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Investigations

The Effect of Adding Zeolite in the Feed of Chickens Cobb 500

[1]Angel Roberto Sánchez Quinche, [1]Faviola Margarita Pindo Nagua, [1]Oliverio Napoleón Vargas González, [1]Carlos Armando Alvarez Díaz, [1]Lenin Fernando Aguilar Galvez and [2]Ion Pérez Baena

[1]*School of Veterinary Medicine and Animal Husbandry,*
Research Group on Food Production and Animal Health (GIPASA) College of Agricultural Sciences,
Universidad Técnica de Machala, Machala-Ecuador
[2]*Institute of Animal Science and Technology, Universitat Politècnica de València, Valencia-Spain*

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Corresponding Author:
Angel Roberto Sánchez Quinche
School of Veterinary Medicine and Animal Husbandry,
Research Group on Food Production and Animal Health GIPASA) College of Agricultural Sciences,
Universidad Técnica de Machala, Machala-Ecuador
E-mail: arsanchez@utmachala.edu.ec

Abstract: The objective of this study was to evaluate the effects of the addition of zeolite on the feeding of Cobb 500 chickens in the productive parameters. The work was carried out in an integral farm of Ecuador, adopting the standards of biosafety and animal welfare for the breeding of poultry; no vaccines or drugs were administered. 200 chickens (1-day old) were studied for 42 days and distributed in 5 treatments, each one with 4 replicates (10 chickens per replicate, randomly selected); the treatments were: T1(control), T2(zeolite 2%), T3(zeolite 3%), T4(zeolite 4%) and T5(zeolite 5%). All of the groups were fed with BALMAR, a commercial feed (Pre-initial: 22.56% CP, 3150 Kcal/kg ME; initial: 21% CP, 3200 Kcal/kg ME; grow-out: 19.5% CP, 3250 Kcal/Kg ME), T1 included a commercial toxin trapper, for all other groups zeolite was added as a substitute for the commercial toxin trap. The variables studied were: feed and water consumption, feed conversion ratio, live weight and mortality. The data were processed with the statistical program Stat graphics Centurion XV.I, by means of ANOVA analysis. The results of this experiment showed that there were no significant statistical differences in water consumption, food intake and feed conversion when comparing the treatments with the control, although, the final weight showed statistical difference ($p<0.05$). The highest mortality was recorded in T1 (12.5%). It is concluded that at higher zeolite increase, better effects, thus the live weight of T5 (1638.9±46.7) was statistically similar to the control (1734.3±49.3); water and feed consumption and feed conversion rate were not affected; possibly the reduction in mortality was due to the toxins trapping action of zeolite.

Keywords: Productive Parameters, Mortality, Toxin Trapping

Introduction

The livestock industry has undergone many changes aimed at the production of safe products, considering mainly the health of the consumer, thus strongly affecting the area of animal feeding for its impact on the productive, economic and social parameters and at the same time addressing the current tendency to cause the least possible impact on the environment (Montossi *et al*., 2013; Fajersson, 2015). In the search for natural alternatives for the management of broiler chickens to replace antibiotics and chemical present in the feed that is offered to the animals, it's emphasized the use of enzymes (Méndez *et al*., 2012; León *et al*., 2014), prebiotics (Velasco *et al*., 2011; González *et al*., 2014), probiotics (Rondón *et al*., 2008; Blajman *et al*., 2015), organic acids (Gonzáles *et al*., 2013; Ortiz *et al*., 2012), natural coccidiostats (Tsinas *et al*., 2011; Major *et al*., 2011) natural pigments (Rojas *et al*., 2015; Chacón-Villalobos *et al*., 2016), medicinal plants (González and Jiménez, 2011; Rodrigues *et al*., 2011; Lambrecht *et al*., 2013; Silva *et al*., 2014; Chiriboga *et al*., 2015; Sánchez *et al*., 2016), among others, have demonstrated efficacy and on its application allow to obtain harmless products for the human being.

The current lines of broilers are notable for their rapid growth but also for the demand of necessary resources for their development, among them the most important and widely studied is the feed, due to its impact on production costs, stressors and contaminants.

The use of feed additives (Ravindran, 2010) as for example the toxin trappers, promote animal health and welfare by counteracting possible contaminants that may be present in the raw materials used in the formulation and hence the importance of their addition in the balanced mixtures. Although there are some toxin trappers used commercially, it was the zeolite that aroused interest for its many attributed benefits and its relatively low price.

The Captador Plus (Zeolite), is a mineral belonging to the aluminosilicates, used in aquaculture, agriculture and poultry in the litter of chickens as an ammonia collector; it has an absorbing effect of ammoniacal gases thereby controlling unpleasant odors, besides is able to stabilize the pH of the water with ion exchange capacity and stimulates the growth of plankton (La Colina, 2017).

