

# Effect of Natural Zeolite on Performance, and Tibia Ash of Broiler Chicks

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## Abstract

An experiment was carried out to determine the effects of different levels of natural zeolite and calcium (supplied by calcium carbonate and dicalcium phosphate) on performance, apparent digestibility of calcium and tibia ash on 480 Ross male broiler chicks. Eight experimental diets were tested in a factorial arrangement with four levels of zeolite (0, 1, 2, and 3 percent) and two levels of calcium (NRC recommended level, and 70 % of NRC level) with completely randomized design with 5 replicates and 12 chicks per replicate. The results indicated that with adding zeolite to diet, feed consumption were reduced in grower and whole period of the experiment ( $P<0.05$ ), but there were not significant difference between control diet (0 % zeolite), and the diet containing 1 percent of zeolite. Adding zeolite to diets improved feed conversion ratio, not significantly. Use of zeolite in diets had no significant effects on carcass percentage, apparent digestibility of calcium, and tibia ash content, but increased relative abdominal fat content ( $P<0.05$ ). With decreasing calcium level, feed consumption were increased, but weight gain and feed conversion ratio decreased in grower period ( $P<0.05$ ). Decreasing calcium level in diets reduced carcass percentage, and tibia ash content significantly ( $P<0.05$ ). Interaction between zeolite and calcium on tibia ash content was significant ( $P<0.05$ ).

**Key words:** Zeolite, Calcium, Digestibility, Tibia, Broiler chicken

## Introduction

Zeolites are crystalline, hydrated aluminosilicates of alkali and alkaline earth cations, having infinite, three-dimensional structures. The most important property of zeolites in agricultural application is the ion exchange capability. Clinoptilolite,  $[(Na_4K_4)(Al_8Si_{40}O_{96}). 24H_2O]$  one of the naturally occurring zeolites, has an ion exchange capacity. The applications of natural and synthetic zeolites for poultry production have been reviewed by Evans and Farrell (1989). Areas where zeolites have potential use are: a feed additive to improve performance of layers and broilers, to reduce toxic effects of aflatoxin, to assist in manure and litter management, and to assist in controlling air quality in poultry house environments (Debeic 1994). Some researchers found that adding zeolites to broiler diets improved body weight gain, feed conversion ratio and tibia ash content (Debeic 1994, Zhang and Hung 1992). In contrast in some other experiments use of zeolites had not or little effect on performance (Esmeralda and Gonzales 1990, Evans and Farrell 1993). The objective of the present study was to evaluate different levels of natural zeolite and calcium (supplied by calcium carbonate and dicalcium phosphate) on performance, carcass characteristics, tibia ash content and apparent digestibility of calcium.

## Materials and Methods

In day 7, 480 male broiler chicks were randomly distributed in a factorial arrangement with four levels of zeolite (0, 1, 2, 3 %) and two levels of calcium (NRC recommended level and 70 % of NRC). The main ingredients in diets were corn, soybean meal, fish meal and soybean oil. In control diet 3 % sand were added and in another diets different levels of zeolite were

replaced instead of sand. The starter, grower and finisher diets were fed from 7-21, 22-42, and 43-56 days of age respectively. From 1-7 days of age a commercial starter diets were fed. Feed and water were provided *ad-libitum*. During the experiment feed intake, body weight gain, feed conversion ratio were measured weekly. Mortality was recorded through the experiment. In day 28 one chick per replicate were killed by cervical dislocation and ileum content were collected to determine apparent digestibility of calcium. In this study chromic oxide ( $\text{Cr}_2\text{O}_3$ ) was used as an indicator. Samples stored at  $-3^\circ\text{C}$  until analyzing. The amount of calcium in samples was measured spectrophotometrically (AOAC 1995). Fat from tibia was extracted for 16 h with ethanol, followed by 16 h extraction with ethyl ether in a soxhlet apparatus, oven dried at  $100^\circ\text{C}$ , and ashed at  $600^\circ\text{C}$  overnight to determine fat-free tibia ash content (AOAC 1995). The factorial arrangement of 8 treatments consisting of four levels of zeolite and two levels of calcium were analyzed using the General Linear Model (GLM) procedure of SAS (SAS Institute 1998). When differences among means were found, means were separated using Duncan's multiple range test (Steel and Torrie 1980).

