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Effect of biochar on growth performance, gas concentration and broiler leg health of broilers

ABSTRACT

This experiment was conducted to investigate the effect of adding biochar to the diet and litter on growth performance, gas concentration, hock burning and dermatitis in the foot pads of broilers. In the experiment, 300 One day old chicks were randomly distributed to 5 treatments 3 replicates each treatment , with (20) birds .T1: as control treatment. T2: (2) kg biochar / 100 kg feed). T3: (4 kg biochar l / 100 kg feed). T4: (2 kg biochar / 100 kg litter). T5: (4 kg biochar / 100 kg litter) . The results of the statistical analysis of the average live body weight and feed conversion factor of broilers showed a significant superiority of the treatments with added biochar to the feed compared to the treatments with added biochar to the litter and the control group. While the results for ammonia gas NH3 levels, the hock burn and footpad dermatitis suggested that the addition of biochar to the litter treatments produced the best results compared to the biochar-added diet group and the control group.

INTRODUCTION

Poultry is the second most consumed meat globally and global consumption is still persistent and high in developing countries as it is a high quality and inexpensive source of protein (Chai et al., 2017; Marty, 2021) and in Vietnam (2017) due to human health concerns related to antibiotic-resistant microbes and the presence of antibiotic residues in animal products (Marshal and Levy, 2011). Therefore, many studies have been conducted to find alternatives to antibiotics in animal rations to find alternative ways of suppressing pathogen burden and maintaining production output as an alternative to antibiotic use, Biochar-modified diets have shown their ability to control poultry pathogens (Prsai et al., 2016).The use of biochar has grown in popularity over the last 10 years, has properties similar to charcoal and activated charcoal and is derived from carbon-rich organic materials and produced by pyrolysis (Man, et al., 2021). The International Biochar initiative defines

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biochar as a solid material obtained from the thermochemical conversion of biomass in an oxygen-limited environment (Giwa, 2019). Most notably, biochar, which is used in Japan and China as a dietary supplement to improve digestion (EBC, 2012). In vivo weight increased the feed conversion ratio (FCR) of broilers and ducks (Ruttanavut et al. 2009; Kana et al., 2010; Prasai et al., 2016). The incidence and severity of pad dermatitis (FPD) is a major concern for the broiler industry, not only in terms of product quality (Bilgili et al., 2008). but also from an animal welfare point of view (Bradshaw et al., 2002). FPD lesions are usually superficial in nature, but may lead to pain and discomfort in the bird when they turn into deep sores. The occurrence of FPD is now used as an objective audit criterion in assessing the welfare of poultry production systems in both Europe and the United States (Cengiz, et al., 2011). Biochar is widely used in commercial poultry production to improve litter quality and reduce ammonia gas formation on a large scale in broiler litter (Linhoss, et al., 2019). Maintaining litter moisture levels between 20 and 30% in modern commercial poultry houses is a critical part of poultry management and important to achieve flock production potential, and high litter moisture levels can lead to frequent footpad and hock skin inflammation shared and increased production of ammonia, which is detrimental to bird performance and health (Bilgili et al., 2009).

MATERIALS AND METHODS

This field experiment was conducted in Poultry farm, Department of Animal Production – College of Agriculture – Tikrit University for the period from (9/18/2021) to (10/23/2021), The study included (5) treatments and each treatment contained (3) replicates of (20) birds/replicate and the birds were randomized among the treatments and the transactions were as follows. T1: Without the addition of biochar in feed and bedding. T2: (2 kg biochar / 100 kg feed). T3: (4 kg biochar / 100 kg feed). T4: (2 kg biochar / 100 kg litter). T5: (4 kg biochar / 100 kg litter) .

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

Feed ingredients	Starter (1-10)days	Growth (11-24)days	Finisher (25-35)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	-	0.05
Salt	0.25	0.25	0.25
total summation	100	100	100
Chemical composition			
Energy (kilocalories/kg of feed)	3000	3100	3200
Crude protein (%)	23.00	21.5	20
Crude Fiber (%)	2.73	3.56	3.36
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 hall was cleaned of dirt with water and detergents, then left open to dry, then disinfected with formalin as an antivirus, then sprinkled with rice husks at (10) cm depth and cooling was used (desert cooling) to bring the temperature in the hall up 32°C, and then gradually reduce the temperature suitable for the chicks. At a rate of 2 C per week, the lighting in the hall was continuous (24 hours) and ordinary amber lamps were used for this purpose. The birds were fed the starter ration from day one to (10) days of their lives, then they were fed the growth broth from (11–24) days, then they were fed the final ration until (35) days, which became the ration manufactured at the feed processing plant of the Faculty of Agriculture - Department of Animal Production, in addition to their components and premixes * used in their composition and Table (1) shows the components of these relations with their chemical analysis:

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 -Average live body weight (gm/bird/week):

The results shown in Table (2) showed the standard error of the mean live body weight of the experimental treatments, and there were significant differences ($p<0.05$) in the body weight between the biochar-added groups and the control group. It is noted that significant superiority was obtained for the second and third addition treatments.

