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EFFECTS OF DIETARY HATCHERY WASTES ON SOME PRODUCTIVE AND PHYSIOLOGICAL CHARACTERISTICS OF BROILER CHICKS

By

Z.S.H.Ismail and A.H.H.Ali

Animal Production Department, Faculty of Agriculture, South Valley University, Egypt

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Abstract: *This experiment was conducted to evaluate the effects of dietary different levels of hatchery wastes (HW) on performance, tibia ash and blood calcium and phosphorus concentrations in broiler chickens. Birds were fed a corn-soybean meal diet for 7 days. The experimental treatments included 3 dietary treatments containing 1.5, 3 and 4.5 percent HW, in addition to the control without hatchery wastes. Five replicate groups of 15 Ross 308 broiler chicks were allocated to each dietary treatment. Data were analyzed in a completely randomized design. Results of the experiment indicated that there were no significant differences between weight gains in different dietary treatments. Feed intake in chicks fed 4.5% HW was significantly higher ($p<0.05$) and those fed 3 % had lower feed intake. The results indicated that feed conversion in 4.5% HW treatment was significantly inferior compared to other treatments. Results of carcass analysis showed no significant differences between treatments. Also there were no significant differences between blood calcium and phosphorous among treatments. Treatments of 4.5 and 3 % hatchery wastes had significantly the highest tibia ash ($p<0.05$) content. Based on the result of this experiment, the utilization of HW as much as 3% can increase tibia strength without having adverse effect on broilers performance.*

INTRODUCTION

Hatchery wastes (HW) normally refer to all the collectible materials remaining in commercial hatching trays after saleable chicks have been removed. This waste includes shells from hatched chicks, infertile eggs, dead embryos still in the shell and dead chicks (Hamm and Whitehead, 1982). This material is usually incinerated, rendered, or taken to landfills (Miller, 1984). HW is a good source of energy, crude protein and has considerable amount of fat and calcium with low phosphorous (Rasool *et al.*, 1999). The progress in the development of poultry industry has lead to increment of HW. About 2.0 -2.5 tons hatchery wastes areproduced every month in Qena province. Aghdam Shahriar *et al.*, (2008) reported that the utilization of HW after proper processing has two advantages. First, it is a useful and economical source of nutrients for poultry. Second, it reduces the pollution (Cunningham and Lilich, 1975). Lilburn *et al.* (1997) subjected HW to 125° C temperature along with 1.76 kg/cm^2 pressure for 15 minutes and then dried for ten hours. The resultant autoclaved mixture showed that it contains protein 35%, ether extract 40.3%, and phosphorus 1.02%. The processing of HW done by Ristic and Kormanjos (1988) involved autoclaving at 135°C for 15 minutes followed by drying at 95° C. The mixture contained crude protein 22.4%, crude fiber 0.4%, crude fat 3.7%, crude ash 53.4% and nitrogen free extract 20.1%. Aghdam Shahriar *et al.* (2008) autoclaved HW at 100° C with pressure of 2.2 kg/cm^2 for 15 minutes

then dried in an oven at 105°C for 24 hours. The processed material contained dry matter 64.28%, crude protein 32.11%, crude fat 27.61% and calcium 28.55%. They fed such material at 2, 4, 6 and 8 % levels in broilers diet. The purpose of this investigation was to evaluate the effect of using different levels of HW on broilers performance, blood calcium and phosphorus and tibia ash.

MATERIALS AND METHODS

Three hundred one day-old Ross-308 broiler chicks were obtained from a commercial hatchery. This experiment was conducted from October to December 2010, and was carried out in farm of South Valley University. The chicks were allotted randomly to 20 pens with 15 chicks per pen. A continuous lighting program was used. Water and assigned diets were provided *ad libitum*. Birds were fed by a corn-soybean meal diet for 7 days. Four experimental diets including 0, 1.5, 3 and 4.5 percent of HW were used and the diets were isocaloric and isonitrogenous based on NRC (1994) recommendations (Table1).