Being considered a natural toxin trapper, it was necessary to ratify the beneficial effects of it and to state what would be the most appropriate inclusion rates to replace a commercial toxin trapper without causing any harm to the animal that ingest it. Considering the preceding text, the objective of this study was to evaluate the effects of the inclusion of Zeolite in the feed for chickens Cobb 500 and its impact on the production parameters and thus contributing with more data to the existing research on this subject.

Materials and Methods

The present study was carried out in the integral farm "San Juan" located in Chilla, province of El Oro, coastal region of Ecuador, whose geographic coordinates are 03° 27´ 00" south latitude, 79 35´ 24" Northeast longitude. Its temperature fluctuates between the 10 °C degrees in the cantonal headland and 28 °C degrees in the tropic, with an altitude is of 2450 m.a.s.l., in the center of the canton and 3500 m.a.s.l., at the highest point, the moor. All possible biosecurity standards for open poultry housing were adopted in order to maintain a total welfare environment for the chickens. The disinfection of the facility was done with formalin followed by an application of quicklime to the floor before the chickens entered. During the first week a layer of paperboard was placed on the litter (wood chip). In order to increase the field challenge, no vaccine or drug was administered. A total of 200 mixed baby chickens from the Cobb 500 line were used, distributed in 5 treatments, each with 4 replicates of 10 chickens taken at random, meaning 40 chickens per treatment, T1 as control, T2 (zeolite 2%), T3 (Zeolite 3%), T4 (zeolite 4%) and T5 (zeolite 5%). BALMAR, a commercial feed was used to feed the chickens in all the treatments (the pre-initial with 22.56% Crude Protein (CP) and 3150 Kcal/kg metabolizable energy (ME), the initial with 21% of CP and 3200 Kcal/kg of ME and fattening with 19.5% of CP and 3250 Kcal/kg of ME). T1 included a commercial toxin trapper, for all of other groups zeolite was added according to the above mentioned percentage as a replacement for the toxin trapper, the response of the different treatments was evaluated for 42 days. The source of heat of the poultry house was provided by 2 gas heaters (for 1000 and 500 birds).

Throughout the study, the following variables were recorded: Feed intake, water consumption, feed conversion ratio, mortality and weight of the birds. The design consisted of 5 treatments with 4 replicates each one the sampling was for 6 weeks, giving a total of 120 sample data (5T×4r×6w) for each variable: feed, water and feed conversion; while for live weight the total actual sampling data was 1200 (5T×4 ×10c×6w) no counting the mortality.

The feed consumption data was obtained weekly by the formula (data of 10 chickens per replica):

Feed consumption (g) = Feed amount offered weekly- Weekly leftover feed

Water consumption was determined daily from each replicate (10 chickens) by the formula:

Daily water consumption (ml) = Water offered daily- Leftover water

The feed conversion ratio was obtained weekly by the formula (10 chickens per replicate):

$$Feed\,Conversion\,Ration = \frac{Total\,feed\,consumed\,(g)}{Final\,live\,weight\,(g) - Initial\,live\,wegiht\,(g)}$$

Mortality data were expressed as total percentage for each treatment, obtained from the number of dead chickens divided by the initial number of them and this multiplied by 100:

$$Mortality\,(\%) = \frac{Number\,of\,dead\,chickens}{Number\,of\,chickens\,started} \times 100$$

The weight data (grams) of the chickens was recorded weekly and individually for the whole time of this study. For this, an electronic balance with a maximum capacity of 5,000±1 g. Water volumes were measured by using a container with a capacity of 1 liter with minimum measures of 10 ml.

Statistical Analysis

Statistical analyzes were performed according to Blasco (2010), for which a parametric Variance Analysis (ANOVA) was used, after verification of the assumptions of Normality and Homogeneity. The method used to discriminate between means was Fisher's Least Significant Difference (LSD), to establish the existence of statistically significant differences between treatments at a confidence level of 95%. All analyzes were performed using the statistical software Statgraphics Centurion XV.I. ®**.**

Results and Discussion

Feed and Water Consumption and Feed Conversion Ratio

When analyzing the results shown in Table 1, it is shown that there is no statistical significant difference for feed and water consumption and feed conversion ratio at day 42 (Week 6). On the other hand, a numeric difference in the feed consumption was observed, i.e. it was lower in the T2 (36863.8 g) when comparing it with T1 or control (43727.5 g); similarly, the water consumption was lower in T5 (77770 g) when compared to T1 (79957.5 g). The lowest feed conversion ratio was for T1 (2.22), while the highest one was for T4 (2.57). The water and feed consumption can be seen in Fig. 1, where differences among treatments are slight and hence are not observable. These results are similar to those reported by Wu *et al*. (2013) who evaluated the effect of dietary supplementation with 2% natural and modified clinoptilolite on broiler performance, as well as the results reported by Öztürk *et al*. (1998) who found something similar in an experiment where they fed a diet supplemented with a natural zeolite to laying hens.

