Effect of varying levels of AZOMITE® Natural Minerals on growth performance and immune response in broilers

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Summary

The aim of present study was to evaluate the effect of varying levels of Azomite (natural mineral mixture) on growth performance carcass characteristics and immune response in broilers. Two hundred and forty day-old chicks (male and female mixed) with average weight of 46 g were used in this trial. Chicks were divided into three groups; A, B and C with eight replicates in each group (80 chicks per group), under Completely Randomized Design. Diet of group A was without the supplementation of Azomite. Remaining groups i.e. B and C were supplemented with 0.25% and 0.5% Azomite, respectively. The study was conducted for a period of 35 days. Weekly feed intake and weight gain were recorded during the trial. Blood samples were collected on 28th and 32nd days of age, to check the antibody titer level. At the end of trial birds were slaughter and weight of whole meat, thigh, breast meat, heart, liver and body fat was recoded to assess the carcass quality.

During whole experiment (1-35 days) the best FCR was found for experimental diet C. Higher weight gain (1.75 kg) was also found in birds supplemented with 0.50% Azomite compared to other diets. The significant difference ($P<0.05$) was found in weight gain within the groups. Highest HI titer against ND and Elisa titer level for IBD was observed for experimental diet C but the differences in titer levels were non-significant ($P>0.05$). The differences in carcass parameters were also non-significant between treatment groups. For carcass quality the weight of breast meat, thigh and liver was highest for experimental diet C with 0.5% Azomite, however higher heart weight was found in control group. It is concluded that the supplementation of Azomite in the diet of broilers is beneficial for their growth performance.

Detailed Report

Project Title: Effect of varying levels of Azomite (natural mineral mixture) on growth performance, immune response and slaughter data in broilers

Introduction

Minerals perform important biological functions and their requirements of broiler chicken have to be met for optimum growth performance. Trace minerals such as copper, zinc and manganese are essential elements for development and growth in broilers. In general, nutrient excretion can be reduced by avoiding the overfeeding of specific nutrients or by using nutritional manipulations to enhance nutrient utilization (Ferket et al., 2002). It has recently been reported (Anonymous, 2004) that remarkably good performance of birds fed successively lower quantities of industry norms, provided the minerals. Trace minerals, Cu, Mn and Zn were selected for detailed description because they are the ones often considered critical in nutrition and hence supplemented. They play primarily catalytic roles in cellular metabolism. Some of these elements appear to function entirely as components of larger molecules whose metabolic role, however, also is fundamentally catalytic. A deficiency in one or more of these elements can compromise immune competence of an animal (Beisel, 1982; Suttle and Jones, 1989).

Zinc dependent enzymes are involved in macronutrient metabolism and cell replication (Hays and Swenson, 1985). The primary role of Zn appear to be in cell replication and gene expression and in nucleic acid and amino acid metabolism .It is needed for tissue repair and wound healing, plays a vital role in protein synthesis and digestion, and is necessary for optimum insulin action as zinc is an integral constituent of insulin. It is an important constituent of plasma (Malhotra, 1998). In birds, zinc is required primarily for the growth and development of the skeleton, the formation and maintenance of epithelial tissue and for egg production (Gordon, 1977).

Manganese is a cofactor of hydrolase, decarboxylase, and transferase enzymes (Murray *et al*., 2000). It is involved in glycoprotein and proteoglycan synthesis and is a component of mitochondrial superoxide dismutase. Mn is a co-factor in phosphohydrolases and phospho transferases involved in the synthesis of proteoglycans in cartilage. Mn is a part of enzymes involved in pyruvate metabolism and the galacto transferase of connective tissue biosynthesis. Mn activates several important enzyme systems and in this capacity it is required for the synthesis of acid mucopolysaccharides, such as chondroitin sulphate, to form the matrices of bones and egg shells. Consequently skeletal deformities and defects in shell quality occur when the Mn intake is inadequate (Gordon, 1977).

