Global Advanced Research Journal of Agricultural Science (ISSN: 2315-5094) Vol. 7(7) pp. 217-222, July, 2018 Issue.
Available online http://garj.org/garjas/home

Full Length Research Paper

Effect of the incorporation of clay on feeding digestibility, nutrient retention, and digestive organ size of broiler

Chouchen Rana[1], Haj ayed Mediha[2], M'hamdi Naceur*[1]

[1]Laboratory of Genetic, Animal and Alimentation Resources, National Agronomic Institute of Tunisia .43 Av. Ch. Nicolle, 1082 Tunis, Tunisia
[2]Higher Institute of Agronomy of Chott-Meriem Chott Meriem, B.P. n° 47 -4042 Chott Meriem Sousse, Tunisia

Accepted 13 February, 2018

Two hundred one day old Hubbard JV chicks with an average initial body weight 37.59 g (± 0, 150) (P=0.228) were used in fattening and digestibility trial. The aim was to study the effect of zeolite supplementation to diet on poultry performance. Chicks were divided into 3 treatment groups: A_0, $A_{0.5}$ and A_1 containing 0; 0.5 and 1% of zeolite, respectively. Three experiments were conducted: fattening, digestibility and carcass trial. Fattening experiment was performed for a 39 days period. Animals were fed ad libitum starter CF1 (1-17 days of age), then grower-finisher CF2 (18-39 days of age) concentrates. Feed digestibility was controlled by using reference on 24 chickens (8×3) aged of 15 days and weighing 425 g of live body weight. At the end of the essay (39 days of age), 24 chickens (8 × 3) were slaughtered to determinate hot and chilling carcass weights and yields and the proportions of breast and thigh and digestive organs in carcass. Overall results indicate that zeolite had no influence on global growth performance (48,71g). Carcass parameters studied were statistically similar for the three treatments (p> 0.26). However it seems that abdominal fat weight for the animals received 0.5% of zeolite tends to be higher than animals of the other treatment (p = 0.052). In conclusion, it appears that the addition of zeolite in broiler feeds does not have any impact on the different parameters studied.

Keywords: carcass parameters, digestibility, poultry, zeolite

INTRODUCTION

Food safety and quality assurance have become the major concern of nations, which has led to changes in many industrial practices, considered as a technical and scientific review contributing to the evolution of livestock and the improvement of their profitability. The use of clay supplements in animal and poultry feed manufacturing is not new. Recent studies involving the use of clays as dietary supplements have given results which suggest that some clay products may have direct beneficial effects upon animal performance. Few such studies have provided evidence that the clay products were themselves making nutritive contributions but most have demonstrated an improved caloric efficiency resulting from their use. Clay supplements have generally been used in animal diets for

*Corresponding author Email: naceur_mhamdi@yahoo.fr

reasons other than the nutrients they supply. Recent reports have shown that low level additions of clay to poultry diets improved caloric efficiency and slowed down feed passage (Kurnick and Reid 1960; Quisenberry and Bradley 1964; Eshleman 1966; Quisenberry 1966; Almquist et al., 1967; Ousterhaut 1967).

Our work is in the use of clays, especially the zeolite and its effects on digestibility and some carcass parameters of broilers.

MATERIALS AND METHODS

Animal, management and feeding

The digestibility trial was conducted from April 18, 2011on 24 chickens aged of 15 days and weighing 425 g of live body. Chicks were divided into 3 treatment groups (8×3): A_0, $A_{0.5}$ and A_1. Animals were fed *ad libitum* starter CF1 (1-17 days of age) and grower-finisher CF2 (18-39 days of age) concentrates. Concentrates used in this test were manufactured in the factory concentrated feed "SOMIPA", Tunisia. Two types of food were made: one for the start-up phase (CF1) and another for growing-finishing phase (CF2). Each type has three different diets: a control diet (A_0) containing neither antibiotic growth nor any alternative product and two experimental ($A_{0.5}$) containing the additive zeolite with a percentage of 0.5% (A_1) containing the zeolite with 1%. Nutritional values provided by the manufacturer for CF1 and CF2 concentrates are the same and listed in Table1.

