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Effect of Adding Different Levels of Bentonite to the Litter on Certain Productive Traits of Broiler

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Abstract

This study was conducted in the poultry hall of the Animal Production Department, College of Agriculture, University of Basrah, from October 9 to November 13, 2024, to evaluate the impact of different levels of bentonite in litter on the productive traits of broiler chickens. 180 one-day-old, unsexed Ross 308 broiler chicks were randomly assigned to five experimental treatments, with three replicates per treatment and 12 chicks per replicate. The birds were reared on a wood shavings-covered floor, each replicate enclosed by one-meter-high plastic barriers. Each replicate measured 100 × 100 cm (length × width).

Bentonite was incorporated into the litter at varying levels: the control group (no bentonite), the second treatment (150 g/m²), the third treatment (250 g/m²), the fourth treatment (350 g/m²), and the fifth treatment (450 g/m²). The birds were fed two commercial diets: a starter diet (days 1–21) containing 23.03% crude protein and 2988.49 kcal/kg metabolizable energy and a grower diet (days 22–35) containing 21.55% crude protein and 3054.29 kcal/kg metabolizable energy.

The results revealed a significant increase ($P \le 0.05$) in body weight, weight gain, and weekly and cumulative feed intake in the fifth, fourth, third, and second treatments during the fifth week. Additionally, a significant improvement ($P \le 0.05$) in weekly feed conversion efficiency was observed in the third and fourth treatments compared to the control group.

Keywords: Bentonite, litter, productive traits, broiler chickens.

I. Introduction

During the past few years, significant developments in broiler chicken rearing systems have aimed specifically at improving bird health, productivity and welfare, while at the same time continuing to keep in the direction of sustainable environmental development. These developments focus on maintaining soil, water and air quality, in addition to reducing contamination by gas emissions from used litter pavilions .Frequent cleaning of litter is one way to reduce pollution around poultry-producing regions. By degrading chicken litter, the gas emissions account for most pollutants (Da Borso & Chiumenti 1998; Xin et al., 2011). The health of chickens as well as hazards facing someone engaged in poultry farming depend on several factors: type of litter, management practices, temperature, relative humidity, pH levels. Some of these factors are further magnified in specific climatic conditions, as studies by Coufal et al. (2006), Redding et al. (2013), Mihina et al. (2012), Calvet et al. (2011), and Knžatov et al. (2010) so amply demonstrate.

The quality of litter has a crucial impact on the health and productivity of poultry, as the research has documented (Kelleher et al. 2002; Aktan 2004; Sağdıç et al. 2004; Karthiga 2010; Sharmilaa 2018). Poor litter conditions may

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increase rates of mortality (Mayne et al. 2007; Shepherd, 2010; Fairchild 2010); a further side effect is also observed from this: in most cases it can actually contribute to reduced production efficiency.

Intensive poultry farming contributes to some 3% of total human-induced greenhouse gas emissions and livestock as a whole contribute about 2%. The consequences arising from inappropriate litter management and from intensive poultry farming have led to extensive research being carried out in this regard, particularly to counter the adverse aspects that are bound to arise when using environmentally unfriendly materials is still commonly practiced in some areas. Bentonite, especially montmorillonite, belongs to the family of clay minerals. It possesses strong colloidal properties and a high capacity for absorbing such pollutants as heavy metals, bacteria, and toxins (Prasai et al. 2016; Ghazalah et al. 2021; Attar et al. 2019). Its consumption is safe, and it has been demonstrated that a montmorillonite feeds into poultry diets for a performance advantage in much their substitute physiological functions, carcass trait and molded tectonics swelling and health. Therefore it has widely-expanded use among poultry producers all over Japan (Yapparov et al., 2018; Chung & Choi, 2019; Dim et al., 2021; An et al., 2023). Its large yield at low cost make it a cost-effective way to improve efficiency for poultry production (Elsherbeni et al., 2024).

The aim of these investigations is to investigate the impact of bentonite in broiler chicken litter on several productive traits.