Copper is a constituent of enzymes like cytochrome c oxidase, amine oxidase, catalase, peroxidase, ascorbic acid oxidase, cytochrome oxidase, plasma monoamine oxidase, erythrocuprin (ceruloplasmin), lactase, uricase, tyrosinase, cytosolic superoxide dismutase etc. and it plays a role in iron absorption. Cu is an essential micro-nutrient necessary for the haematologic and neurologic systems. It is necessary for the growth and formation of bone, formation of myelin sheaths in the nervous systems, helps in the incorporation of iron in haemoglobin, assists in the absorption of iron from the gastrointestinal tract (GIT) and in the transfer of iron from tissues to the plasma (Malhotra, 1998). The copper-containing protein in red blood cells (RBC) is erythrocuperin, in liver, it is hepatocuperin and in brain, it is cerebrocuperin. In the monogastric animals, Cu is absorbed mainly in the upper part of the small intestine, where the pH of the contents is still acidic. In general, Cu is poorly absorbed, and under normal conditions >90% of the ingested copper appears in the faeces. Most of the faecal Cu is unabsorbed dietary Cu, but some of it comes from the bile, which is the major pathway of Cu excretion (Hays and Swenson, 1985). Boron through different biochemical and haematological mechanisms has a positive effect on mineral metabolism (Kurtoglu et al. 2005), it also involved to regulate the functions of cell membranes (Nielsen, 2008).

It is proved that Chromium (Cr) can be used (in the range of 200-400 parts per billions) in diet of animals without negative effect on production performance (Qinghua, 1996). It has significant function for maintenance of nucleic acids and recreation of insulin form pancreas (Anderson, 1987) and minimize the effect of thermal stress (Sahin, 2002). According to Uthus and Seaborn (1996), circumstantial evidence suggests that aluminum, rubidium and germanium are also essential. Arsenic is required by the birds in ultra-trace amounts only. Arsenic has a function in the methylation of molecules and also involved in methionine metabolism (NRC, 2005; Uthus, 2003).

Limited information is available on use of natural minerals in broiler in open shed under local climatic conditions. Therefore, the present study was conducted to the effect of Azomite (natural mineral mixture) supplementation on growth performance, carcass characteristics and immune response against infectious bursal disease and New castle disease in broilers

Material and methods

This study was conducted at Animal Nutrition Farm of University of Agriculture, Faisalabad

Product Information

AZOMITE is a micro mineral feed additive from Utah, USA. It contains A to Z of minerals including trace elements. It is certified natural and mined from a unique volcanic deposit rich in trace minerals. Typical analysis reveals 70 trace minerals.

Mineral Analysis	**Percentage (%)**
Alumina, Al_2O_3	11.43
Barium oxide, BaO	0.09
Calcium oxide, CaO	3.67
Carbon, C (320)	0.61
Chlorine, Cl	0.22
Ferric oxide, Fe_2O_3 (50,000)	1.37
Hydrogen, H	0.38
Magnesium, MgO	0.78
Manganese oxide, Mn_2O_3 (1,000)	0.02
Nitrogen, N	0.15
Oxygen (O)	0.73
Phosphorus pentoxide P_2O_5	0.15
Potassium oxide, K_2O	5.23
Silica, SiO_2	65.8
Sodium oxide, NaO_2	2.07
Strontium oxide, SrO	0.03
Sulfur trioxide, SO_3	0.21
Titania, TiO_2	0.20
Loss on Incineration	6.43

Additional Analysis	Element ppm	Additional Analysis	Element ppm
Antimony	0.4	Molybdenum	12.6
Arsenic	1.1	Neodymium	5.1
Beryllium	3.3	Nickel	2.6
Bismuth	3.5	Niobium	40
Boron	29	Oxygen	7253
Bromine	6.6	Palladium	0.008
Cadmium	0.3	Praseodymium	27
Cerium	230	Rhenium	0.011
Cesium	21.7	Rhodium	0.002
Chromium	6.1	Samarium	6.2
Cobalt	22.3	Scandium	2.7
Copper	12	Selenium	0.7
Dysprosium	2.7	Silver	0.005
Erbium	1.7	Strontium	380
Europium	3.7	Sulfur	240
Fluorine	900	Tantalum	2.7
Gadolinium	3.7	Tellurium	0.022
Gallium	15	Terbium	0.8
Germanium	6.1	Thallium	5.9
Gold	0.005	Thorium	180
Hafnium	21	Thulium	0.6
Holmium	0.6	Tin	2.9
Indium	0.01	Tungsten	26
Iodine	2.2	Uranium	4
Lanthanum	220	Vanadium	7.8
Lead	6.2	Ytterbium	1.4
Lithium	859	Yttrium	23
Lutetium	0.5	Zinc	64.3
Mercury (Hg)	0.01	Zirconium	62.7

