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Effect of *Yucca schidigera* and Natural Zeolite on Broiler Performance

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Abstract: The effects of dietary supplementation of *Yucca schidigera* and natural zeolite on broiler performance, ammonia concentration of broiler house, litter moisture, fecal dry matter and fecal crude ash were investigated. One day-old, nine hundred and sixty unsexed broiler chicks obtained from a commercial hatchery were divided into 4 treatment groups of 240 birds each. Birds were randomly assigned to the four treatment diets, consist of control, 15 g natural zeolite/kg, 25 g natural zeolite/kg and 120 mg *Yucca schidigera*/kg. Body weights of birds were significantly (P<0.05) different among the treatments, birds fed on diet containing 120 mg *Yucca schidigera* /kg being the highest and this treatment was followed by chicks fed diet control at days 21 to 42 and 42nd day. Feed conversion ratio was not affected by the supplementation of *Yucca schidigera* and natural zeolite at days 21 to 42. From 21 to 42 and 42nd day of age, the feed intake was not significantly different between the treatments. Ammonia concentration of house was significantly (P<0.05) decreased by adding *Yucca schidigera* and natural zeolite to diet. The supplementation of *Yucca schidigera* and natural zeolite to the diet reduced significantly (P<0.01) fecal dry matter and crude ash. On the other hand, dry matter of the broiler litter and livability were not affected by treatments. It can be concluded that the supplementation of *Yucca schidigera* to the diet reduced ammonia concentration in broiler house, fecal dry matter and crude ash without any adverse effect of broiler performance.

Key words: *Yucca schidigera*, natural zeolite, Ammonia, performance, broiler

Introduction

Intensive poultry farms are frequently the subject of odour complaints and are also known emitters of ammonia. Atmospheric ammonia in poultry production has long been recognized as a significant environmental problem in both laying hen and broiler houses. In practice, poultry are often exposed to 50 ppm ammonia (Reece *et al*., 1981). Poultry may develop a variety of disorders when exposed to ammonia levels as low as 20 ppm for extended periods (Beker *et al*., 2004). Natural zeolite minerals may have potential to reduce odour and ammonia emissions. The ammonia absorption properties of the zeolites have been reported by Bernal and Lopez-Real (1993) Similarly, Carlile (1984) published a comprehensive review of aerial ammonia in poultry houses. Carlile (1984) summarized also the findings of Nakaue *et al*. (1981) who showed that incorporating clinoptilolite in the feed throughout the lifetime of the birds reduced aerial ammonia concentrations by an average of 8 %, significantly. Yucca extract has also been used as a feed supplement to reduce ammonia concentration in poultry houses (Johnston *et al*., 1981, 1982; Headon and Dawson, 1990) and Yucca extract was studied on urease activity in the intestinal contents of broiler chicks by Yeo and Kim (1997).

Johnston *et al*. (1981) reported that the aerial ammonia concentration was not reduced by the supplementation of yucca extract to broiler diet at 63 ppm. However, whether natural zeolite and yucca effect are attained through reduced ammonia of poultry houses has not been clearly demonstrated. Therefore, the present study was conducted to further evaluate the effect of dietary natural zeolite or yucca extract on ammonia of broiler houses, body weight, feed intake, feed conversion ratio, fecal and litter dry matter, fecal crude ash and mortality of broilers.

Materials and Methods

One day-old, nine hundred and sixty unsexed broiler chicks obtained from a commercial hatchery were divided into 4 treatment groups of 240 birds each and randomly assigned to the four treatment diets at 21st day, consist of control, 15 g natural zeolite/kg, 25 g natural zeolite/kg and 0.120 mg yucca schidigera/kg. Each treatment group was further sub-divided in to 5 replicates of 48 birds per replicates. Diets were isocaloric and isonitrogenous. Birds were fed on starter and grower diets from 1 to 21 and 22 to 42 days of age, respectively. Dietary treatments began at 22nd day. Experimental diet in mash form and water were provided *ad-libitum* for a period of 1 to 42 days. Control group as standard diet did not contain *Yucca schidigera* and natural zeolite as feed additive. Birds were kept on wood shavings' litter in floor 25 pens (3 x 1.7 m) with an open-sided naturally ventilated broiler house. A photoperiod of

Table 1: Composition of zeolite used in the experiment

Minerals	g/kg	Trace minerals	mg/kg	Trace minerals	mg/kg
SiO_2	657.2	As	35	Mo	25.4
Al_2O_3	108.8	Ba	342	Ni	6
TiO_2	0.7	Br	5.5	Pb	85
Fe_2O_3	11.9	Cd	1.4	Se	1.3
Na_2O	6.5	Cl	189	Sn	7
K_2O	29.8	Cr	18	Ti	1.9
CaO	25.5	Cu	<3	Zn	41
MgO	9.8	F	331	Zr	92
P_2O_5	0.35	Hg	<0.3		
SO_3	0.6	Mn	358	PH	7.0

