]	132[ab]	4.10
Triglycerides, mg/dL	108[a]	102[ab]	77[ab]	101[ab]	69[b]	89[ab]	3.93
Albumin, g/dL	1.21[a]	1.18[a]	0.78[b]	1.12[a]	0.68[b]	1.16[a]	0.04
Total protein, g/dL	2.68[a]	2.62[a]	1.81[b]	2.47[a]	1.61[b]	2.61[a]	0.08
Creatine kinase, U/L	987[b]	1,166[b]	2,450[a]	804[b]	1,835[ab]	865[b]	139

[a–c]Means within a row with no common superscript differ significantly ($P < 0.05$).

gain are probably not real. Oral lesions were observed in Experiment 1 in birds treated with T-2 toxin with no differences in severity when SAC was included; however, in Experiment 2 birds fed SAC + T-2 toxin had a significantly lower lesion score than those fed T-2 alone. It is possible that these lesions may have been severe enough to cause the non-significant decrease in feed intake observed in Experiment 2; however, feed intake in the SAC + T-2 toxin treatment was not improved, even though the severity of oral lesions was reduced. Biehl *et al.* (1989) reported that superactivated charcoal was effective in reducing the severity of lesions due to topical T-2 toxin exposure in swine.

In Experiment 1, feeding T-2 toxin decreased serum cholesterol, total protein, urea nitrogen, and MCV; however, only cholesterol returned to levels comparable to controls when SAC was added to the diet. The addition of SAC induced MCV values that were no different from control birds or birds fed T-2 toxin. A superactivated charcoal was reported to be efficacious in treating rats exposed orally to T-2 toxin (Buck and Bratich, 1986; Galey *et al.*, 1987). No differences were noted for any of the other hematological parameters examined in Experiment 2 in birds fed T-2 toxin, either with or without SAC, and in general these treatments did not appear to produce the same toxic response as in Experiment 1. These results are surprising and reasons for the differences are unknown.

To our knowledge this is the first report describing the effects of a "super"-activated charcoal in broilers fed AF, and of any activated charcoal used in the treatment of T-2 toxicosis in broilers. Our results indicate that the SAC tested was marginally effective in reducing some of the toxic signs of chronic toxicosis in growing broilers fed AF, but of little benefit when T-2 toxin was fed. Any protective effect probably involves the sequestration of the toxic molecules in the gastrointestinal tract and chemisorption to the charcoal. These results suggest that SAC is highly variable in its ability to alleviate the toxic effects of AF in growing broilers and to bind AF *in vivo.*

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