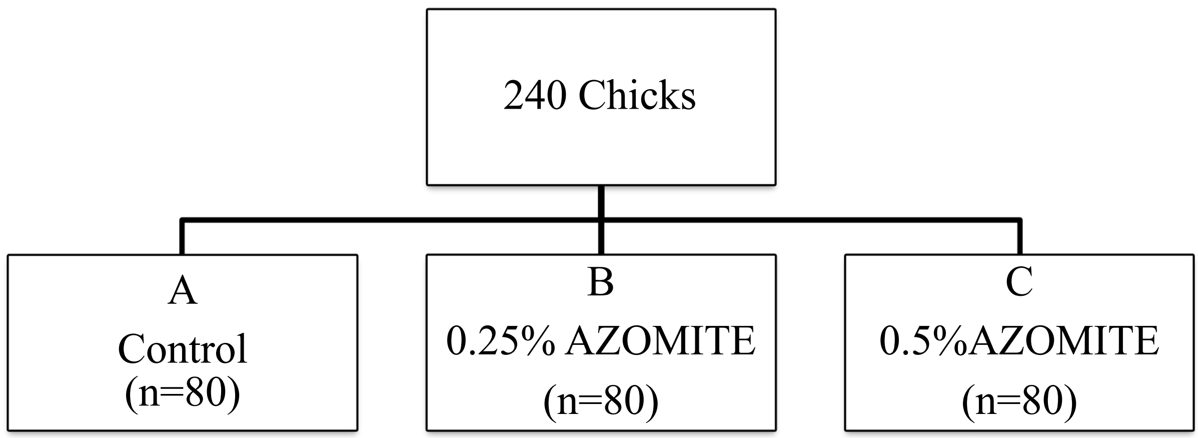
Experimental diets

Three experimental diets were formulated by using different levels of natural mineral mixture (AZOMITE) in diets. Diet A was used as control diet, diet B, and C was supplemented with 0.25% and 0.5% AZOMITE, respectively. Ingredient and chemical composition of diets starter, grower and finisher are given in Tables 1, 2, 3 and 4.

Birds, feeding and housing

Cleaning and fumigation of shed was done before the arrival of chicks. Feeders and drinkers were disinfected before the arrival of chicks. Two hundred and forty day-old chicks (Male and Female mixed) with average weight of 46 g were selected for this experiment. Brooding was done for 7 days. After that chicks were divided into three groups; A, B, and C with eight replicates (10 chicks per replicate) under each group, under Completely Randomized Design. For first 10 days starter diets were offered to the chicks and the grower diets were used from 11-25 days and finisher diets were offered to the chicks from 25-35 days. The birds were fed ad libitum and had 24 h/d access to fresh water. The birds were exposed to continuous fluorescent light and proper ventilation was provided.

Experimental Layout



Vaccination and blood collection schedule

The detail of vaccination schedule followed is given below

Age (days)	Vaccine	Route
5	Newcastle Disease	Intraocular
15	Infectious Bursal Disease	Intraocular
22	Infectious Bursal Disease	Drinking water
28	Newcastle Disease	Drinking water

Blood samples were collected 28th and 32nd days to check the antibody titer level, HI titter against ND and IBD Elisa titter value.

- **Parameters studied**
    - Growth performance
    - Immune response
    - Slaughter data

Growth performance was studied on the bases of feed intake, weight gain and feed conversion ratio (FCR). Daily feed intake and fort night weight gain was recorded to find FCR. Blood serum was analysed to get Log_2 value of HI titter against ND and IBD Elisa titter level. To check the weight of lymphoid organs and carcass characteristics, birds were slaughter at 35th day. Dressing percentage and weight of abdominal fat, heart, and liver was recorded.