Concentrates sampling analysis

Physical analysis is to determine the size distribution of food. It was made May 6, 2011 in the Soil Science Laboratory, the principle is to move the samples by superimposed sieves in descending order; each sample for 5 minutes left in the sieve and the particles will be distributed in the appropriate diameter of the sample particles are well distributed over the different sieves separately. Once the analysis is completing each recovered amount of each sieve was weighed to determine its percentage share in the feeds.

Protocol of the experiment

The digestibility trial is based on the method of Bourdillon *et al.*[7]. The protocol is to adapt the animals for a certain period and then collect and analyze droppings. During the adaptation phase (6 days), the food was distributed ad libitum to follow the daily consumption and to achieve a stable level of intake. A digestion study of 25 days duration, involving quantitative collection of feeds, refusals and faeces was conducted to determine the apparent digestibility of the diet. Representative samples of concentrate, refusals and faeces were collected, bulked, mixed, dried at 105°C to determine daily intake of DM for each animal and then ground to pass a 1 mm sieve for subsequent laboratory analysis to determine DM, OM and CP.

Carcass parameters

The slaughter of chickens took place on 12/05 at an age of 39 days after a water diet 24 hours. From each batch, 2-3 animals were taken, weighed and slaughtered. The average weight of the animals was 1982 ± 100 g. Each animal had a card on which all measures will be graded.

Statistical analysis

The statistical analysis aims to determine, from the collected data the effect of zeolite supplementation on the digestibility of foods and some carcass parameters for broiler. We carried out an analysis of variance using the general linear model (GLM) of the SAS software Version 9.14[8] and compared the averages calculated by the "Student" test.

RESULTS AND DISCUSSIONS

Chemical composition of mixed feeds

Compared to the theoretical values (Table 1) CF and CP given by the manufacturer and the results of chemical analyzes in the laboratory of Animal Production of the Higher Institute of Agronomy of Chott-Mariem, Sousse, Tunisia, are in the standards (2.98 % CF and 20.88% CP and 2.89% CF and 20.71% CP, respectively, for the crumbled and pelleted food). However, the chemical compositions between A_0 concentrates, $A_{0.5}$ and A_1 are close. This indicates that the addition of zeolite additive has not changed the DM, OM, and CF in the mixture during the manufacturing process, while a slight decrease was observed in CP with the zeolite doses. Therefore, the animals of the three treatments have received identical contents of fiber and protein (table2).

The granulometric composition of the concentrate crumbled and granulated food appears homogeneous[9] and the coarse fraction is the major fraction of each food in the range of 76.24, 67.1 and 58.38% for A_0, A_1 and $A_{0.5}$ for crumbled food (table3).

It is noted that control food is more homogeneous than fortified foods (figure1).

From Figure2, the heterogeneity between the different size fractions of crumbled and granulated food is low except for a difference of 9 and 18% (crumbled food) and 5 and 10% (granulated food) for the size fraction> 1 mm. According (Cheeke 1991), clays are probably the most used binders in the production of concentrates. (Mateos et

Table 1. Nutritive values concentrate feed

Nutritive values	%
Protein	19
Fat	3
Energy (Kcal / kg)	2900
Crude fiber	5
P	0,6
Ca	1
Ash	7

Table 2. Results of the chemical analysis concentrate

chemical analysis	***CF1***			***CF2***		
	A_0	$A_{0.5}$	A_1	A_0	$A_{0.5}$	A_1
Dry matter (%)	91.32	91.97	92.36	92.01	92.34	92.37
Organic matter(% DM)	94.45	94.44	94.64	94.39	94.58	95.03
Crude fiber (% DM)	2.91	3.27	2.77	2.68	3.34	2.65
Crude protein (% DM)	21.37	21.47	19.81	21.36	20.95	19.84

