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Effects of Different Levels of Hatchery Wastes on the Performance, Carcass and Tibia Ash and Some Blood Parameters in Broiler Chicks

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Abstract: This experiment was conducted to evaluate the effects of different levels of Hatchery Wastes (HW) on performance, tibia ash, blood calcium and phosphorus concentrations in broiler chickens. Birds were fed a corn-soybean meal diet for 7 days. The experimental treatments included a corn soybean meal diet and 3 other treatments containing 1.5, 3.0 and 4.5% HW. five replicate groups of 15 Ross 308 broiler chicks were allocated to each dietary treatment. Data were analyzed in a completely randomized design. Results indicated that there were no significant differences in weight gains among different dietary treatments. Feed intake in the 4.5% treatment was significantly higher ($p<0.05$) and 3% treatment had lower feed intake than the other treatments. The results indicated that feed conversion in the 3% HW treatment was lower in most of the period ($p>0.05$). Results of carcass analysis showed no significant differences between treatments. Also, there were no significant differences between blood calcium and phosphorous among treatments. The 4.5 and 3.0% hatchery wastes treatments had the highest tibia ash ($p<0.05$). Based on the result of this experiment, the utilization of hatchery wastes as much as 3% can increase tibia strength without having adverse effect on broilers performance.

Key words: Broiler, hatchery by product, performance, ash, blood

INTRODUCTION

Hatchery Wastes (HW) contain the materials that remain in commercial hatching trays after the chicks have been removed. This material includes shells from hatched chicks, dead embryos, infertile eggs and dead chicks (Hamm and Whitehead, 1982). This material is usually incinerated, rendered, or taken to landfills (Miller, 1984). Hatchery wastes is a good source of energy, crude protein, fat and calcium with low phosphorous. The HW meal is comparable with fish meal (Rasool *et al*., 1999). The progress in the development of poultry industry has lead to increment of HW. About 20-21 tons HW are produced every month in Iran (Shahriar *et al*., 2008). Utilization of HW after proper processing has two advantages. First, it is a useful and economical source of nutrients for poultries. Second, it reduces the pollution (Cunningham and Lillich, 1975).

Wisman (1964) reported that HW contains 26% crude protein and 20.9% calcium. Lilburn *et al.* (1997) subjected turkey HW to 125°C temperature along with 1.76 kg cm^{-2} pressure for 15 min and then dried for 10 h. 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 Komanjos (1988) involved autoclaving at 135°C for 15 min 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 21.1%. Shahriar *et al*. (2008) autoclaved HW at 100°C with pressure of 2.2 kg cm^{-2} for 15 min then dried in oven (105°C) for 24 h. The material contained dry matter 64.28%, crude protein 32.11%, crude fat 27.61% and calcium 28.55%. They fed HW at 2, 4, 6 and 8% levels in broilers diet.

The purpose of this investigation was to evaluate effect of using different levels of HW on broilers performance, blood calcium, phosphorous and tibia ash.

MATERIALS AND METHODS

Three hundred, one-day-old Ross-308 broiler chicks were obtained from a commercial hatchery. This research project was conducted from 2007 October to 2007 December and was carried out in Gorgan University Farm. 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, 3.0 and 4.5% of

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Table 1: Percentage and calculated composition of starter and grower diets

	Starter				Grower			
Ingredients	Control	1.5% HW	3% HW	4.5% HW	Control	1.5% HW	3% HW	4.5% HW
Corn grain	54.99	56.28	55.34	51.81	61.02	62.30	61.01	57.69
Soybean meal	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	1.70	1.89	2.74
Hatchery waste	0.00	1.50	3.00	4.50	0.00	1.50	3.00	4.50
Dicalcium phosphate	1.41	1.30	1.68	3.04	1.02	0.91	1.54	2.80
Calcium carbonate	1.25	0.31	0.00	0.00	1.33	0.39	0.00	0.00
Salt	0.42	0.42	0.42	0.42	0.32	0.32	0.32	0.32
Vitamin mineral mix 1	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Antioxidant	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
DL-Methionine	0.12	0.11	0.10	0.10	0.04	0.04	0.03	0.03
Calculated analysis								
ME (kcal kg^{-1})	2900.00	2900.00	2900.00	2900.00	3000.00	3000.00	3000.00	3000.00
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	0.50	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 (%)	1.20	1.20	1.20	1.21	1.05	1.05	1.06	1.07
Met+Cys (%)	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, 3,600,000 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, 40,000 mg; Fe, 20,000 mg; Zn, 40,000 mg; Cu, 4,000 mg; I, 400 mg; Se, 80 mg

HW were used and the diets were isocaloric and isonitrogenous based on National Research Council (1994) recommendations (Table 1). The HW was taken from a local hatchery factory. They toasted the raw material at 100°C, duration of toasting was 5-8 h. 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, 40 birds were bled for measuring calcium and phosphorus of plasma. Mortality was recorded as it occurred. At the end of the trail (day 42), 40 birds (2 per pen) 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 tibiae were taken and were defleshed 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 oven and then weighed and ashed at 600°C for 8 h (AOAC, 1990).