Chemical analysis

Feed samples were analysed for dry matter (DM), crude protein (CP), ether extract (EE), crude fibre (CF) and ash. The DM content was determined by oven drying at 105°C for 4h. Nitrogen (N) was determined by Kjeldhal method (AOAC, 2000) and CP was calculated as N×6.25. EE was determined by using Soxhlet apparatus.

Statistical analysis

Data collected for each parameter were analysed using PROC GLM procedure of Statistical Analysis System (SAS, 2009) in the completely randomized design. The means were compared using Tukey test and the differences were checked for statistical significance ($P<0.05$).

Results

Data on growth performance (feed intake, weight gain and FCR) is presented in Table 5. Higher feed intake was found in broilers fed diet A (3.05 kg) without supplementation of Azomite whereas higher weight gain was highest in birds which fed diet C (1.75 kg) containing 0.5% Azomite. Weight gain within the groups was significantly different ($P<0.05$). The FCR was improved with the supplementation of Azomite.

Data on immune response (ND and IBD titer level) showed positive effect of AZOMITE on immunity of broilers (Fig. No.1 & 2). Highest antibody titer level against NDV was found in group C and similar results were found for Elisa titer level against IBDV ($P>0.05$).

Table 6 shows data on carcass characteristics of broilers. Highest relative weight of thigh, breast and liver was found in experimental group C, but highest relative heart weight was in group A ($P>0.05$). Abdominal fat% was same in both experimental group and it was 10 gram more in the broilers of control group ($P>0.05$).

Discussions

Minerals are chemical elements used by the biological systems in several ways. Although the mineral elements do not yield energy for the birds but they have essential role in many biological activities in the body (Malhotra, 1998). Every form of living matter requires these inorganic elements for their normal life processes (Hays and Swenson, 1985; Ozcan, 2003). Contrasting other nutrients, mineral elements cannot be synthesized by living entities (McDowell, 2003), thus these elements must be supplied from the exogenous sources through diets. Minerals have four broad functions like structural, physiological, catalytic and hormonal or regulatory. In addition to supplying major nutrients like energy and proteins, these feed ingredients (minerals and vitamins) must be supplied for proper functioning of birds and animals.

In the current study, feeding to commercial broilers on diet supplemented with Azomite increased body weight and average daily gain compared to the diet without Azomite supplementation. Almost similar results were found in growth performance after inclusion of AZOMITE in the diet with proper concentrations (Wang and Xu, 2003; Halle et al. 2002; Zhang and Shao, 1995). In the present study, the feed intake was reduced with the supplementation of Azomite at 0.25% but at 0.50% supplementation, feed intake was similar to control. Less feed intake was might be due to managemental stress but the clear factor is unknown. However, the feed efficiency was improved with increasing level of Azomite which shows the positive effect of Azomite on growth performance of broilers. Final live weight of broiler was higher for experimental diet C compared to other diets. Similar trend in increase live body weight with increasing levels of Azomite was observed by Zubyare (2014). McNaughton et al. (2011) reported that 0.5% AZOMITE® supplementation had non-significant effect on live body weight but significant effect on feed conversion ratio in broiler. It can be concluded that the Azomite supplementation improves the feed efficiency but its effect on feed intake should be investigated with higher supplementation levels.

Data on carcass characteristics shows that the physical values were found higher for experiment diet C but the differences between experimental groups were found non-significant. Although, minerals have positive effect on carcass characteristics but non-significant results in the present study might be due to low supplementation levels of Azomite compared to previous studies. Data on immune response was found better for experimental group C but results were non-significant. Actually, results between replicates were inconsistent. This might be use of low quality vaccine or error in the vaccination method.

Conclusions

Based on the results of current study, it is concluded that the inclusion of natural mineral mixture (Azomite) improves growth performance of broilers. Carcass characteristics and immune response were better for diet C. Therefore, Azomite can be suggested as a potential mineral source for broiler to get optimum growth performance.