Table (2): Effect of adding biochar to feed and litter on the weekly live body weight of broilers (gm)

Treatment	Weekly body weight (gm)				
	WEEK 1	WEEK 2	WEEK 3	WEEK 4	WEEK 5
T1 Control	152.68 a 4.22±	363.66 b 4.07±	914.25 b 16.25±	1427.50 b 24.66±	1897.67 c 22.04±
T2 (2kg of biochar / 100 kg of feed)	156.40 a 1.15±	384.83 a 3.97±	976.50 a 3.96±	1550.17 a 17.32±	2104.17 a 20.48±
T3 (4kg of biochar / 100 kg of feed)	150.86 a 1.93±	374.75 a 5.16±	994.33 a 13.63±	1506.70 a 16.00±	1999.92 a 21.30±
T4 (2kg of biochar / 100 kg of litter)	153.16 a 2.33±	372.33 b 1.92±	925.91 b 9.76±	1431.50 b 22.58±	1865.25 c 17.80±
T5 (4kg of biochar / 100 kg of litter)	150.66a 2.61±	367.30 b 2.36±	929.83 b 1.26±	1425.00 b 16.64±	1955.00 b 13.22±
Significant level	N.S	*	*	*	*

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

Average body weight was recorded as (384.83) (374.75) g/bird compared to the two groups added to the litter which recorded (372.33) and 367.30) g/bird, respectively, and the Control (363.66) g/bird from 2nd to 5th week. On the other hand, the results of the study indicated that the addition

of biochar to the feed had the best live weight rate compared to the addition treatments to the litter. This may be due to charcoal's crucial role in improving gastrointestinal health by improving the microbiome and improving nutrient digestion. And it results in biochar's ability to reduce toxins and eliminate them from the body through excretions (Hien et al., 2018). These results agreed with the results of Jiya et al. (2013) reported that the best body weight rate was recorded when biochar was added to the feed at a rate of (2)%. These disagreed with Ardcorp (2014) who found that the addition of 0.5 and 1% biochar did not record significant differences in body weight and attributed this to the variety of biochar used.

Feed conversion factor(gm/bird/week): 2-

Table (3) shows the results of the statistical analysis of the effect of adding biochar to feed and litter on the feed conversion factor ± standard error for the weeks of the experiment, as we note that there were no significant differences at the level ($p<0.05$) between treatments during the first and second weeks, while the results showed that The treatments of adding biochar to the feed recorded the best rate of the feed conversion factor compared to the control group during the third week, and there were no significant differences between the treatments of adding litter compared with the control treatment. The results of the fourth and fifth week also recorded the best rate of the feed conversion factor in favor of the second treatment compared to the treatments Mattress and control treatment The results of the total period also showed the best food conversion factor for the two treatments of adding biochar to the feed compared to the two treatments of adding biochar to the litter, and the control treatment. These results did not agree with what was stated by Kalus (2020), who used biochar in the litter at a rate of (2) and 4%, as he noticed an increase in the feed conversion factor by (8%)and these results did not agree with what was stated by Ardcorp (2014) when using biochar at a ratio of(0.5) and (1)%, which did not record any significant differences.

Table (3): The effect of adding biochar to the feed and litter on the weekly feed conversion factor of broilers (gm)

Treatment	weekly feed conversion factor					Total
	Week1	Week2	Week3	Week4	Week5	
T1 (the control)	1.33 0.05±	1.33 0.10±	1.25 a 0.03±	1.50 a 0.10±	1.76 a 0.09±	1.46 a 0.02±
T2 (2) kg of biochar / 100 kg of diet)	1.32 0.03±	1.46 0.07±	1.08 b 0.02±	1.26 b 0.07±	1.44 b 0.06±	1.28 b 0.02±
T3 (4) kg of biochar l / 100 kg of diet)	1.33 0.02±	1.50 0.08±	1.06 b 0.02±	1.48 a 0.02±	1.61 ab 0.06±	1.38 b 0.03±
T4 (2) kg of biochar / 100 kg of litter)	1.28 0.01±	1.34 0.03±	1.17 ab 0.04±	1.59 a 0.04±	1.98 a 0.11±	1.51 a 0.01±
T5 (4) kg of biochar / 100 kg of litter)	1.34 0.03±	1.37 0.05±	1.17 ab 0.02±	1.54 a 0.06±	1.62 ab 0.04±	1.42 a 0.01±
morale level	N.S	N.S	*	*	*	*

