Journal of Animal and Veterinary Advances 7 (1): 100-105, 2008
ISSN: 1680-5593

Effects of Dietary Different Levels of Hatchery Wastes in Broiler

H. Aghdam Shahriar, K. Nazer-Adl, J. Doolgarisharaf and H. Monirifar
Department of Animal and Veterinary Sciences, Islamic Azad University,
Shabestar Branch, Shabestar, Iran

Abstract: This study is presented to investigate the effects of different levels of Hatchery Wastes (HW) in broiler chickens diets. One hundred and eighty days old male chickens were in randomize complete design in to 5 groups and 3 replicates from of 7-56 days age, levels of 0, 2, 4, 6 and 8% fed HW in diets. The HW were controlled after processing (drying and eliminating the microbial load). Weight gain and feed intake were measured weekly and period in each replication. Results of the data showed the use of wastes until to the level of 4%, non significant difference in weight gain, feed intake and Feed Conversion Ratio (FCR) between groups (in various period). Average carcass combination included were significant in breast weight% ($p<0.05$) and abdominal fat ($p<0.01$) in between groups and organoliptic quality of the grille breast meat was significant both in males and females ($p<0.05$). The glucose value of serum was significant in 5 and 8 weeks ($p<0.01$), but CHOL and TG value were only significant in eighth week ($p<0.05$). Results showed, we could use from the HW to 4% level after necessary processing in broiler diets.

Key words: Hatchery waste, performance, serum, broiler, dietary different levels

INTRODUCTION

The Hatchery Wastes (HW) are the products that remain in hatcheries after the period of hatching. Hatchery residue is primarily composed of dead chicks or poults, infertile whole eggs and shells from hatched eggs (Wisman, 1964; Hamm and Whitehead, 1982). This material is usually incinerated, rendered, or taken to landfills (Miller, 1984). The high moisture content of fresh residue makes disposal and incineration costly to the producer and it may be unsafe environmentally (Vandepopuliere *et al*., 1977; Miller, 1984).

This products (HW) are rich sources of protein, energy, fat and Calcium. The incorrect use of this feed compound results in the elimination of a valuable feed source in the poultry and fish feeding (Shanawany, 1992; Sharara *et al*., 1992). By processing correctly these HW and by correct using of them, a part of poultry and fish diets requirements of our country will be satisfied.

Researchers found that factors like age of breeding hens, the incorrect ratio betweenmale and female, presence of weak birds in the flock, malnutrition of breeding hen, mycotoxines, stress and other factors like these affect the hatchery rate. Thus the hatchery waste increases after incubation period (Ilian and Salman, 1986). The way of keeping hatchery eggs after laying them in the incubator and the difficulties resulting from the incorrect management, are the problems that every hatchery company is involved. According to Mouldim (1997) when the Setter and Hatcher are not adjusted and CO_2 gas increases 0.4% in setter and 0.8% in Hatcher, the developing embryos will be damaged (Gupta, 1988).

Dried hatchery residue is reported to have approximately 21% calcium and 26% CP (Wisman, 1964). The performance of broiler chicks and laying hens fed corn-soybean diets containing 5 or 15% dried hatchery residue was similar to that of birds fed control diets (Wisman, 1964; Wisman and Beane, 1965). Vandepopuliere *et al*. (1977) reported similar results in layers fed diets containing up to 16% dried hatchery residue. In some reports, dried hatchery residue was used as is Wisman and Beane (1965) and Vandepopuliere *et al*. (1977) or mixed with other feed ingredients (Wisman, 1964; Miller, 1984; Tadtiyanant *et al*., 1993).

If the hatcheries were equipped with economic and quick waste removal system, or they had storage vessels for storing the wastes in some place out of the hatchery, they could prevent from contamination of the environment and bad smell or stink. So correct dumping of the HW and also recovering that and especially using that as a valuable animal protein, is not costly for management and this industry. From a billion eggs yearly applied in hatchery units, more than a thousand ton wastes are produced.

Corresponding Author: Habib Aghdam Shahriar, Department of Animal and Veterinary Sciences, Islamic Azad University Shabestar Branch, Joy Park of Shabestar, Iran

The quantity of the wastes in moist form is estimated as 55-60 tons in averagely, so 35-37% of the wastes are dry matter. Therefore, 20-21.6 tons hatchery remains are produced every month in our province (Aghdam Shahriar; 2001). Shingari *et al*. (1995) estimated total dry wastes of hatchery machine in 331 hatchery units in India. Their estimation showed the wastes of broilers and egg laying chicks is approximately 17400 tons every year. Among of many laying eggs in hatchery units (for a year), it would be produced the wastes more than thousands tone. (Blake, 1998a, b)

Considering the quality and chemical compound of the produced HW, it can be used as a source of protein and calcium (Blake, 1998b). Therefore, the aim of this study was to investigate the effects of different levels of HW in broiler chickens diets.