Table 3. Results of the sieve analysis concentrated feed

Fraction size (%)	*CF2* crumbled			*CF2* pelleted		
	A_0	$A_{0.5}$	A_1	A_0	$A_{0.5}$	A_1
>1mm	76.24	67.10	58.38	98.86	93.81	89.10
1 - 0.9mm	2.60	3.28	3.50	0.08	0.54	1.05
0.9 - 0.8mm	3.68	4.59	4.91	0.04	0.42	1.01
0.8 - 0.71mm	1.78	2.22	2.18	0.02	0.26	0.59
0.71 - 0.63 mm	3.08	4.10	4.85	0.03	0.46	0.08
0.63 - 0.5 mm	3.19	4.20	4.68	0.03	0.43	1.07
0.5 - 0.4 mm	3.70	3.62	5.53	0.02	0.46	0.89
0.4 - 0.315 mm	1.40	1.87	3.01	0.002	0.29	0.59
0.315 - 0.2 mm	3.16	5.22	7.03	0.05	1.09	1.64
< 0.2 mm	1.18	3.08	3.13	0.01	0.99	0.97

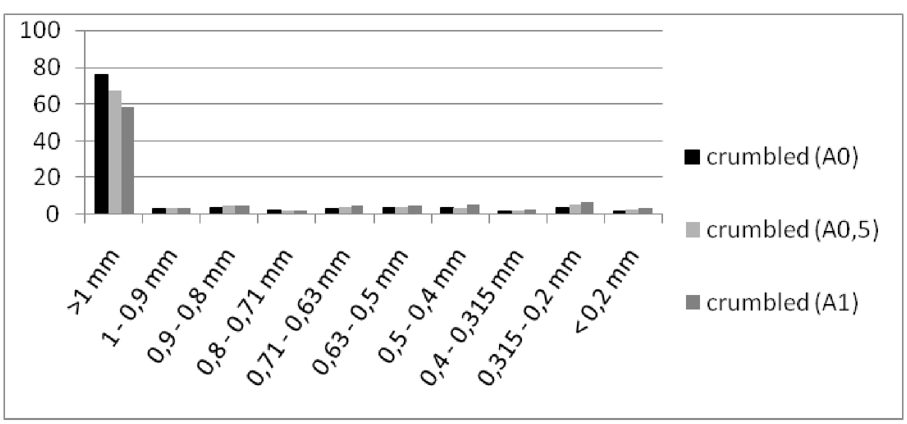

Figure1. Distribution of particles of crumbled food

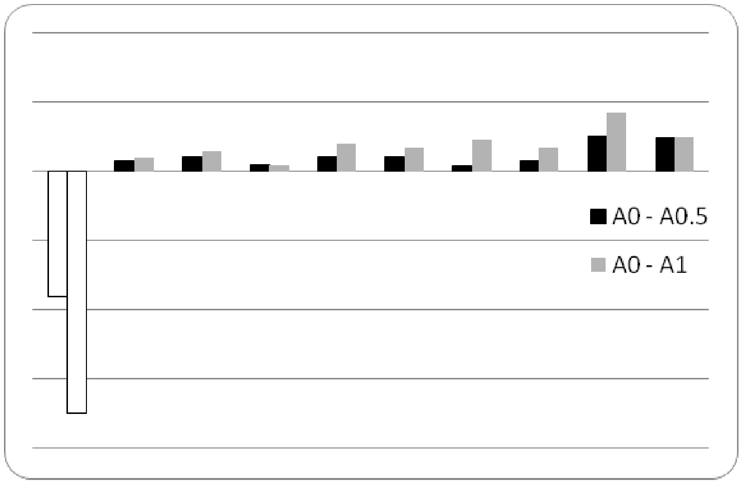

Figure 2. Deviation in the size distribution of the crumbled food supplemented with zeolite compared to the control

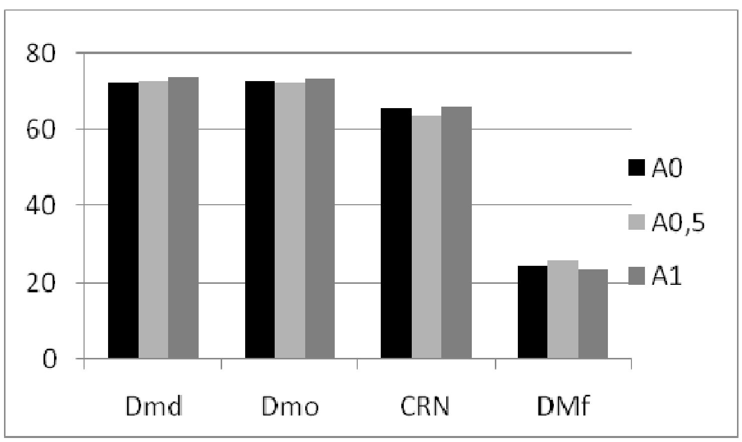

Figure 3. Variation of Dmd, Dmo, CRM and DMf as a function diets A_0, $A_{0.5}$ and A_1