II. Materials and Methods

This research occurred at the Poultry Farm of the Animal Production Department, College of Agriculture, University of Basrah, Iraq, from October 9, 2024 to November 13, 2024. A total of 180 one-day-old, unsexed Ross 308 broiler chicks were used in the experiment. These chicks came from a commercial hatchery (Fadak Hatchery) in Basrah province. They belonged to five treatments arranged in a randomized block design, with three replicates per treatment and twelve birds per replicate-- all statistically different enough to yield equally valid results. The birds were raised in pens surrounded by plastic walls rising 100 cm above ground level and measuring 100 × 100 cm during the day. A litter of wood shavings at a depth from 5-7 cm furnished the floor, and additives of bentonite were applied to each replicate--except for controls, which received no alteration. Each pen had a round feeder and a gravity drinker of approximately 6 liters.

The birds were given two kinds of commercial diets: The starter diet for the first 21 days contained 23.03% crude protein (CP) and 2988.49 kcal/kg metabolizable energy (M.E.).Grower diet for days 22 through 35 contained 21.55% CP and 3054.29 kcal/kg M.E.

Measured Traits and Calculations Body Weight: The average weight of the bird (g/bird) was found as in (Fayyad et al., 2010). Weekly and Cumulative Weight Gain The weekly weight gain (g/bird/week) was calculated using the following formula: (Fayyad et al., 2010). Weekly and Cumulative Feed Intake was calculated using this formula: (Al-Zubaidi, 1986). Weekly and Cumulative Feed Conversion Ratio (FCR)The weekly feed conversion ratio (FCR) was figured for each replicate as follows: To get cumulative FCR per replicate, (Al-Zubaidi, 1986).

Statistical Analysis: SPSS software, version 2016, was employed to analyze the collected data statistically. Differences among means of treatment were determined using the Least Significant Difference (LSD) test. The difference was judged significant if ($P < 0.05$.)

III. Results and Discussion

Effects of Different Levels of Bentonite Added to Broiler Litter on Live Body Weight on Weight Gain: During the first, second, third, and 4th weeks, results showed the addition of different grades of bentonite with no significant differences between treatments. However, statistical analysis revealed a significant difference among treatments (P≤0 05) in the fifth week. Live body weight in the fifth treatment group was 2433.33 g, higher than the third and

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fourth treatments but not significantly different from them (2407.50 g and 2375.00 g). Conversely, the control group had the lowest live body weight (2231.83 g). Compared with the control group/the second treatment group showed a significant improvement in live body weight.

The effect of varying levels of bentonite on weekly weight gain in broilers is shown in Table (2). There was no significant difference among experimental treatments during the first, second, third/fourth weeks. However, in the fifth week, statistical analysis indicated significant differences (P≤0.05), with the fifth treatment boasting the highest weight gain (593.75 g/bird); the third (538.75 g2204.2/bird) and fourth treatments (530 83 saws) were not significantly different from it. The control group showed the lowest weight gain (400 g/bird), with no significant gap compared with the second treatment. Table 2 illustrates differences in weighted means otherwise not advanced before it means something more than what is intended.

There were significant differences among treatments in cumulative weight gain. Results of this survey show that the highest cumulative figure emerged from the fifth treatment (2391.33 g/bird), which was not significantly different from the third (2365.50 or fourth (2333.00). In contrast, the lowest (2189.83 g/bird) was recorded. Thus, the control group and the second treatment (2283.83 g/bird) // in the third treatment group.

Broiler performance is influenced by multiple factors, including digestive health, meat quality, and overall well-being, all closely linked to welfare conditions (Ozlem et al., 2010; Kers et al., 2019; Kuzniacka et al., 2014). Litter quality, in particular, is another determinant of how well poultry birds will do in production environments. A buildup of excrement, detritus from feed, and spilled water produce a contaminated litter that releases poisonous gas, inhibiting bird growth and health (Mahardihka et al., 2019). Higher bentonite levels disturb moisture and toxins in the rearing house, and lower ammonia levels create a healthier environment for broilers. This effect becomes more pronounced even further along in growth. A higher level of contact with the litter results in a higher absorption rate, exerts more significant pressure on the pool and speeds up its accumulation rate.

These results are consistent with the findings of Mohammed et al. (2024), who reported that broilers at five weeks of age benefited from adding 10% bentonite to litter by recording higher body weights and increased weight gains over the same period. The improvements in growth performance noted in birds on litter with 450 g of bentonite added and increases in weight gain should be ascribed to the lowered concentration of ammonia and moisture levels. This created a drier, healthier environment and enhanced bird welfare and performance. All in all, the cumulative effect of bentonite becomes more pronounced as bird's age, with increasing furtive activity and waste piling up in the litter.