Mortality

The mortality recorded in the study Table 1 shows that the Treatment 1 (T 1 = Control), chickens fed with a diet containing a commercial toxin trapper showed the highest mortality when compared to the other treatments. A decrease on the mortality when the amount of zeolite in the diet increased was observed, noting that the mortality in T1, T4 and most of T2 were recorded in the first two weeks, observing as clinical signs low weight chickens Table 2 which it could be due to Onfalitis or poor quality birds originated at the incubator (Juárez-Caratachea and Ortiz, 2001; Mamani *et al*., 2010), while the rest of the mortality presented at weeks 3 and 4 was normally expected in production facilities at the area. This differs from the data found by Al-Nasser *et al*. (2011) who found no statistical difference in mortality by adding 1, 1.5 and 2% of Zeolite to the feed of broiler chickens to evaluate their effect against Salmonella and also from data reported by Öztürk *et al*. (1998).

Live Weight of Birds

In Table 2 and Fig. 2, the trend of weight gain during the 6 weeks of the experiment is shown. There is not statistically significant difference among the treatments at week 1 and 3 when compared to the control (T1); while in week 2, T4 and T5 were different from the control as they showed greater weight. On the other hand, at week 4 and 5 treatments T3, T4 and T2, T3 respectively, showed statistical difference when noting a lower weight than T1. Finally, in week 6 it is shown that T5 does not present statistical significant difference when compared to T1, although the other treatments showed a lower weight Table 2. This result is similar to data reported by Cornejo *et al.* (1995) who evaluated an unpurified clinoptilolite added to the feed at 2, 4 and 6% in broiler chickens without finding significant statistical differences in the final weight of the birds, indicating that the impurities could be coating the surface of the zeolite, thus substantially decreasing its physicochemical properties. Furthermore, Collazos (2015) stated that those results may be due to variations in amount used, the type of zeolite (natural or synthetic) and the content of impurities.

Table 1. Average ± S.D. of productive data, obtained with the administration of Zeolite at different percentages in the feed of broilers Cobb 500

	Productive data by day 42 (6 weeks)			
Treat.[1]	Ac. Feed Con. (g)[2]	Ac. Water Con. (ml)[3]	Feed Conv. R.[4]	Mortality (%)
1	43727.5±5641.9[a]	79957.5±3782.4[a]	2.22±0.36[a]	12.5
2	36863.8±5641.9[a]	81573.8±3782.4[a]	2.31±0.36[a]	7.5
3	41832.5±5641.9[a]	81001.3±3782.4[a]	2.53±0.36[a]	5.0
4	41922.3±5641.9[a]	81338.3±3782.4[a]	2.57±0.36[a]	5.0
5	40617.5±5641.9 [a]	77770.0±3782.4[a]	2.31±0.36[a]	2.5

[1]Treat.: Treatments, 1 Control, 2 inclusion of 2% Zeolite, 3 inclusion of 3% Zeolite, 4 inclusion of 4% Zeolite and 5 inclusion of 5% Zeolite, in the feed. [2]Ac. Feed Con. (g): Accumulated feed consumption in grams at the end of the study. [3]Ac. Water Con. (ml): Accumulated water consumption in milliliter at the end of the study. [4]Feed Conv. R.: Feed conversion ratio at the end of the study

Table 2. Weekly mean live weight of broilers Cobb 500 fed with a diet containing Zeolite at different percentages

Treat.[1]	Live weight (average per week) Weekly weight 1 g[2]	Weekly weight 2 g[2]	Weekly weight 3 g[2]	Weekly weight 4 g[2]	Weekly weight 5 g[2]	Weekly weight 6 g[2]
1	110.4±3.3[a]	232.9±8.0[a]	390.9± 18.0[ab]	876.0±31.3[a]	1391.7±58.3[a]	1734.3±49.3[a]
2	111.1±3.1[a]	239.5±7.6[ab]	392.1±17.3[ab]	910.5±30.0[a]	1276.9±56.0[b]	1591.1±47.3[bc]
3	112.8±3.1[a]	237.8±7.5[ab]	393.2±17.3[ab]	806.8±30.0[b]	1276.7±56.0[b]	1544.0±47.3[c]
4	116.2±3.1[a]	257.7±7.6[c]	382.7±17.0[a]	813.1±29.6[b]	1315.1±55.3[ab]	1607.1±46.7[bc]
5	113.2±3.1[a]	249.5±7.5[bc]	417.3±16.8[b]	856.7±29.6[ab]	1335.0±55.3[ab]	1638.9±46.7[ab]