Table 2: Ingredients and chemical composition of diet (as fed)

Ingredients (g/kg)	Starter (1 to 21 d)	Grower (22 to 42 d)			
		Diet 1	Diet 2	Diet 3	Diet 4
Corn	459.0	607.0	582.0	567.0	606.9
Soybean meal (0.48 CP)	277.8	260.0	237.0	230.0	260.1
Wheat	100.0	-	-	-	-
Sunflower meal	54.8	0.0	0.0	0.0	0.0
Full fat soybean (0.36)	-	25.0	50.0	60.0	25.0
Fish meal	34.5	40.0	45.0	45.0	40.0
Vegetable oil	40.0	40.0	43.0	45.0	40.0
Salt	2.5	3.0	3.0	3.0	3.0
Ground limestone	15.9	9.5	9.5	9.5	9.4
Dicalcium phosphate	10	10.0	10.0	10.0	10.0
Vitamin premix*	2.5	2.5	2.5	2.5	2.5
Mineral premix**	1.0	1.0	1.0	1.0	1.0
DL-methionine	1.0	1.0	1.0	1.0	1.0
L-lysine	1.0	1.0	1.0	1.0	1.0
DK powder 35 *(Yucca schidigera)*[#]	-	-	-	-	0.12
Natural zeolite,	-	-	15	25	-
Total	1000	1000	1000	1000	1000
Calculated value g/kg					
Total calcium	11	10	10	10	10
Total phosphorus	6.0	5.5	5.5	5.5	5.5
Composition, g/kg (Analyzed)					
Crude protein (N x 6.25)	214.5	191.1	187.8	188.5	191.1
Ether extract	44.5	75.2	74.0	79.1	75.2
Starch	400.0	380.4	385.9	375.0	380.4
Sugar	44.8	35.4	38.7	37.7	35.4
ME (kcal/kg)	3099	3153	3166	3163	3153

Diet 1: control: without *Yucca schidegera* and natural zeolite

Diet 2: with 15 g/kg natural zeolite

Diet 3 with: 25 g /kg natural zeolite: Diet 4: with 120 mg/kg *Yucca schidegera*

*Vitamin premix (IU or mg/kg diet): vitamin A, 12000 IU; vitamin D_3, 1500 IU; vitamin E, 30 mg; vitamin K_3, 5 mg; vitamin B_1,3 mg; vitamin B_2, 6 mg; vitamin B_6, 5 mg; vitamin B_{12}, 0.03 mg; nicotine amid, 40 mg; calcium-D-pantothenate, 10 mg; folic acid , 0.75 mg; D-biotin, 0.075 mg; choline chloride, 375 mg; antioxidant, 10 mg

**Mineral combination (mg/kg diet): manganese, 80; iron , 80; zinc, 60; copper, 8; iodine, 0.5; cobalt, 0.2; selenium, 0.15.

[#]DK powder 35 was processed from *Yucca schidigera* plant containing average 9 % steroid saponin

24 hours/day was given. Body weight of birds were individually measured in pens each and feed intake in pens each were recorded after consuming experimental diets at 21st to 42nd days in order to evaluate feed conversion rate. The birds were weighted at 21 and 42 days in order to determine body weight. Mortality was recorded daily and was used to adjust the total number of birds by end of 42 days of ages to determine the feed intake and feed efficiency Ammonia of broiler houses was measured, using the Dräger gas detector pomp

Table 3: Feed intake (g) and feed conversion ratio (g/g) of the broilers

Treatment	Feed intake, g		Feed conversion ratio, g/g	
	21 to 42 d	42 d	21 to 42 d	42 d
Control	3055.33	4023.33	2.47	2.13[b]
Natural zeolite (15 g/kg)	2965.67	3982.67	2.65	2.27[a]
Natural zeolite (25 g/kg)	3095.67	4113.00	2.62	2.25[a]
Yucca (120 mg/kg)	3022.33	4023.00	2.36	2.09[b]
SEM	46.79	42.52	0.07	0.03
Probability	0.3117	0.2252	0.8531	0.0117

a-b: Means within columns with no common superscript differ significantly (P<0.05)

Table 4: Body weight (g), livability (%) and ammonia concentration (ppm) of the broiler house

Treatment	Body weight, g			Livability, %	Ammonia, ppm
	21d	21 to 42 d	42 d	21 to 42 d	39d
Control	639.57	1272.25[a]	1911.82[a]	97.03	21.25[a]
Natural zeolite (15 g/kg)	639.61	1123.33[b]	1762.94[c]	97.83	17.25[b]
Natural zeolite (25 g/kg)	639.71	1179.67[b]	1819.39[b]	98.72	17.75[b]
Yucca (0.120 g/kg)	638.72	1276.66[a]	1915.38[a]	96.50	18.00[b]
SEM	4.17	21.25	12.73	1.12	0.960
Probability	0.9997	0.0273	0.0001	0.2678	0.0514

a-c: Means within columns with no common superscript differ significantly (P<0.05)