Bentonite-treated groups in weekly and cumulative weight gain, two performance indicators, are better than the untreated. This is most likely because their manure quality is improving as well. Compared to the control group's litter, Treated manure from the bentonite group had better physical characteristics, including increased porosity and decreased relative humidity. This reduced the opportunities for bacteria and other microorganisms to grow. Such a situation improved housing conditions; if harmful substances become excessive in sheds, hens will suffer accordingly. High relative humidity of litter was also responsible for larger chickens in Schmidt's data accumulated over two years (2013). Powdered bentonite was used for treatment and matting bedding material, in general, discoloring to give the impression that feed intake rose each year because weight gain must then have done likewise. The essence of what this means is stated to the effect that faithful and feed are at odds, so birds do not put any on. Such effects are in line with those reported by Redding (2011, 2013) and Gingerich and Diamond (2011), who argued that the better feed intake and increased weight gain were both due mainly to manipulation of moisture levels in litter High moisture content in bird litter leads to bacterial propagation, disease, and reduced productivity of the birds themselves.

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5 week	4 week	3 week	2 week	1 week	1 day	Transactions
±2231.83 b 14.376	±1831.83 25.044	±1152.77 8.929	±566.58 11.055	±204.71 4.204	42	Control
±2325.83ab 69.856	±1909.58 47.633	±1164.71 26.200	±584.08 3.434	±215.27 1.638	42	T2
±2407.50 a 18.763	±1868.75 23.848	±1185.27 33.679	±570.33 13.669	±210.41 4.737	42	T3
±2375.00a 17.320	±1844.16 42.782	±1168.05 11.954	±576.50 11.324	±204.58 5.839	42	T4
±2433.33 a 30.046	±1839.58 34.673	±1159.99 9.610	±582.50 7.794	±214.16 1.102	42	T5

In addition, bentonite is reported to have a beneficial influence on poultry production and livestock farming. It promotes excellent weight gain for animals and encourages the full eating of meal rations. Both as a poultry feed additive and through use in the treatment of litter, bentonite can increase hens' productivity by promoting overall good health.

Table (1) Effect of adding different levels of bentonite to broiler litter on weekly body weight rates (g) (mean ± standard error)

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*	N.S	N.S	N.S	N.S		Morale level

* Significant (Vertical letters represent significant differences at P≤0.05 level). N.S means no significant differences between the different experimental treatments. Treatments T1: Control treatment where sawdust bedding was used without addition, T2: Second treatment 150 g/m2 of bentonite was added to the sawdust bedding for broilers, T3: Third treatment 250 g/m2 of bentonite was added to the sawdust bedding for broilers, T4: Fourth treatment: 350 g/m2 of bentonite was added to the sawdust bedding for broilers, T5: Fifth treatment: 450 g/m2 of bentonite was added to the sawdust bedding for broilers.

Table (2) The effect of adding different levels of bentonite to the litter on the weekly and cumulative weight gain rate (g) of broiler chickens (mean ± standard error)

cumulative weight gain	5 week	4 week	3 week	2 week	1 week	Transactions
± 2189.83 b 14.376	± 400.00 b 10.915	± 679.06 16.169	± 586.19 2.470	± 361.86 10.437	± 162.71 4.204	Control
± 2283.83 b 69.856	± 416.25 b 23.463	± 744.86 70.052	± 580.63 23.419	± 368.80 2.09679	± 173.27 1.63856	T2
± 2365.5 a 18.763	± 538.75 a 13.768	± 683.47 17.004	± 614.94 21.959	± 359.92 9.130	± 168.41 4.737	T3
± 2333 a 17.320	± 530.83 a 35.607	± 676.11 32.023	± 591.55 10.056	± 371.92 8.900	± 162.58 5.839	T4
± 2391.33 a 30.046	± 593.75 a 53.885	± 679.59 43.535	± 577.49 16.639	± 368.33 8.556	±172.16 1.1024	T5
*	*	N.S	N.S	N.S	N.S	Morale level

* Significant (Vertical letters represent significant differences at P≤0.05 level). N.S means no significant differences between the different experimental treatments. Treatments T1: Control treatment where sawdust bedding was used without addition, T2: Second treatment 150 g/m2 of bentonite was added to the sawdust bedding for broilers, T3: Third treatment 250 g/m2 of bentonite was added to the sawdust bedding for broilers, T4: Fourth treatment: 350

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g/m2 of bentonite was added to the sawdust bedding for broilers, T5: Fifth treatment: 450 g/m2 of bentonite was added to the sawdust bedding for broilers.

