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Effect of adding biochar to the diet and litter on the rate of diet consumption, relative humidity and gut health of broilers (Ross308)

ABSTRACT

This experiment was conducted to investigate the effect of adding biochar to the diet and litter on growth performance and broilers the hock burn and footpad dermatitis. In the experiment, 300 One day old chicks were randomly distributed to 5 treatments 3 replicates each treatment , with (20) birds per replicate and with an average weight (39.7) g. T1: Without adding biochar in the diet and litter. T2: (2) kg of biochar / 100 kg of diet). T3: (4 kg of biochar l / 100 kg of diet). T4: (2 kg of biochar / 100 kg of litter). T5: (4 kg of biochar / 100 kg of litter) . The results of the statistical analysis of the weekly diet consumption rate indicated a significant superiority of the treatments of adding biochar to the diet over the treatments of adding biochar to the litter and the control group . While the results of relative humidity, level ammonia NH3 level indicated that adding biochar to the litter treatments recorded the best results compared to the group adding biochar to the diet and the control group. As for the results of the microbial characteristics, it was shown that the treatments of adding biochar to the diet recorded the best results compared with the group adding biochar to the litter and the control group, which recorded a decrease in the number of colon bacteria and an increase in the number of lactic acid bacteria. While the relative humidity results indicated that adding biochar to the litter treatments recorded the best results compared to the group adding biochar to the diet and the control group.

The aim of this study is to evaluate biochar as a food additive and a positive stimulant of the intestinal flora in maintaining the health of the broiler digestive system. Besides, due to its absorbent properties, it can reduce the moisture content of the litter and improve the overall environment of broiler breeding halls.

INTRODUCTION

The use of antibiotics in animal diet has been widespread in the global poultry industry for more than 60 years, reducing the load of pathogenic bacteria and improving growth and diet conversion efficiency (Huyghebaert, 2011). Antibiotic use in animal production is expected to increase by 67%. Between 2010-2030 if no action is taken in currently unregulated developing countries (Marshall, 2011) Concern about the emergence of antibiotic-resistant pathogens led to a ban on the use of non-therapeutic antibiotics in animal production in Europe in2011, (Crawshaw, 2015) There is likely to be additional tightening of regulations governing the use of antibiotics worldwide, with the Food and Agriculture Organization of the United Nations (FAO), the World Health Organization (WHO) and the World Organization for Animal Health collaborating to tackle antimicrobial resistance (Papaioannou et al, 2007 ; Pasha at al ,2005) therefore, the poultry industry needs to identify alternatives that reduce pathogen loads while still imparting the growth and

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performance advantages associated with the use of antibiotics in diet. Therefore, many studies have been conducted to find alternatives to antibiotics in animal rations in order to find alternative ways to suppress pathogen loads and maintain productive performance as an alternative to the use of antibiotics. (Prasai et al., 2016). Biochar is fine granules obtained by charring biomass in isolation or with little or no oxygen, or it is a solid material obtained from thermochemical conversion of biomass in a limited or no oxygen environment into biochar and can be used directly Or as an ingredient within another product that is mixed with it, and there are different types of biomass such as pine trees and some herbs Biochar is prepared from several inexpensive sources, such as date kernels and olive kernels, and prepared from animal waste such as poultry droppings. Biochar has been used to selectively remove pathogens without reducing microbial richness and diversity in the gut (Daboni et al., 2005; Al-Badran 2013; Al-Samarrai. ,2020).

MATERIAL AND METHODS

This field experiment was conducted in poultry halls, Department of Animal Production - College of Agriculture - Tikrit University for the period from (18/9/2021 to 22/10/2021, for a study) to study the effect of adding biochar to the diet and litter on the rate of diet consumption, relative humidity and bowel health Broiler (Ross308). 300 unsexed broiler chicks (Ross 308) were used in the experiment, average chick weight 39.7 g at one day old, equipped from Al-Mu'tasim hatchery - Salah Al-Din Governorate - Samarra district, raised in poultry halls, College of Agriculture - Tikrit University - Department of Animal Production, The study included (5) treatments, and each treatment contained (3) replicates of (20) birds/ Redundant, and birds were randomly distributed among the treatments, and the transactions were as follows. T1: Without adding biochar in the diet and litter. T2: (2 kg of biochar / 100 kg of diet). T3: (4 kg of biochar / 100 kg of diet). T4: (2 kg of biochar / 100 kg of litter). T5: (4 kg of biochar / 100 kg of litter) . The hall was cleaned of dirt with water and detergents, then left open to dry, then it was disinfected with formalin as a viral precaution, then it was spread with rice husk at a depth of (10) cm, and the cooling used (desert cooling) to reduce the temperature of the hall to 32°C, then gradually reduce the temperature appropriate for the chicks. At a rate of 2°C per week.