Table 5: Fecal dry matter (%) fecal crude ash (%) and litter dry matter (%) of the broilers

Treatment	Fecal dry matter	Fecal crude ash	Litter dry matter
Control	22.22[a]	4.14[a]	44.97
Natural zeolite (15 g/kg)	21.51[ab]	3.39[b]	45.88
Natural zeolite (25 g/kg)	20.31[bc]	3.07[b]	43.27
Yucca (0.120 g/kg)	19.65[c]	3.40[b]	44.79
SEM	0.397	0.163	1.816
Probability	0.0073	0.0097	0.7877

a-c: Means within columns with no common superscript differ significantly (P<0.05)

(model 21/31) at 39th day of experiment. Faeces and litter were collected for crude ash and dry matter analyses the at 35th and 42 nd days of experiment. The standard techniques of the proximate analysis were used to determine nutrient content of experimental diets (Naumann and Bassler, 1993). The data were analyzed using the General Linear Models procedure of SAS (1985). Significant differences between treatment means were separated using the Duncan's multiple range test with a 5% probability. The zeolite and ingredients and chemical composition of the experimental diet are shown in Table 1 and 2.

Results and Discussion

The effect of dietary natural zeolite and *yucca schidegera* on the feed intake and feed conversion ratio on the 21 to 42 and 42nd day of experiment are presented in Table 2. There were no significant effects of dietary treatments on feed intake at 21 to 42 days and 42nd day of age. Although feed conversion ratio of the broiler was not different between treatments at days 21 to 42, the feed conversion ratio was significantly improved by supplementation of the *Yucca shidigera* at the 42nd day when compared to natural zeolite. However, the feed conversion ratio was similar the birds receiving control diet and the diets containing the *Yucca shidigera* at the 42nd day. Similarly, Yao and Kim (1997) reported that *Yucca shidigera* inclusion to the broiler diet did not any effect on feed intake and feed efficiency. In contrast to our result, Elliot and Edwards (1991) found that the addition of natural zeolite to the broiler diet improved the feed efficiency. But Amon *et al*. (1997) reported that the supplementation of zeolite to the diet had no any effect on feed efficiency or on body weight gain, but the supplementation of yucca extract to the diet had improved the feed efficiency. Body weight, livability and ammonia of broiler house are presented in Table 4. The body weight of broilers was not significantly different between treatments at 21st day. But, there were significant effects on body weight at 21 to 42 and 42nd

day of age. Moreover, the body weight of the broiler was significantly decreased by supplementation of natural zeolite at 21 to 42 days of age when compared to *Yucca shidigera* and control. Similarly, the body weight was also decreased by supplementation of natural zeolite at the 42nd day. But Elliot and Edwards (1991); found that the addition of natural zeolite to the broiler diet had no any effect on body weight. On the other hand, the addition of the *Yucca schidigera* to the broiler diet increased numerically the body weight of the broiler compared to control. The ammonia concentration of broiler house was different between treatments at 39th day. Moreover, the ammonia concentration was significantly reduced by addition of natural zeolite at two levels and *Yucca shidigera* compared to control. Amon *et al.* (1997) found that the mean ammonia concentration in poultry house was significantly reduced by the addition of yucca extract to the diet. In contrast to our results, Amon *et al.* (1997) reported that the ammonia concentrations in the zeolite treatment were significantly higher than the concentration in control. Livability of the broilers did not differ between treatments from 21 to 42 days.

The fecal dry matter, fecal crude ash and litter dry matter of the broilers are shown in table 5. The fecal dry matter and crude ash of the broilers were different ($P<0.05$) between treatments. The fecal dry matter was reduced significantly ($P<0.05$) by the inclusion of *Yucca shidigera* compared to control and natural zeolite at level of 15 g/kg diet. Fecal crude ash of the dietary treatments was also significantly ($P<0.05$) lower than control group. On the other hand, the litter dry matter was not effected by dietary treatments ($P>0.05$).

In this study, the effects of the supplementation of *Yucca schidigera* and natural zeolite to the diet on broiler performance, ammonia concentration of broiler house and litter characteristics were investigated. The data obtained from this research indicated that the supplementation of *Yucca schidigera* to the broiler diet reduced the ammonia concentration in broiler house, fecal dry matter and crude ash without any adverse effect of broiler performance. Addition of natural zeolite to broiler diet decreased the ammonia concentration of broiler house, and but also reduced the body weight gain of the broiler. Therefore, the *Yucca schidigera* may be considered as environmentally friendly feed additive for broiler production.

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