3- NH_3 Concentration

Table (4) shows the effect of adding biochar to feed and litter on the concentration of ammonia gas (ppm) in the broiler field for the period from the first week to the fifth week of the experiment when the results of the statistical analysis for the first week and the second week showed that there were no significant differences ($p<0.05$) between treatments as there was no increase in ammonia gas levels in the field during this period, while the third week showed a significant decrease in ammonia gas levels for the treatments (second, third, fourth and fifth) that recorded (0.2 and 0.13, 0.1 and 0.1) compared to the control treatment, respectively, The results of the statistics The analysis for the fourth and fifth Week 1 showed a significant decrease at the fifth treatment when the lowest value recorded which was (0.43 and 0.80 respectively) and the control treatment on The increases in ammonia gas levels recorded were (1.2 and 2.7) for the fourth and fifth weeks, respectively. Compared to the remaining treatments (second, third and fourth), respectively (0.73, 0.66 and 0.60) for the fourth week and (1.16, 0.96 and 0.86) for the fifth week recorded. The results of the study showed that adding biochar to the litter gave the best results compared to the treatments adding it to the feed. These results are consistent with the finding by Kalus (2020) that the use of biochar in litter results in a significant reduction (2 and 4%) in ammonia emissions.

Table (4): Effect of adding charcoal to feed and litter on the concentration of ammonia gas for broilers

Treatment	Duration in weeks				
	Week 1	Week 2	Week 3	Week 4	Week 5
T1 (the control)	0a	0a	0.53 a 0.08±	1.20 a 0.05±	2.70 a 0.11±
T2 (2 kg of biochar / 100 kg of feed)	0a	0a	0.20 b 0.05±	0.73 b 0.08±	1.16 b 0.14±
T3 (4 kg of biochar / 100 kg of feed)	0a	0a	0.13 b 0.03±	0.66 b 0.12±	0. 96 b 0.08±
T4 (2) kg of biochar / 100 kg of litter)	0a	0a	0.10 b 0±	0.60 b 0.05±	0.86 b 0.12±
T5 (4 kg of biochar / 100 kg of litter)	0a	0a	0.10 b 0±	0.43 b 0.12±	0.80 b 0.11±
Significant level	N.S	N.S	*	*	*

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

4- leg health:

A-the soles of the feet

Table (5) gives the effect of adding biochar to feed and litter on the soles of feet of broilers aged (5) weeks when the results of statistical analysis in the degree of injury (0) since healthy footsoles indicate significant superiority ($p<0.05$) for the fourth and fifth treatments, which scored (85.66) and (84.33) for all treatments, the second and third treatments, respectively , which scored (66.66) and (60.00), respectively, recorded significant superiority over the control treatment, which scored (58.33). injury degree No. (1) as superficial or slight lesion of the sole of the foot, the control treatment and the second and third treatments showed significant superiority to the fourth and fifth treatments in injury degree No. (1) and showed none significant differences for all treatments in injury grade (2, 3, and 4) for non-emergence scores compared to the food-added group and the control group. These results agree with what was reported by Linhoss et al. (2019) the addition of biochar at a level of (10-20)% to pine mulch in the bedding of rearing broilers reduced the levels of

inflammation of the soles of the feet. It was also consistent with the statements of Albiker and Zweifel (2019) as they found that when both (fermented biochar product) and (pure biochar) were added to the diet, both treatments reduced the inflammation of the soles of the feet by 92% compared to the control group.

Table (5) Effect of adding biochar to feed and litter on the soles of the feet of broilers at 5 weeks of age.

Treatment	degree of injury (%)				
	WEEK 1	WEEK 2	WEEK 3	WEEK 4	WEEK 5
T1 Control	58.33 c 3.33±	35.00 a 2.88±	0.00 a 0.00 ±	0.00 a 0.00 ±	0.00 a 0.00 ±
T2 (2kg of biochar / 100 kg of feed)	66.66 b 2.18±	29.33 a 2.18±	0.00 a 0.00 ±	0.00 a 0.00 ±	0.00 a 0.00 ±
T3 (4kg of biochar / 100 kg of feed)	60.00 b 1.52±	27.33 a 2.60±	0.00 a 0.00 ±	0.00 a 0.00 ±	0.00 a 0.00 ±
T4 (2kg of biochar / 100 kg of litter)	85.66 a 2.33±	14.33b 2.33±	0.00 a 0.00 ±	0.00 a 0.00 ±	0.00 a 0.00 ±
T5 (4kg of biochar / 100 kg of litter)	84.33 a 2.33±	15.66b 2.33±	0.00 a 0.00 ±	0.00 a 0.00 ±	0.00 a 0.00 ±
Significant 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 ($p < 0.05$).