Table1. Percentage and calculated composition of starter and grower diets

	Starter				Grower			
Ingredients and analysis	**Control**	**1.5 % HW**	**3% HW**	**4.5 % HW**	**Control**	**1.5 % HW**	**3% HW**	**4.5% HW**
Corn grains	54.99	56.28	55.34	51.81	61.02	62.30	61.01	57.69
Soybean meal (44% CP)	39.18	38.12	37.43	37.18	33.33	32.27	31.63	31.34
Soybean oil	2.04	1.38	1.45	2.38	2.36	1.7	1.89	2.74
Hatchery waste	0	1.5	3	4.5	0	1.5	3	4.5
Dicalcium phosphate	1.41	1.30	1.68	3.04	1.02	0.91	1.54	2.80
Calcium carbonate	1.25	0.31	0	0	1.33	0.39	0	0
NaCl	0.42	0.42	0.42	0.42	0.32	0.32	0.32	0.32
Vitamin mineral mix 1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Antioxidant	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
DL-Methionine	0.12	0.11	0.1	0.1	0.04	0.04	0.03	0.03
Total	99.99	100	100	100.01	100	100.01	100	100
Calculated analysis :								
ME, kcal/kg	2900	2900	2900	2900	3000	3000	3000	3000
Crude Protein%	20.84	20.84	20.84	20.84	18.75	18.75	18.75	18.75
Ca%	0.91	0.91	1.26	1.94	0.84	0.84	1.21	1.87
Available P %	0.41	0.41	0.5	0.78	0.33	0.33	0.47	0.72
Na%	0.18	0.18	0.18	0.18	0.14	0.14	0.14	0.14
Lysine%	1.2	1.2	1.2	1.21	1.05	1.05	1.06	1.07
Meth + Cyst	0.82	0.82	0.82	0.82	0.69	0.70	0.70	0.71

Broiler premix contained 50% vitamin premix and 50% mineral premix. Each kg of vitamin premix Contained: vitamin A, 3600.000 IU; vitamin D3, 800.000 IU; vitamin E, 7,200 IU; vitamin K3, 800 mg; vitamin B1, 720 mg; vitamin B2, 2,640 mg; vitamin B3, 4,000 mg; vitamin B5, 12,000 mg; vitamin B6, 1,200 mg; vitamin B9, 400 mg; vitamin B12, 6 mg; vitamin H2, 40 mg; Choline chloride. 200,000 mg; and each kg of mineral premix contained: Mn, 400,000 mg; Fe, 20,000 mg; Cu, 4,000 mg; I, 400 mg; Se, 80 mg.

Raw HW was taken from a local hatchery factory, and toasted at 100° C. This type of cooking was carried out without addition of water, then the meal was ground in laboratory mill. This meal was used as a part of the diet of the experimental groups. Records for live weight, feed consumption and feed conversion ratio were obtained weekly. On day 42, a total of 40 birds were bled for measuring calcium and phosphorus of plasma. Mortality was recorded as it occurred. At the end of the trial, 40 birds (2 per pen) from dietary treatments were

weighed, killed by bleeding, scalded and picked off their feathers. The heads and feet were removed and each carcass was cut-up by hand. The left tibia of birds were taken and were deflated and cartilaginous caps were removed immediately after collection. The length and width of the tibia were measured. They were kept frozen in plastic bags at 20° C to maintain wetness until analysis for ash content. The tibia was dried in an oven then weighed and ashed at 600 °C for 8 hours. Ash content was calculated by weight loss (AOAC, 1990).

Chemical composition of hatchery wastes:

Chemical composition of hatchery wastes was analyzed in Animal nutrition laboratory of South Valley University. Dry matter content was determined by oven drying at 110 °C. Crude protein was determined by the Kjeldahl method (AOAC, 1990). Ether extract content was obtained by Soxhlet extraction. The sample was analyzed for ash, moisture, calcium and phosphorus according to the procedures of AOAC (1990). The chemical compounds of the HW are shown in Table 2.

Statistical Analysis:

Data were analyzed statistically according to the General Linear Model (GLM) procedure of SAS (1998). The experimental design was a completely random design with four treatments (levels of HW in the diet) and five replicates (15 chicks in each pen). Mean comparison was carried out using Duncan test at 5 percent probability level (Duncan, 1955).

Table2. Chemical composition of hatchery wastes (%)

Chemical compound	
Gross energy(kcal/kg)	3987.42
Dry matter (%)	83.2
Crude protein (%)	24.31
Ether extract (%)	12.15
Calcium (%)	25.62
Phosphorous (%)	1.47
Ash (%)	37.05

RESULTS AND DISCUSSION

Broiler performance:

Weight gain, feed intake and feed conversion data for different growth periods are presented in Table 3. Results showed that there was no significant difference in body weight of broilers for the starter, grower and total period between different dietary treatments. Results of feed intake showed a significant difference between broilers fed different levels of hatchery wastes in the starter and grower period. The broilers fed with 4.5% hatchery wastes had higher feed intake than broilers fed 3% and control group ($P<0.05$). In total period, feed intake in broilers fed 4.5% hatchery wastes was significantly higher than the control and 3% hatchery waste groups. In the starter period, there was no significant difference in feed conversion ratio between experimental treatments. In the grower and total periods, the worse feed conversion was observed in birds fed 4.5% hatchery wastes. In total period, feed conversion ratio in birds fed 4.5% hatchery wastes was significantly inferior than the other treatments ($P<0.05$). However, in grower period, the difference in feed conversion between broilers fed 4.5% hatchery wastes and control group was only significant ($P<0.05$). The results of this study for body weight of broilers were in agreement with the results of Aparana and Patterson (1997) and Aghdam Shahriar *et*

al. (2008), as they also observed no significant difference in weight gain in broilers fed different levels of hatchery wastes. Moreover, Aghdam Shahriar *et al.* (2008) observed no significant difference in weight gain in broilers that fed 2 and 4% hatchery wastes. However, they s howed that utilization of hatchery wastes more than 4% in broilers diet lead to reduction in weight gain. They reported that this observation was due to the calcium and oil level in the hatchery wastes.

Table 3. Effects of different levels of hatchery waste on broiler performance (*)

	Starter period			*Grower period*			*Total period*		
Dietary treatments	**WG(g)**	**FI (g)**	**FCR(g/g)**	**WG(g)**	**FI (g)**	**FCR(g/g)**	**WG(g)**	**FI (g)**	**FCR(g/g)**
0	510.88	730.60^{b}	1.43	1878.23	3714.75^{b}	1.98^{b}	2389.1	4445.35^{b}	1.86^{b}
1.5%	505.32	739.25^{ab}	1.47	1887.16	3783.47^{ab}	2.01^{ab}	2392.48	4522.72^{ab}	1.89^{b}
3%	498.37	708.05b	1.42	1882.66	3754.38^{ab}	1.99^{ab}	2381.02	4462.42^{b}	1.87^{b}
4.5%	504.66	798.85^{a}	1.58	1892.57	3862.67^{a}	2.04^{a}	2397.24	4661.52^{a}	1.94^{a}
SEM	12.58	20.32	0.05	20.03	41.41	0.02	27.28	48.83	0.02

WG, weight gain; FI, feed intake, FCR, feed conversion ratio

* Means with different superscripts in each column are significantly different (P<0.05).

Increasing feed intake in broiler fed 4.5% hatchery wastes could be attributed to the high level of dietary calcium and phosphorus (Onyango *et al.*, 2003). In the present study, in spite of significant difference in feed intake, there were no significant differences in weight gains between different treatments. This observation can be attributed to the high amount of dietary calcium in this group. Watkins *et al.* (1989) showed that high dietary calcium prevents weight gain. It was shown in another study that 0.9 and 1.8 excess dietary calcium decreased weight gain (Bafundo *et al.*, 1984). Results of feed conversion obtained herein were in agreement with Aparana and Patterson (1997) and Aghdam Shahriar *et al.* (2008), they also detected no significant difference between experimental diets in feed conversion , due to feeding various levels of hatchery wastes .

Carcass characteristics

The effects of hatchery wastes on broiler's breast, thighs, abdominal fat, liver, gizzard percentage are presented in Table 4. These characteristics were not significantly influenced by the dietary treatments. There were no significant differences in any of the carcass characteristics. It demonstrated that hatchery wastes has no unfavorable effect on carcass characteristics. In this connection, Aparana and Patterson (1997) also observed no significant difference in carcass characteristics between different treatments including HW. Aghdam Shahriar *et al.* (2008) reported that with the increase of HW levels, breast and wing weights were decreased (P<0.05).

Table 4. Effects of different levels of hatchery waste on carcass yield (%)

Dietary treatments	Carcass	Breast	Thigh	Abdominal fat	Liver	Gizzard
0%	65.28	23.14	20.15	1.94	1.93	1.19
1.5%	64.48	23.26	20.49	1.91	2.06	1.33
3%	65.89	22.89	20.66	1.70	2.06	1.28
4.5%	65.30	23.40	20.22	2.10	1.96	1.24
SEM	1.11	0.36	0.44	0.21	0.08	0.08

Blood calcium and phosphorous:

No significant difference (P>0.05) in blood calcium and phosphorous were detected among the broilers fed different levels of hatchery waste (Table 5). Detecting no significant difference between dietary treatments in blood calcium and phosphorous shows that high level of calcium and phosphorous of hatchery wastes didn't affect blood calcium and phosphorous. Effects of different levels of hatchery wastes on blood calcium and phosphorous has not investigated in any study before, but there are studies shows that dietary calcium and phosphorous affect blood calcium and phosphorous (Shafey and Mcdonald, 1990; Smith *et al.*, 2003).