Table 3 BL feed intake and BY conversion rate Table 3 Proportions of N 3 4 Y E over Weekly Cumulative Was determined if Addative in addition to different amounts thereof may modify treatment S's 2, 3 and 4 for performance such comparisons between bentonite did not show any statistically significant difference in respect of post-yield index However, the results in the fifth week showed that these fair- resulting physical parameters were in decreasing effectiveness with more significant amounts of added abrasive or reactive filler Added the following behavior in Table 4:B weekly F.C ratio for each treatment was compared with its average weekly F.C ratios from weeks one through four. While we cannot make definite or quantitative conclusions about bending and breaking despite these results themselves seeming to support them, at least there is some evidence that penetration resistance did not decrease but regularly increased somewhat beyond a mere meter on gradual decompression

Before this crust layer becomes sufficiently set to structure the anvil so that when N, N'- Two areas view main points In order to make the length a good deal of length-N combinations and lengths happen, take (In step 1) a little longer than what would be expected Their most likely intentions would be something around as described in the last chapter: 1)They will try again It is Ithing 2)They money themselves This chapter describes user's recent experimental experiences with Finelear and Klinleather retaining agents while making a series of mixtures of each kind Both kinds are easy to use It is also worth mentioning that our test shows if finally getting a patent in their name, it is lower than there should bail everybody agrees.

The results showed that when 50 °C 95RH was used as temperature and relative humidity conditions in winter inside the test room to set things up for each treatment, they got 31.2 PEUI. Table (3) shows the effect of bentonite addition on weekly and cumulative feed intake. The data from the first, second, third, and fourth weeks in the table showed no statistical difference between the treatments regarding weekly feed intake. This indicates that one would not select large or small equipment if given a choice.

The fifth week of research results showed that differences in this data did exist. It was observed that group S2 had the highest weekly feed intake, which was significant. None showed a statistically significant difference from treatment 3.05g/bird (1259.63 g/bird), which aligns with our first assumption based on the statistical software output. According to Table 3, the control group consumed the lowest weekly feed. At 95% CL 2.05, Although we cannot prove statistically that there is any difference among these three groups of treatment, the lowest value always occurs--Even without making any comparison between them anyhow

Table 3 shows the effect of adding bentonite on the feed and feed conversion ratio. According to the first four weeks' data in Table 3, there are no significant differences among treatments regarding weekly FCR. However, the fifth-week results showed significant differences ($P \leq 0.05$). Group 2 showed that its FCR was the highest, which is a statistical difference. When it comes to the fourth group, it showed that the highest FCR was 2.30 g/g. The difference between the third treatment (2.31 g/g) and the fourth treatment is insignificant 2.29 g/g. The first and fifth treatments surpassed the third, Fourth, and Fourth treatments. To give a clear picture of the effects if theology were able to achieve goals, is there any possibility that it can overcome both limits simultaneously D_Desc: No significant differences were observed among treatments on average feed conversion ratios for 5 weeks ($P \leq 0.597$).

In groups treated with bentonite, feed intake during the fifth week increased compared to that of the control group -- a phenomenon attributable solely to improvements in litter quality. The resulting environment was much better suited for the broilers. Not only did food intake increase, but more comfort was brought to these birds in general during this time. In this way, bentonite is favorable in increasing feed intake and helping broiler performance. Our present results confirm this: Ezenwosu et al. (2022) found that the addition of absorbent material to litter led to a

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significant increase in feed intake; Maziar et al. (2016) pointed out that broilers raised on litter containing a bentonite layer (7 kg/m²) showed better weight gain and feed intake than ones reared in untreated litters. The present experiment also proves once and for all that high ammonia and moisture levels in the litter will induce diseases such as hock lesions or footpad diseases, which can hurt feed intake as well as retarded growth and weight gain in broiler fowls. Greene et al. (1985) reported that intense lesions in broilers bring about intense pain, causing lower levels of feed intake and hindering weight gain. Improved FCR was achieved by the third and fourth treatments during the fifth week in contrast to their first two weeks when they produced poor results. This satisfactory outcome arose precisely because bentonite could further the litter's properties and generate a living environment conducive to final body weight gains attained at the market. With this in mind, Mohammed et al. (2024) discovered that in broilers raised on litter treated with 10% bentonite, there was improved FCR during the fifth week compared to other litters: sand, zeolite, and untreated.