Chemical composition of hatchery wastes: Chemical compound of HW was analyzed in animal nutrition laboratory of Gorgan 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.

Table 2: Chemical composition of hatchery wastes (%)

Chemical compound	Value
Gross energy (kcal kg^{-1})	3987
Dry matter (%)	83.2
Crude protein (%)	24.31
Ether extract (%)	12.15
Calcium (%)	25.62
Phosphorous (%)	1.47
Ash (%)	37.05

Statistical analysis: Data were analyzed statistically according to the General Linear Model (GLM) procedure of SAS Institute (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's multiple range test ($p<0.05$).

RESULTS

Broiler performance: Weight gain, feed intake and feed conversion data for difference growth period are shown in Table 3. Results showed that there was no significance difference in body weight of broilers for the starter, grower and total period between different diets. Broilers fed with 4.5% HW had higher feed intake than broilers fed 3% and control group ($p<0.05$). In total period feed intake in broilers fed by 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 among experimental treatments. In the grower and overall period the highest feed conversion was observed in birds fed by 4.5% hatchery wastes. In total period, feed conversion ratio in birds fed 4.5%

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^{-1})	WG (g)	FI (g)	FCR (g g^{-1})	WG (g)	FI (g)	FCR (g g^{-1})
0	510.88	730.60^{b}	1.43	1878.23	3714.75^{b}	1.98^{b}	2389.10	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	708.05^{b}	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 ($p<0.05$)

Table 4: Effects of different levels of hatchery waste on carcass yield (g/100 g)

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

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

	Blood calcium	Blood phosphorous
Dietary treatments	(mg dL^{-1})	
0 (%)	9.10	6.68
1.5 (%)	9.23	6.23
3 (%)	9.91	6.33
4.5 (%)	9.33	6.22
SEM	0.46	0.54

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 ($p<0.05$)

hatchery wastes was significantly higher than the other treatments ($p<0.05$). In grower period the difference between broilers fed 4.5% hatchery wastes and the control group was significant ($p<0.05$).

Carcass characteristics: The effects of hatchery wastes on broiler's breast, thighs, abdominal fat, liver, gizzard percentage are shown in Table 4. These characteristics were not significantly influenced by the dietary treatments.

Blood calcium and phosphorous: No significant differences ($p>0.05$) in blood calcium and phosphorous were detected among the broilers fed different levels of hatchery waste (Table 5).

Bone characteristics: Bone ash content was higher in the tibia of the birds fed diets containing 3 and 4.5% than the other two treatments (Table 6). There was significant difference between the two treatments fed 3.0 and 4.5% hatchery wastes and control group ($p<0.05$). Length and width of the tibia were not influenced by different levels of HW.

DISCUSSION

The results of this study for body weight of broilers were in agreement with the results of Aparana and Patterson (1997) and Shahriar *et al.* (2008). They also observed no significant difference in weight gain in broilers fed different levels of hatchery wastes. Shahriar *et al.* (2008) observed no significant difference in weight gain in broilers that fed 2 and 4% hatchery wastes. They showed 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. Increasing feed intake in broiler fed 4.5% hatchery wastes was because of 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 (Bafunda *et al.*, 1984). Present results in feed conversion was in agreement with Aparana and Patterson (1997) and Shahriar *et al.* (2008), they also detected no significant difference between experimental diets in feed conversion.

There was no significant difference in any of the carcass characteristics. It demonstrated that hatchery wastes has no unfavorable effect on carcass characteristics. Aparana and Patterson (1997) also observed no significant difference in carcass characteristics among different treatments. They had used hatchery wastes in broilers at 2.5 and 5% level. Shahriar *et al.* (2008) reported that with the increase of HW levels, breast and wing weights were decreased ($p<0.05$).

Detecting no significant difference between dietary treatments in blood calcium and phosphorous shows that

high level of calcium and phosphorous of hatchery wastes did not 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 dietary calcium and phosphorous effect blood calcium and phosphorous (Shafey and Mcdonald, 1990; Smith *et al*., 2003).

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 Coon (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^{-1}, at constant P, led to reduction in bone strength. Therefore, in our study, birds fed 3.0 and 4.5% hatchery wastes that had higher bone ash, had more strength tibia bones.

Effects of different levels of hatchery wastes on tibia length and width have not been 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) that reported dietary calcium has no effect on the length and width of tibia.

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 the level of 3% increased tibia bones strength in broilers.

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