Table (1): Components of diets with their chemical analysis

Diet material	Starter (1-10)days	Growth (11-25)days	Finisher (26-35)days
yellow corn	56.535	60.21	62.32
Soybean meal (48% protein)	33.74	29.97	26.50
premix *	5	5	5
sunflower oil	1.95	2.75	4
Dicalcium Phosphate	0.43	0.1	0
Limestone	1.66	1.65	1.57
Lysine	0. 195	-	0.13
Methionine	0.24	0.07	0.18
Threonine	-	-	0.05
Salt	0.25	0.25	0.25
total summation	100	100	100
Chemical composition**			
Energy (kilocalories/kg of diet)	3000	3100	3200
Crude protein (%)	23.00	21.5	20
Lysine (%)	0.89	1.15	1.19
Methionine (%)	1.03	0.55	0.64
Methionine + Cysteine (%)	0.97	0.87	0.94
Threonine (%)	0.27	0.82	0.81
Calcium (%)	0.88	0.87	0.81
Available phosphorous (%)	0.3	0.28	0.24

(*)Use the premix Brocon-5 Special W produced by the Dutch company WAFI, which contains 40% crude protein, 5% crude fat, 3.14% calcium, 5.38% available phosphorous, lysine 3.85%, methionine 3.70%, methionine + cysteine 4.12% , represented energy 2117 kilocalories/kg, crude fibers 2.81%.

(**)According to the chemical composition serving in the bush according to the NRC (1994).

The birds were fed from the first day until (10) days of their life on the starter ration, then they were fed on the growth broth from (11-24) days, then they were fed on the final ration until (35) days, the ration was prepared in the diet processing plant of the Faculty of Agriculture - Department Animal production in addition to its components and premix * used in its composition and table (1) shows the components of these relationships with their chemical analysis

Measuring dietconsumption(gm/Bird/week): The diet that was consumed weekly for each repeater during the experiment period was calculated by weighing the remaining dietquantity at the end of each week and subtracting it from the total amount of dietprovided at the beginning of the week, according to what was mentioned (Naji, 2006):

$$\text{Dietconsumption rate} \frac{\text{Duration start in dietquantity} - \text{Amount of dietleft}}{\text{Number of birds per duplicate}}$$

Calculation and estimation of the numbers of intestinal flora bacteria (CFU/g):

An amount of (5) g was taken from the intestines of (6) slaughtered birds from each treatment and of both sexes equally at the age of (5) weeks, and it was added to the physiological saline solution in a volume of 45 ml in sterile conditions and decimal dilutions were made from it until dilution 10^{-4} For the purpose of estimating the numbers of the following microorganisms:

1- *E.coil numbers (CFU/g)*

2- *Lactobacillus numbers(CFU/g)*

The numbers of these bacteria were estimated by the Spread Plating Method, according to the method of (Samanta et al., 2010) using MacConkey Agar to estimate the numbers of *coliform bacteria* and MRS Agar to estimate the numbers of *lactic acid bacteria*, as these media were prepared in advance in culture dishes, and it was verified that They were freed from contamination by leaving them in the incubator at 37°C for 24 hours. They were removed from the last decadal dilutions using a sterile 0.1 ml pipette, spread on the hardened medium surface by means of a sterile curved glass rod resembling the letter L. The dishes were incubated upside down at 37°C for 24 hours for the MacConkey Agar dishes, while the MRS Agar dishes were inverted in the anaerobic container. And incubated at 37°C for 48 hours, the developing colonies were counted in each of the two mediums, then they multiplied the preparation of Colony Forming Units (CFU) that were counted in the reciprocal of dilution, and the concentrations of these neighborhoods were converted into a logarithmic preparation of the base 10 and expressed as (L10). and tm/g).

Measuring the relative humidity in the dwelling:

The humidity was measured using an electronic meter type (THERMO HYGRO- CLOCK TA218A).

Picture (1): Sensor used to measure the relative humidity of the environment

Statistical analysis: The equation for the mathematical model was as follows:
Yijk = μ + Pi + eijk
The results were statistically analyzed by applying the statistical analysis system (SAS, 2001) using complete random design (CRD). and the significance was tested using the modified Duncan's multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

1-Weekly diet consumption (gm/Bird/week):