### Results and Discussion

Results of this experiment are given in Table 1. In comparison to control diet, use of natural zeolite in diets significantly decreased feed intake in whole period of the experiment ( $P<0.05$ ). Effect of different levels of natural zeolite on feed intake was not significant in all phases of the experiment. Adding zeolite to diets increases transition time of digesta and this causes bird intend to reduce feed intake (Bartko et al 1995). The present results are in agreement with findings of the previous studies (Evans and Farrell 1993). In contrast use of natural zeolite in some experiments had not significant effect on feed intake (Esmeralda and Gonzales 1990). Use of natural zeolite had no significant effect on body weight gain in all periods of the experiments. This finding is in agreement with results of previous experiment (Dion and Carew 1984, Evans and Farrell 1993). Adding natural zeolite to diets improved feed conversion ratio in whole period of the experiments, but the differences were not statistically significant. In some previous experiments use of natural zeolite improved this trait (Willis et al 1982, Zleobina 1990). In contrast in another experiments use of this substance in diets had not significant effect on feed conversion ratio or impaired it (Dion and Carew 1984, Evans and Farrell 1993). Effect of zeolite on poultry performance depends on source of zeolite (mine) and impurity (Willis et al 1982).

With decreasing calcium levels in diets up to 70 % recommended level, feed intake increased, body weight gain decreased and feed conversion ratio impaired in grower phase. In recommended level of calcium zeolite had the most influence on performance of broiler.

Effects of zeolite on carcass percentage, abdominal fat, tibia ash and apparent digestibility of calcium were not significant. Calcium digestibility in diets containing 3 % zeolite was higher than other treatments. Effect of calcium levels on tibia ash content was significant ( $P<0.05$ ). In treatments when the feed contained the recommended calcium level, tibia ash was higher than the other group. It is possible that use of natural zeolite in diets increased retention of calcium in the body (Cool and Willard 1982). Due to the ability of ion exchange capacity for ions such as Ca, and Mg and absorption of these ions, use of zeolite in diets increases blood calcium and this affects on participation much calcium in bones. Ballard and Edwards (1988) reported adding 1 % zeolite in broiler diets containing 0.65 % calcium, increased tibia ash significantly ( $P<0.05$ ). Interaction of zeolite and calcium level was not significant on performance, carcass traits and calcium digestibility. Interaction of zeolite and calcium was significant on bone ash ( $P<0.05$ ). Due to higher level of calcium in treatments with NRC recommended level and in concept of nearly similar digestibility of this element in all treatments, use of zeolite in diets with adequate levels of calcium increased tibia ash.

**Table 1.** Effects of different levels of zeolite and calcium on performance, carcass percentage, abdominal fat, calcium digestibility and tibia ash.

Treatment	Feed intake 7-56 days (g)	Body weight gain 7-56 days (g)	Feed conversion ratio 7-56 days	Carcass percentage	Relative abdominal fat content %	Calcium digestibility %	Tibia ash %
Zeolite %							
0	5516	2622	2.108	61.75	2.88	56.78	36.36
1	5241	2495	2.108	61.39	3.38	55.53	37.11
2	5198	2497	2.084	61.88	3.12	59.19	37.12
3	5111	2477	2.067	61.56	3.82	55.27	37.50
SEM	86.59	44.63	0.04	0.63	0.25	1.43	0.73
Calcium level							
NRC	5246	2554	2.057	62.45 <sup>a</sup>	3.06	56.68	38.69 <sup>a</sup>
70 % NRC	5287	2491	2.125	60.84 <sup>b</sup>	3.52	56.70	35.35 <sup>b</sup>
SEM	61.22	31.56	0.03	0.45	0.17	1.01	0.52

Mean with different superscripts in each columns are significantly different (P<0.05).

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