B-the hock joint

Table (6) shows the effect of adding biochar to the diet and litter on the hock joints of broilers at 5 weeks of age as the results of statistical analysis in injury grade No. (0) as healthy skin reported for the ankle until Significant superiority at the level ($p<0.05$) of the fourth treatment, which scored (84.00) over all treatments with no significant differences to the second and fifth treatments, which scored 75.66) and 83.33, respectively. The third treatment, which scored 73.33 points, outperformed the control treatment, which scored 60.00 points)). Regarding injury grade No. (1) as mild signs of ankle burn of less than half of the ankle area, no significant differences occurred between all treatments and no significant differences occurred. For all treatments at infection levels (2, 3 and 4) for non-emergence, the results of the study showed that adding biochar to the litter produced better results compared to the group adding biochar to the feed and the control group. These results are consistent with the statements of Albiker and Zweifel (2019) who found that when both (fermented biochar product) and (pure biochar) were added to the diet, both treatments reduced ankle inflammation by 74% compared to controls.

Table (6): Effect of adding biochar to feed and litter on the hock joint of broilers at 5 weeks of age

Treatment	Degree of injury (%)				
	WEEK 1	WEEK 2	WEEK 3	WEEK 4	WEEK 5
T1 Control	60.00c 5.77±	21.66a 1.66±	0.00 a 0.00 ±	0.00 a 0.00 ±	0.00 a 0.00 ±
T2 (2kg of biochar / 100 kg of feed)	75.66ab 1.45±	16.00 a 0.57±	0.00 a 0.00 ±	0.00 a 0.00 ±	0.00 a 0.00 ±
T3 (4kg of biochar / 100 kg of feed)	73.33 b 2.72±	16.66 a 2.40±	0.00 a 0.00 ±	0.00 a 0.00 ±	0.00 a 0.00 ±
T4 (2kg of biochar / 100 kg of litter)	84.00 a 0.57±	19.33 a 1.76±	0.00 a 0.00 ±	0.00 a 0.00 ±	0.00 a 0.00 ±
T5 (4kg of biochar / 100 kg of litter)	83.33ab 2.40±	21.00 a 1.52±	0.00 a 0.00 ±	0.00 a 0.00 ±	0.00 a 0.00 ±
Significant level	*	N.S	N.S	N.S	N.S

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

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 feed were significantly superior to the treatments of adding biochar to the litter and the control group significantly at the level ($P \leq 0.05$).
2- The treatments of adding biochar to the litter significantly reduced at the level ($P \leq 0.05$) both foot inflammation and achilles joint compared to the treatments of adding biochar to the feed and the control group.
3- The addition of biochar within the levels used in the litter led to a significant decrease ($P \leq 0.05$) in the level of ammonia gas.

REFERENCES

Albiker, D., & Zweifel, R. (2019). Wirkung von Pflanzenkohle im Futter oder in der Einstreu auf den Stickstoffgehalt in der Einstreu bei Broilern. Innovatives Denken für eine nachhaltige Land-und Ernährungswirtschaft. Beiträge zur 15. Wissenschaftstagung Ökologischer Landbau, Kassel, 5. bis 8. März 2019.

ARDCorp, B. C. (2014). Investigating Benefits of Supplementing Broiler Feed with Broiler Litter Biochar.

Bilgili, S. F., Hess, J. B., Blake, J. P., Macklin, K. S., Saenmahayak, B., & Sibley, J. L. (2009). Influence of bedding material on footpad dermatitis in broiler chickens. Journal of Applied Poultry Research, 18(3), 583-589.

Bilgili, S. F., Zelenka, D., & Marion, J. E. 2008. Quality standards for chicken feet (paws) during processing. In Proc. World's Poultry Congress, Brisbane, Australia [CDROM]. World's Poultry Science Association (WPSA), Beekbergen, the Netherlands .

Bradshaw, R. H., Kirkden, R. D., & Broom, D. M. 2002. A review of the aetiology and pathology of leg weakness in broilers in relation to welfare. Avian and poultry biology reviews, 13(2), 45-104 .

Cengiz, Ö., Hess, J. B., & Bilgili, S. F. 2011. Effect of bedding type and transient wetness on footpad dermatitis in broiler chickens. Journal of Applied Poultry Research, 20(4), 554-560.