al., 2012), reports that if proportion of the coarse fraction is important there will be an increase in the size of the gizzard and an improvement in its functioning since these particles remain longer in it, increasing the pH and provide a good mix of nutrients and enzymes as well as the homogeneity of the finished product.

Digestibility trial

Statistical analyzes show that levels of digestibility of dry matter and organic matter for animals of different diets are identical ($p = 0.202$ and $p = 0.227$) (figure3).

For dry matter of faeces chickens of control diets and those supplemented diets are identical (24.47 and 24.79 respectively). The zeolite used in doses 0.5 and 1% did not improve the digestibility of food. These values were averaged 73.08, 72.81 and 64.65% respectively for Dmd, Dmo and CRN (table4).

Incorporation of zeolite showed a significant effect on the valorization of food for diets $A_{0.5}$ and A_1 ($p = 0.01$). However, water consumption is significantly different ($p = 0.329$). This consumption is proportional to that of the food for subjects receiving the additive. Despite this difference in consumption of dry matter of faeces chickens of A_0, $A_{0.5}$ and A_1 are identical (24.47, 25.93 and 23.66 respectively). ($p = 0.661$). These results partially explain the low incidence of food supplement on growth, consumption, feed intake, mortality rates as well as the parameters of

Table 4. Digestibility of dry matter (Dmd), digestibility of organic matter (Dmo), coefficient of nitrogen retention (CRN), water consumption (W), feed intake (FI), dry matter of faeces (DMf) by treatment

Treatment	Dmd (%)	Dmo (%)	CRN (%)	DMf (%)	W (ml)	FI (g)
A0	72.18	71.97	65.27	24.47	965	491.92
A0.5	72.51	72.23	63.66	25.93	867.37	428.1[b]
A1	73.66	73.40	65.64	23.66	885	437.1[b]
Prob	0.202	0.227	0.631	0.661	0.329	0.017
CME*	0 .592	0.602	1.538	0.018	48.037	73.894

*CME: Mean Square of Error. The average of the same column with different letters are significantly different (p<005).

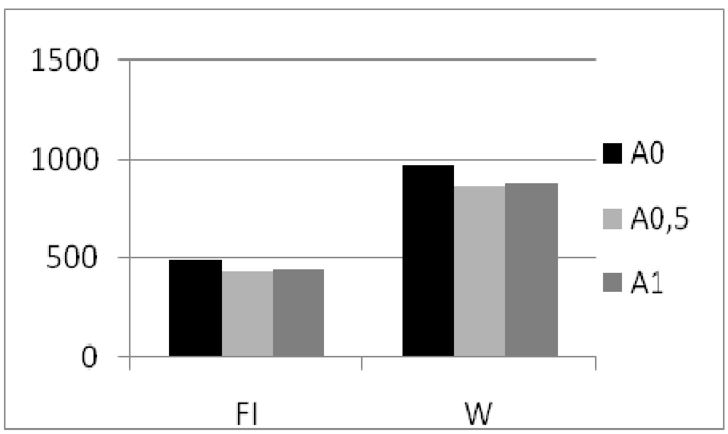

Figure 4. Evolution of ingested and the quantity of water consumed depending on diet

chicken carcasses. The composition of the zeolite, its purity, its origin and nutritional characteristics and centesimals of concentrate feed are missing elements in this study and that could explain the level of effectiveness of the clay (figure4).

Carcass parameters

With the exception of the weight of abdominal fat (p=0052), no significant difference was observed (p> 0.222) on the different parameters analyzed. The percentages of the weight of abdominal fat of animals of each treatment were significantly different. It appears that the zeolite tends to show a positive effect on reducing fat accumulated in animals consuming 0.5% of zeolite. These results are identical to those obtained by (Castaing 1994), who have shown that the effect of the addition of the clay on the reduction of body fat of the carcass and the increased rate of muscle (table5). (Rotermel et al., 1964), reported an increase in chest width and carcass fat of two groups of swine fed diets containing 1% of clay, suggesting an increase in calorie retention.