[1]Treat.: Treatments, 1 Control, 2 inclusion of 2% Zeolite, 3 inclusion of 3% Zeolite, 4 inclusion of 4% Zeolite and 5 inclusion of 5% Zeolite, in the feed. [2]Weekly weight 1, 2, 3, 4, 5, 6 (g): Live weight of the chickens per week, the number identifies them

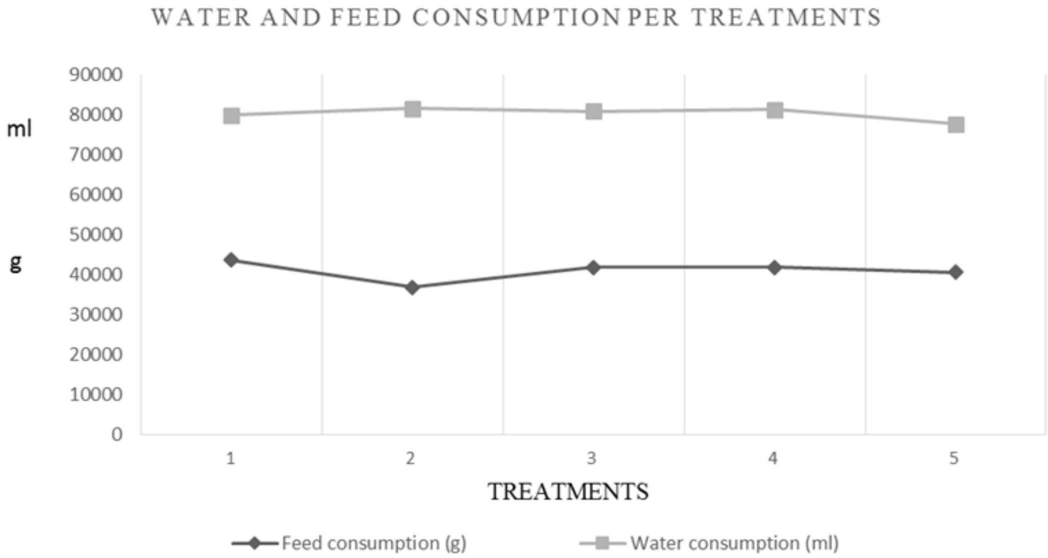

Fig. 1. Graphic representation of the average data for accumulated water and feed consumption in Cobb 500 chickens at day 42 (week 6) in the different treatments

Fig. 2. Graphic representation of the average live weight (per week) in Cobb 500 chickens in the different treatments

Conclusion

On the basis of the results, the inclusion of 2-5% zeolite in the feed does not show an effect on the feed and water consumption and on the feed conversion ratio of the broilers Cobb 500. The lower mortality observed may be due to a higher level of toxin uptake by Zeolite. Finally, including 5% of Zeolite in the feed yields similar results to that of the absolute control, with a savings of $ 0.3 per 40 kg of feed (price of the feed without toxin trapping and adding the cost of the mineral inclusion). Furthermore, the higher the percentage of zeolite in the ration, the lower the moisture and odors in the chicken beds.

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Author's Contributions

Angel Roberto Sánchez Quinche: The principal investigator of the study.

Faviola Margarita Pindo Nagua: Record the data of the experiment at the field and contributes to the writing of the article.

Oliverio Napoleón Vargas González: Prevention of pathologies in birds and contributes to the writing of the article.

Carlos Armando Alvarez Díaz: Management of the welfare of the birds and contributes to the writing of the article.

Lenin Fernando Aguilar Gálvez: Biosafety of the birds and contributes to the writing of the article.

Ion Pérez Baena: Analysis of the data and contributes to the writing of the article.

Ethics

The present study was approved by the Honorable Directing Council of the Agricultural Sciences Unit of the Universidad Técnica de Machala as part of the 2016 Qualification process (Research to obtain the degree of Veterinarian and Zootechnician - Ecuador), taking the General Guide of Voluntary Character, regarding the Adoption and Certification of Good Poultry Practices (GPP), AGROCALIDAD-Ecuador. In the field study, the animal welfare, feed and environmental security principles were taken care of, following the norms established by the regional (UTMACH), national (AGROCALIDAD) and international (FAO, OIE and FOOD CODEX) policies.

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