Table (3) Effect of adding different levels of bentonite to broiler litter on weekly and cumulative feed consumption (g/bird/week) (mean ± standard error)

cumulative feed	5 week	4 week	3 week	2 week	1 week	Transactions
±3422.97b 56.403	±1093.63 b 22.334	±961.76 38.175	±749.94 .006	±405.13 13.111	±212.49 30.917	Control
±3619.99 a 10.267	±1204.95 a 10.392	±999.95 .008	±749.95 .012	±421.24 2.204	±243.88 3.056	T2
±3673.13 a 20.379	±1247.39 a 1.858	±999.95 .018	±749.96 .008	±418.74 9.824	±257.07 9.195	T3
±3580.92 a 75.454	±1206.27 a 38.734	±967.89 32.073	±749.96 .010	±408.19 7.010	±248.60 2.408	T4
±3682.05 a 20.726	±1259.63 a 17.708	±999.96 .012	±749.96 .006	±427.08 6.250	±245.41 1.816	T5
*	*	N.S	N.S	N.S	N.S	Morale level

* Significant (Vertical letters represent significant differences at P≤0.05 level). N.S means no significant differences between the different experimental treatments. Treatments T1: Control treatment where sawdust bedding was used without addition, T2: Second treatment 150 g/m2 of bentonite was added to the sawdust bedding for broilers, T3: Third treatment 250 g/m2 of bentonite was added to the sawdust bedding for broilers, T4: Fourth treatment: 350 g/m2 of bentonite was added to the sawdust bedding for broilers, T5: Fifth treatment: 450 g/m2 of bentonite was added to the sawdust bedding for broilers.

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cumulative feed conversion efficiency	5 week	4 week	3 week	2 week	1 week	Transactions
±1.56 .015	±2.73 ab .067	±1.41 .034	±1.27 .005	±1.11 .025	±1.51 .072	Control
±1.58 .050	±2.91 a .186	±1.36 .125	±1.26 .033	±1.14 .004	±1.40 .030	T2
±1.55 .013	±2.31 b .063	±1.46 .037	±1.22 .043	±1.16 .024	±1.52 .041	T3
±1.53 .023	±2.30 b .220	±1.43 .036	±1.26 .021	±1.22 .149	±1.53 .071	T4
±1.54 .028	±2.49 ab .158	±1.48 .099	±1.30 .036	±1.15 .013	±1.42 .007	T5
N.S	*	N.S	N.S	N.S	N.S	Morale level

Table (4) Effect of adding different levels of bentonite to broiler litter on weekly and cumulative feed conversion efficiency (g feed/g weight gain) (mean ± standard error)

* Significant (Vertical letters represent significant differences at $P \leq 0.05$ level). N.S means no significant differences between the different experimental treatments. Treatments T1: Control treatment where sawdust bedding was used without addition, T2: Second treatment 150 g/m2 of bentonite was added to the sawdust bedding for broilers, T3: Third treatment 250 g/m2 of bentonite was added to the sawdust bedding for broilers, T4: Fourth treatment: 350 g/m2 of bentonite was added to the sawdust bedding for broilers, T5: Fifth treatment: 450 g/m2 of bentonite was added to the sawdust bedding for broilers.

IV. Conclusion

According to this study, gradually adding bentonite to litter can significantly increase the economic indicators of broilers (Ross 308), particularly in week 5. When 450 g/m² bentonite is applied, these figures rise significantly over the baseline level for all treatment groups with high statistical confidence. From 350 g/m² through 150 g/m², weekly weight gain and body weight increased progressively worse in comparison to that of the control group. Pushing this further by incorporating three more groups into our experiment to evaluate feed conversion efficiency (1 of 25 each) yielded better results for the third and fourth treatment groups. This again indicates the beneficial role of bentonite in maintaining an environment good enough to help birds grow and drying up any possible escape of moisturizing additives from the air or residual moisture within litters. Based on these results, it can be proposed that the Attapulgite ratio in broiler floor litter should be 0.350-450 g/m^2 under conditions incorporating reversible air ventilation (wind-proof against internal negative pressures with sensible counterbalancing) and good bulking-up at feeders as well: by so doing you maximize improvement in production performance, minimize all foreseeable environmental risk signals emitted.

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