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Table 1: Ingredients composition (%) of starter diets

Ingredients	Diets[1]		
	A	B	C
Maize	39.87	39.87	39.87
Rice broken	15	15	15
Rice Polish	8	8	8
Corn gluten meal (60%)	2	2	2
Soybean meal	22.44	22.44	22.44
Canola meal	9.54	9.54	9.54
Marble chips	1.15	1.15	1.15
Di-calcium phosphate	0.808	0.808	0.808
Salt	0.333	0.333	0.333
Soda bicarbonate	0.099	0.099	0.099
DL. Methionine	0.164	0.164	0.164
Lysine Sulphate	0.485	0.485	0.485
L threonine	0.088	0.088	0.088
Phytase	0.005	0.005	0.005
Axtrazap	0.01	0.01	0.01
AZOMITE	0.00	0.25	0.50

[1] Diet A without AZOMITE supplementation; diet B contain 0.25% AZOMITE and diet C contain 0.5% AZOMITE in starter, grower and finisher phase.

Table 2: Ingredients composition (%) of grower diets

Ingredients	Diets[1]		
	A	B	C
Maize	42.088	42.088	42.088
Rice broken	15	15	15
Rice Polish	8	8	8
Corn gluten meal (60%)	2	2	2
Soybean meal	23.122	23.122	23.122
Canola meal	6.581	6.581	6.581
Marble chips	1.24	1.24	1.24
Di-calcium phosphate	0.752	0.752	0.752
Salt	0.334	0.334	0.334
Soda bicarbonate	0.101	0.101	0.101
DL. Methionine	0.185	0.185	0.185
Lysine Sulphate	0.488	0.488	0.488
L threonine	0.092	0.092	0.092
Phytase	0.005	0.005	0.005
Axtrazap	0.01	0.01	0.01
AZOMITE	0.00	0.25	0.50

[1] Diet A without AZOMITE supplementation; diet B contain 0.25% AZOMITE and diet C contain 0.5% AZOMITE in starter, grower and finisher phase.

Table 3: Ingredients composition (%) of finisher diets

Ingredients	Diets[1]		
	A	B	C
Maize	48.02	48.02	48.02
Rice broken	10	10	10
Rice Polish	8	8	8
Corn gluten meal (60%)	2.13	2.13	2.13
Soybean meal	22.44	22.44	22.44
Canola meal	6.368	6.368	6.368
Marble chips	1.17	1.17	1.17
Di-calcium phosphate	0.65	0.65	0.65
Salt	0.333	0.333	0.333
Soda bicarbonate	0.102	0.102	0.102
DL. Methionine	0.181	0.181	0.181
Lysine Sulphate	0.485	0.485	0.485
L threonine	0.089	0.089	0.089
Phytase	0.005	0.005	0.005
Axtrazap	0.01	0.01	0.01
AZOMITE	0.00	0.25	0.50

[1] Diet A without AZOMITE supplementation; diet B contain 0.25% AZOMITE and diet C contain 0.5% AZOMITE in starter, grower and finisher phase.

Table 4: Chemical composition (%) of diets

Parameters	**Diets**		
	Starter	Grower	Finisher
Metabolizable energy (kcal / kg)	2820	2855	2865
Crude Protein	20.136	19.61	19.35
Fat	3.24	3.319	3.48
Fibre	4.5	4.28	4.298
Calcium	0.9	0.9	0.85
Phosphorus	0.42	0.4	0.38
Na	0.18	0.18	0.18
Cl	0.25	0.25	0.25
K	0.875	0.86	0.85
Linoleic acid	1.16	1.2	1.29
Digestible Lysine	`1.1	1.08	0.78
Digestible Methionine	0.47	0.48	0.477
Digestible M+C	0.79	0.79	0.78
Threonine	0.737	0.72	0.71
Isoleucine	0.737	0.72	0.71

Table 5: Growth performance of broilers fed experimental diets from 1-35 days

Parameters	Diets[1]			SEM[2]	Significance[3]
	A	B	C		
Feed intake (kg)	3.05	2.96	3.03	0.03	NS
Weight gain (kg)	1.70	1.66	1.75	0.03	*
Feed conversion ratio	1.81	1.78	1.73	0.02	*

[1] Diet A without AZOMITE supplementation; diet B contain 0.25% AZOMITE and diet C contain 0.5% AZOMITE in starter, grower and finisher phase.

[2]Standard error of mean.

[3]NS: Non-significant; *: P < 0.05; **: P < 0.01; ***: P < 0.001.