Chai, S. J., Cole, D., Nisler, A., & Mahon, B. E. (2017). Poultry: The most common food in outbreaks with known pathogens, United States, 1998–2012. Epidemiology & Infection, 145(2), 316-325 .

Duncan, D.B. (1955). Multiple range and multiple "F99 test Biometrics. II: 1-2.

EBC, H. (2012). European Biochar Certificate–Guidelines for a Sustainable Production of Biochar, European Biochar Fondation (EBC), Arbaz, Switzerland .

Giwa, A., Yusuf, A., Ajumobi, O., & Dzidzienyo, P. (2019). Pyrolysis of date palm waste to biochar using concentrated solar thermal energy: Economic and sustainability implications. Waste Management, 93, 14-22.

Hien, N. N., Dung, N. N. X., Manh, L. H., & Le Minh, B. T. (2018). Effects of biochar inclusion in feed and chicken litter on growth performance, plasma lipids and fecal bacteria count of Noi lai chicken. Livestock Research for Rural Development, 30.(7)

Kalus, K., Konkol, D., Korczyński, M., Koziel, J. A., & Opaliński, S. 2020. Effect of biochar diet supplementation on chicken broilers performance, NH3 and odor emissions and meat consumer acceptance. Animals, 10(9), 1539.

Kana, J. R., Teguia, A., & Tchoumboue, J. (2010). Effect of dietary plant charcoal from Canarium schweinfurthii Engl. and maize cob on aflatoxin B1 toxicosis in broiler chickens. Advances in Animal Biosciences, 1(2), 462.

Linhoss, J. E., Purswell, J. L., Street, J. T., & Rowland, M. R. (2019). Evaluation of biochar as a litter amendment for commercial broiler production. Journal of Applied Poultry Research, 28(4), 1089-1098.

Man, K. Y., Chow, K. L., Man, Y. B., Mo, W. Y., & Wong, M. H. (2021). Use of biochar as feed supplements for animal farming. Critical Reviews in Environmental Science and Technology, 51(2), 187-217.

Marshall, B. M., & Levy, S. B. (2011). Food animals and antimicrobials: impacts on human health. Clinical microbiology reviews, 24(4), 718-733.

Marty, C. A. (2021). Evaluating the effects of pine and miscanthus biochar on water activity and Escherichia coli populations in commercial broiler litter (Doctoral dissertation, Mississippi State University).

NRC. 1994. Nutrient requirement of poultry.9TH edition. National Academy Press. Washington. D.C.USA.

Prasai, T. P., Walsh, K. B., Bhattarai, S. P., Midmore, D. J., Van, T. T., Moore, R. J., & Stanley, D. (2016) Biochar, bentonite and zeolite supplemented feeding of layer chickens alters intestinal microbiota and reduces campylobacter load. PLoS One, 11(4), e0154061.

Ruttanavut, J.; Yamauchi, K.; Goto, H.; Erikawa T. (2009). Effects of Dietary Bamboo Charcoal Powder Including Vinegar Liquid on Growth Performance and Histological Intestinal Change in Aigamo Ducks. International Journal of Poultry Science.;8(3):229–36.

SAS Institute . (2001). SAS User's Guide : Statistics Version 6.12ed . SAS Inst. Inc., Cary, NC., USA..

عمر إبراهيم أحمد عمر الجميلي طارق خلف حسن الجميلي

قسم الانتاج الحيواني - كلية الزراعة - جامعة تكريت - العراق

الخلاصة

أجريت هذه التجربة لدراسة تأثير إضافة الفحم الحيوي في العليقة والفرشة على أداء النمو وتركيز الغازات وحرق العرقوب والتهاب الجلد في وسادة القدم لفروج اللحم .استخدم في التجربة 300 طائر فروج لحم ((Ross 308 بعمر يوم واحد غير مجنسة, ووزعت عشوائياً على 5)) معاملات لكل معاملة (3) مكررات بواقع (20) طيراً لكل مكرر.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 وزن الجسم الحي ومعامل التحويل الغذائي لفروج اللحم الى تفوق معنوي لمعاملات اضافة الفحم الحيوي في العلف على معاملات اضافة الفحم الحيوي الى الفرشة ومجموعة السيطرة. بينما اشارت نتائج التحليل لكل من مستوى غاز الامونيا والتهاب باطن القدم والتهاب مفصل العرقوب الى ان اضافة الفحم الحيوي الى معاملات الفرشة سجلت افضل النتائج مقارنة بمجموعة اضافة الفحم الحيوي الى العلف ومجموعة السيطرة .

الكلمات المفتاحية:
غازالأمونيا،الفحم الحيوي،الافراخ