Table (2) shows the results of the statistical analysis of the effect of adding biochar to the diet and litter on the diet consumption rates ± the standard error for the weeks of the experiment. The results of the first and second weeks indicated that there was an arithmetic superiority for all treatments at the level ($p<0.05$) over the control treatment, but this superiority It did not rise to the level of morale, while the results of the third week showed a significant superiority in favor of the control treatment, which recorded (689.42) gm/bird, and the fifth treatment, which scored (659.66) gm/bird, and the results showed that there were no significant differences between the third and fourth treatments. The results of the study indicate that the addition of biochar to the litter recorded the highest consumption of diet compared to the treatments of adding to the diet. The reason for this is that biochar played a role in meeting the bird's energy needs, while the fourth week recorded a significant superiority in favor of the fourth treatment, which amounted to (805.66). g/bird These results agree with what Linhoss et al. (2019) brought when adding biochar to pine sawdust with a percentage of (10-20) %, which recorded the highest diet consumption, And there were no significant differences between the control treatment, the third treatment, and the fifth treatment, which recorded (768.33) gm/bird, (760.16) gm/bird and (760.83) gm/bird., respectively . These results were similar to what Linhoss et al**,** (2019) reported when supplementing chicken diet with (1) % rice husk biochar or adding it to the litter, but it had no significant effect on diet consumption, and the results also showed a significant superiority in favor of the control treatment and the fourth treatment, while The results of the total period showed that there were no significant differences between the experimental treatments.

Table (2): The effect of adding biochar to the diet and litter on the weekly diet consumption for broilers (gm/Bird) (mean ± standard error)

Treatment	Weekly diet consumption (gm/bird)					Total
	Week1	Week2	Week3	Week4	Week5	
T1 (the control)	150.83 6.52±	281.41 18.92±	689.42 a 4.55±	768.33 ab 11.02±	830.16 a 11.56±	2720.15 9.30±
T2 (2) kg of biochar / 100 kg of diet)	155.17 3.37±	334.58 12.20±	638.00 b 16.76±	723.91 b 29.62±	796.41 b 13.71±	2648.07 31.04±
T3 (4) kg of biochar l / 100 kg of diet)	148.33 3.72±	337.91 18.06±	658.33 ab 21.69±	760.16 ab 16.63±	795.25 b 27.81±	2699.98 81.18±
T4 (2) kg of biochar / 100 kg of litter)	146.25 4.77±	295.50 6.41±	647.80 ab 15.05±	805.66 a 31.72±	860.16 a 36.96±	2755.37 36.96±
T5 (4) kg of biochar / 100 kg of litter)	149.50 4.19±	297.75 11.21±	659.66 a 10.42±	760.83 ab 22.09±	857.50 a 19.64±	2725.24 36.03±
morale level	N.S	N.S	*	*	*	N.S

The different letters within the same column indicate the presence of significant differences at the level of significance ($p<0.05$)

2- Microbial tests (the effect of adding biochar to the diet and litter on some microbial characteristics of broilers)

Table (3) shows the results of the statistical analysis of the effect of adding biochar to diet and litter on some microbial characteristics ± standard error. The results obtained for coliform bacteria indicate a significant decrease at the level ($p<0.05$) in the biochar addition treatments. In the diet and treatments of adding biochar to the litter compared to the control treatment, which recorded the highest significant difference, these results agree with what Prasai et al. (2017) indicated that adding biochar to chicken diet leads to a reduction of *E. coli*, While the results for lactic acid bacteria indicated a significant superiority in favor of the treatments of adding biochar to the diet compared with the treatments of adding biochar to the litter and the control group. These results are consistent with Gerlach and Schmidt (2012) who assert that biochar supplementation in the diet promotes beneficial bacterial populations in the gut, and plays a positive role in detoxification and gut health in poultry.

Table (3): Effect of adding biochar to the diet and litter on some microbial characteristics of broilers ((CFU/g) at (35) days old (averages + standard error)

Treatment	*coliform bacteria (CFU/g)*	*Lactic acid bacteria (CFU/g)*
T1 (the control)	6.84 a 0.01±	5.70 e 0.02±
T2 (2) kg of biochar / 100 kg of diet)	4.58 d 0.03±	7.17 b 0.02±
T3 (4) kg of biochar / 100 kg of diet)	4.46 e 0.04±	7.49 a 0.01±
T4 (2) kg of biochar / 100 kg of litter)	6.12 b 0.02±	6.56 d 0.03±
T5 (4) kg of biochar / 100 kg of litter)	5.82 c 0.01±	6.79 c 0.02±
morale level	*	*

The different letters within the same column indicate the presence of significant differences at the level of significance ($p<0.05$).

3- Relative humidity of the dwelling environment:

Table (4) indicates the effect of adding biochar to diet and litter on the weekly relative humidity of broilers (centigrade) (mean ± standard error), if the results of the statistical analysis indicate that there are no significant differences at the level ($p<0.05$) between treatments during the first week , while the results of the second week indicated a significant increase in the relative humidity for the control treatment in all the treatments without significant differences with the third treatment, while the results showed a significant decrease for the fourth and fifth treatments, without significant differences with the second treatment. The results of the third week showed that there were arithmetic differences, but they did not rise to the level of morale, and the results of the fourth week confirmed a significant increase in the relative humidity for the control treatment and the second treatment, while the fourth and fifth treatment recorded the least significant differences without significant differences with the third treatment, and the results of the fifth week showed A significant increase in the relative humidity of the control treatment, while the rest of the treatments decreased significantly, On the other hand, the results of the study indicate that the addition of biochar to the litter recorded the best results compared to the treatments of adding to the diet. Reducing the moisture content and thus changing the water activity in broiler litter (Linhoss et al**,** 2019).