Table 6: Carcass characteristics of broiler fed experimental diets

Variables (g)	Diets[1]			SEM[2]	Significance[3]
	A	B	C		
Carcass	1160.0	960.0	1220.0	76.88	NS
Breast meat yield	380.0	350.0	420.0	18.62	NS
Thigh meat yield	70.0	70.0	80.0	2.18	NS
Relative liver weight	40.0	40.0	50.0	1.02	NS
Relative heart weight	20.0	10.0	10.0	3.77	NS
Relative abdominal fat	40.0	30.0	30.0	2.27	NS

[1] Diet A without AZOMITE supplementation; diet B contain 0.25% AZOMITE and diet C contain 0.5% AZOMITE in starter, grower and finisher phase.

[2]Standard error of mean.

[3]NS: Non-significant; *: $P < 0.05$; **: $P < 0.01$; ***: $P < 0.001$.

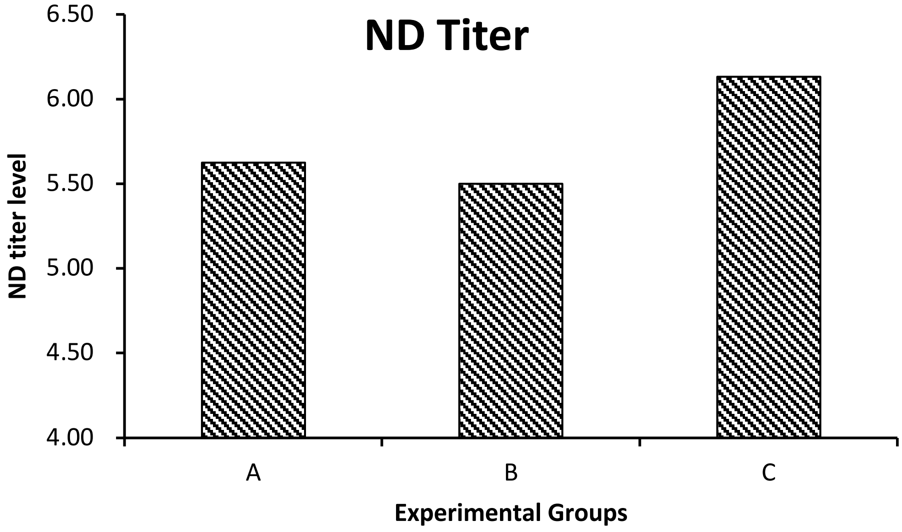

Figure 1: Titer level against Newcastle disease of broilers fed experiment diets A, b and C.

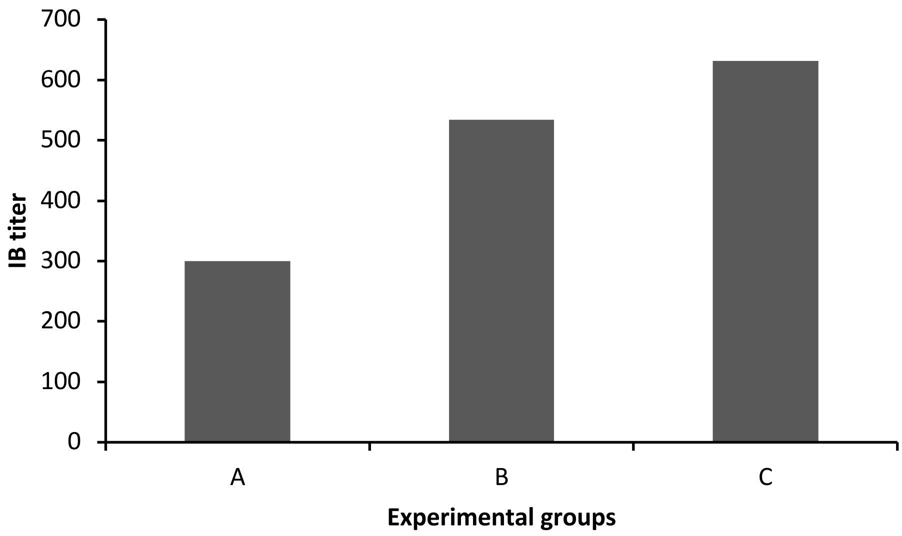

Figure 2: Titer level against infectious bronchitis of broilers fed experiment diets A, b and C.