Table 5. Effects of different levels of hatchery waste on blood calcium and phosphorous

Dietary treatments	Blood calcium (mg/dl)	Blood phosphorous (mg/dl)
0%	9.1	6.68
1.5%	9.23	6.23
3%	9.91	6.33
4.5%	9.33	6.22
SEM	0.46	0.54

Bone characteristics:

Results showed that bone ash values were significantly different between the treatments (Table 6). Bone ash was higher in the tibia of the birds fed diets containing 3 and 4.5% HW. There was significant difference between broilers fed 4.5% hatchery wastes and those having 1.5% hatchery wastes as well as control group (P<0.05). Length and width of the tibia were not influenced by different levels of HW. Studies have shown that by increasing dietary calcium and phosphorous, tibia ash increases (Rowland *et al*,. 1967; Onyango *et al.*, 2003; Hall *et al.*, 2003; Mutus *et al.*, 2006; Venalainen *et al.*, 2006). Zhang and Koon (1997) have shown a positive relationship between bone ash and bone strength. Also Ziaei *et al.* (2008) observed that decreasing dietary Ca level below 7.3 g/kg, at constant P level, led to reduction in bone strength. Therefore, in this study, the birds fed 3 and 4.5% hatchery wastes that had higher bone ash, might had more strength tibia bones.

Effects of different levels of hatchery wastes on tibia length and width has not investigated in any study before, but the results of our study were in agreement with the findings of Mutus *et al.* (2006) and Skinner *et al.* (1992) who reported that dietary calcium had no effect on the length and width of tibia.

In conclusion, this study demonstrated that hatchery wastes had no adverse effect on broilers performance, carcass characteristics, blood calcium and phosphorus. Also, the results showed that utilization of hatchery wastes at level of 3% may increase strength of tibia bones in broilers.

Table 6. Effects of different level of hatchery waste on bone characteristics*

Dietary treatments	Ash (%)	Bone length (cm)	Bone width (cm)
0%	44.03^{bc}	9.34	0.39
1.5%	43.14^{c}	9.47	0.35
3%	45.53^{ab}	9.48	0.36
4.5%	46.52^{a}	9.29	0.35
SEM	0.93	0.13	0.03

* Means with different superscripts in each column are significantly different (P<0.05)

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الملخص العربى

تأثير أضافة مخلفات المفقسات على الأداء و بعض الخواص الفسيولوجية لدجاج اللحم

زينهم شيخون حسن اسماعيل، عبدالله حسن حسين على

قسم الانتاج الحيوانى و الدواجن - كلية الزراعة - جامعة جنوب الوادى - مصر

أجريت هذه التجربة لدراسة تأثير إستخدام مستويات مختلفة من مخلفات المفقسات على الإنتاج، رماد الساق و محتوى الدم من الكالسيوم و الفوسفور فى كتاكيت اللحم. تم تغذية الطيور على عليقة مكونة من الذرة الصفراء و كسب فول الصويا لمدة ٧ أيام فى حين ان علائق التجربة تكونت من عليقة الكنترول بالإضافة الى ٣ أعلاف تجريبية تحتوى على ١.٥، ٣.٠ و ٤.٥% من مخلفات المفقسات. إستخدم فى كل معاملة ٥ مكررات تحتوى ١٥ كتكوت بكل مكررة بإجمالى ٣٠٠ كتكوت لحم من سلالة روس ٣٠٨ . لم يتأثر الزيادة فى وزن الجسم بأى من المعاملات التجريبية المستخدمة. بالنسبة لإستهلاك العلف، لوحظ زيادة معنوية للكتاكيت المغذاه على مستوى ٤.٥% من مخلفات المفقسات فى حين أن الكتاكيت المغذاه على ٣.٠% كانت اقل معاملة فى استهلاك العلف. كانت الكفاءة التحويلية للعلف للكتاكيت المغذاه على ٤.٥% مخلفات المفقسات أقل معنويا مقارنة بالمعاملات الأخرى فى حين لم تؤثر المعاملات على أى من صفات الذبيحة وكذلك مستوى الكالسيوم و الفوسفور فى الدم. أدت التغذية على أعلاف محتوية على ٣.٠ و ٤.٥% مخلفات المفقسات الى زيادة معنوية بالنسبة للرماد فى الساق مقارنة بالمعاملات الأخرى و الكنترول. إستنادا إلى النتائج المتحصل عليها من التجربة فإن إستخدام نسبة ٣% من مخلفات المفقسات فى أعلاف كتاكيت اللحم يمكن أن يؤدى الى زيادة نسبة الرماد فى الساق بدون أية تأثيرات سلبية على الأداء الإنتاجى لكتاكيت اللحم.