Table (4): Effect of adding biochar to diet and litter on the relative humidity Weekly for broilers (Celsius) (mean ± standard error)

Treatment	relative humidity Weekly				
	Week1	Week2	Week3	Week4	Week5
T1 (the control)	32.03 ± 0.17a	29.73 ± 0.20a	27.93 ± 0.88a	25.33 ± 0.18a	23.40 ± 0.20a
T2 (2) kg of biochar / 100 kg of diet)	32.56 ± 0.16a	29.30 ± 0.05bc	27.53 ± 0.08ab	25.03 ± 0.06a	22.33 ± 0.12b
T3 (4) kg of biochar / 100 kg of diet)	32.43 ± 0.03a	29.50 ± 0.05ab	27.76 ± 0.31ab	24.50 ± 0.23bc	22.70 ± 0.10b
T4 (2) kg of biochar / 100 kg of litter)	32.56 ± 0.13a	29.10 ± 0.05c	27.33 ± 0.08b	23.16 ± 0.06 c	22.26 ± 0.12b
T5 (4) kg of biochar / 100 kg of litter)	32.10 ± 0.32a	29.10 ± 0.11c	27.63 ± 0.08b	23.93 ± 0.08c	22.26 ± 0.18b
morale level	N.S	*	*	*	*

The different letters within the same column indicate the presence of significant differences at the level of significance ($p<0.05$).

CONCLUSIONS

1- The biochar additions within the levels used had a clear role in the productive traits, as the treatments of adding biochar to the dietwere significantly superior to the treatments of adding biochar to the litter and the control group significantly at the level ($P\leq 0.05$).

2- Adding biochar to the diethad a clear effect on some microbial characteristics, so that biochar treatments recorded a significant decrease at ($P\leq0.05$) in the numbers of colon bacteria and a significant increase at ($P\leq0.05$) in the numbers of *lactic acid bacteria*.

3- The addition of biochar within the levels used in the litter led to a significant decrease ($P\leq0.05$) in the level of relative humidity

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تأثير إضافة الفحم الحيوي الى العليقة و الفرشة على معدل استهلاك العلف والرطوبة النسبية وصحة أمعاء فروج اللحم (Ross308)

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الكلمات المفتاحية:
الفحم الحيوي ، بكتريا حامض اللاكتيك ، الفرشة

الخلاصة

أجريت هذه الدراسة لمعرفة تأثير إضافة الفحم الحيوي الى العليقة و الفرشة على معدل استهلاك العلف والرطوبة النسبية وصحة أمعاء فروج اللحم (Ross308). استخدم في التجربة 300 طائر فروج لحم ((Ross 308 بعمر يوم واحد, ووزعت عشوائياً على 5)) معاملات لكل معاملة (3) مكررات بواقع (20) طيراً لكل مكرر وبمعدل وزن (39.7)± غم. المعاملة الأولى T1:(بدون إضافة الفحم الحيوي الى العلف أو الفرشة)،المعاملة الثانيه2 :T2) كغ فحم حيوي/ 100كغ علف) الى العلف ،المعاملة الثالثة:4 T3) كغ فحم حيوي/ 100كغ علف) الى العلف ،المعاملة الرابعة:2 T4) كغ فحم حيوي/ 100كغ فرشة)الى الفرشة ،المعاملة الخامسة:4 T5) كغ فحم حيوي/ 100كغ فرشة)الى الفرشة. اشارت نتائج التحليل الاحصائي لمعدل استهلاك العلف الاسبوعي الى تفوق معنوي لمعاملات اضافة الفحم الحيوي في العلف على معاملات اضافة الفحم الحيوي الى الفرشة ومجموعة السيطرة . اما نتائج الصفات الميكروبية فقد بينت ان معاملات اضافة الفحم الحيوي الى العلف سجلت افضل النتائج مقارنة مع مجموعة اضافة الفحم الحيوي الى الفرشة ومجموعة السيطرة ، حيث سجلت انخفاض في اعداد بكتريا القولون وزيادة اعداد بكتريا حامض اللاكتيك . بينما اشارت نتائج الرطوبة النسبية ان اضافة الفحم الحيوي الى معاملات الفرشة سجلت افضل النتائج مقارنة بمجموعة اضافة الفحم الحيوي الى العلف ومجموعة السيطرة .