(Ousterhout 1967), reported that the inclusion of various clays at levels as high as 16% in practical broiler rations improved caloric efficiency with no apparent effect upon growth or carcass quality.)

Table 5. Different parameters measured carcass after slaughtering

	A_0	$A_{0.5}$	A_1	Prob
Body weight (g)	1933.33	2054.03	1980.98	0.221
Carcass weight (g)	1675.15	1748.74	1721.58	0.394
Hot carcass weight eviscerated (g)	1475.75	1527.70	1510.73	0.572
Cold carcass weight (g)	1437.00	1514.09	1486.08	0.267
Liver weight (g)	41.65	43.35	45.65	0.446
Weight gut (g)	143.17	160.07	153.05	0.110
Gizzard weight (g)	28.67	31.60	31.40	0.431
Gizzard fat weight (g)	8.02	9.62	7.57	0.565
Weight of abdominal fat (g)	15.37	12.13	16.61	0.113
Duodenum Weight (g)	14.85	15.17	14.15	0.662
Juojunum weight (g)	25.15	24.25	25.00	0.783
Ileum Weight (g)	18.72	19.50	20.47	0.331

* CME: Mean Square of Error.
The average of the same column that does not contain the letters is not significant (p> 0.05).

CONCLUSION

The results of our study show that clay tested and incorporated with 0.5 to 1% in concentrates starter for broilers are not very conclusive and do not allow us to crown the effect of zeolite on digestibility and some of carcass parameters that is why we have to investigate other levels of zeolite supplementation to confirm its effects on feeding digestibility, nutrient retention, and digestive organ size of broiler.

REFERENCES

Almquist HJ, Christensen HL, Maurer S (1967). The effects of bentonites on nutrient retention by turkeys: *Feedstuffs* 39, 54.

Anne Bourdillon B, Carré L, Conan MF, Fuentes M, Huyghebaert G, Janssen WMMA, Leclercq B, Lessire M, McNab J, Rigoni M, Wiseman J (1990). European reference method of in vivo determination of metabolisable energy in poultry: Reproducibility, effect of age, comparison with predicted values, British Poultry Science, 31:3, 567-576, DOI: 10.1080/00071669008417288

Castaing (1994). Effet de l'introduction de sépiolite Exal selon les teneurs en cellulose brute et matière grasse d'aliments pour porcs charcutiers. Journées Rech. Porcine en France, 26, 199.206.

Cheeke PR (1991). Applied Animal Nutrition: Feeds and Feeding. Macmillan, New York, NY. 504 p.

Eshleman JC (1966). Poultry feed containing about 1% diatomaceous earth: U.S. Patent Office, Patent No. 3, 27l, 161.

Kurnick AA, Reid BL (1960). Poultry nutrition studies with bentonite: *Feedstuffs* 32.

Mateos GG, Jiménez-Moreno E, Serrano MP, Lázaro RP (2012). Poultry response to high levels of dietary fiber sources varying in physical and chemical characteristics. Poultry science association, Inc.156-174

Melcion (1995). Emploi des liants pour le pressage des aliments des animaux : aspects technologiques et nutritionnels. INRA Prod. Anim., 1995, 8 (2), 83-96.

Ousterhaut LE (1967). The effect of kaolin on the feed efficiency of chickens: In press.

Ousterhout LE (1967). The effect of kaolin on the feed efficiency of broilers. Poultry Sci. 46:1303.

Quisenberry JH (1966). Research reports on factors that influence laying hen performance: *Feedstuffs* 38, 28.

Quisenberry JH, Bradley JW (1964). Sodium bentonite feeding experiments: *Feedstuffs* 36, 22-23.

Rotermel ZA, Kirsanov NV, Zaleznjak PN (1964). Bentonite clays increase weight gains of pigs. Svinovodstvo, 12:28-29.

SAS Institute Inc. SAS/STAT user's guide. Version 9.1 [computer program]. SAS Institute Inc., Cary, N.C., USA.