MATERIALS AND METHODS

An experimental, effect of different levels of the hatchery waste in broiler diets in a Completely Randomized Design (CRD) evaluated. One hundred and eighty day old chicks were fed experimental diets include 0, 2, 4, 6 and 8% of HW in 5 treatments and 3 replicates form of 7-56 days age. This test was conducted in research farm of Islamic Azad University Shabestar in 2001. The experimental diets were isocaloric and isonitrogenous based on NRC (1994) recommendation. The following stages were conducted to supplying the waste products of Hatchery houses, reducing the microbial and moisture reduction of the wastes, under control of laboratory tests and repeated microbial cultures, which were carried out in the medium of SS agar, Mac Conkey agar, Blood agar and Saboroud dextrose agar, then wastes were autoclaved at 100°C with a pressure of 2.2 kg cm^{-2} for 15 min. So, the microbial load decreased and the product was optimized for consumption. Considering the quantity of moisture in the HW, were exposed 24 h to 105°C oven and are dried and stored. After drying, embryo less eggs and eggs with dead embryo and egg shells are mixed. This mixture was used as a part of the diet of the experimental groups.

Weight gain, feed intake and Feed Conversion Rate (FCR) were recorded weekly and different period and some of biochemical characters (glucose, cholesterol and triglyceride) were measured in 35 and 56days age.

Chemical composition of hatchery wastes: Chemical compound of wastes and remains of hatchery units in Azerbaijan province after combining it in replicate was analyzed in Animal nutrition and Microbiological laboratories of Islamic Azad university of Shabestar.

Table 1: Chemical composition of hatchery wastes (DM %)

Dry matter	64.28
Metabolizeble Energy(Kcal)	3520
Crude protein	32.11
Crude fat	27.61
Ash	00.56
Calcium	28.55
Phosphor	21.46
	02.35

Experimental diets were milled through a 1mm screen in preparation for chemical analysis. Dry matter content was determined by oven drying at 105°C for 16 h. Crude protein was determined by the Kjeldahl method (AOAC, 1980). Ether extract content was obtained by Soxhlet extraction using anhydrous diethyl ether. The crude fibre content was determined using 12.5% sulphuric acid and 12.5% sodium hydroxide solutions (Naumann and Bassler, 1993). The samples were analyzed for starch, sugar, ash, calcium and phosphorus according to the procedures of the AOAC (1980). Estimates of ME were based on protein, ether extract, starch and sugar levels determined from the experimental feeds. ME was estimated using a prediction equation (Rose, 1997):

$$\begin{aligned} \text{ME MJ kg}^{-1} = {} & 0.3431(\text{fat g kg}^{-1}) \\ & + 0.01551(\text{crude protein g kg}^{-1}) \\ & + 0.01301(\text{total sugar g kg}^{-1}) \\ & + 0.1669(\text{starch g kg}^{-1}) \end{aligned}$$

The chemical compounds of these wastes are shown in the Table 1.

Statistical analysis: Data collected subjected to analysis of variance and significant differences observed in means subjected to Duncan's multiple range test. All data were analyzed by ANOVA using the General Linear Model (GLM) procedures of the SAS Institute (1998).

RESULTS AND DISCUSSION

Results showed, body weight of broilers in different period was significantly affected by HW ($p<0.01$). With the increase of levels wastes in diets were weight gain decreased (in 2-3, 3-6 and 6-8 wk) (Table 2). Supplementation with HW resulted in lightweight birds when compared with control group. This different were could be related to fat and Ca levels in wastes. Paixao *et al*. (1989) reported using the HW to 75% can improve daily weigh, last weight, feed forming and protein quality positively. Also, high Ca intake with HW hasn't been any influence on surviving or carcass composition.

Total feed intakes of broilers were affected by hatchery waste, but feed intake in 3-6 wk non significant

Table 2: Performance parameters fed groups with different levels of hatchery wastes

	2,3 week			3-6 week			6-8 week		
Trait waste	Weight gain	Feed intake	FCR	Weight gain	Feed intake	FCR	Weight gain	Feed intake	FCR
0	559.6^{a}	774.8^{a}	1.38^{a}	962.4^{a}	2202.1^{a}	2.28^{b}	817.7^{a}	2130.9^{a}	2.61^{b}
2%	552.2^{ab}	771.4^{a}	1.40^{a}	946.0^{a}	2163.1^{a}	2.28^{b}	792.1^{a}	2048.7^{a}	2.58^{b}
4%	548.8^{ab}	769.6^{a}	1.40^{a}	939.3^{a}	2201.4^{a}	2.34^{ab}	780.8^{a}	2132.8^{a}	2.73^{b}
6%	526.1^{b}	759.0^{a}	1.44^{a}	845.6^{b}	2116.7^{a}	2.51^{a}	682.7^{b}	2056.7^{a}	3.02^{a}
8%	470.8^{c}	719.4^{b}	1.53^{b}	840.1^{b}	2105.8^{a}	2.49^{ab}	624.5^{c}	1900.9^{b}	3.04^{a}
CV%	2.59	2.62	3.44	2.00	4.74	4.74	3.75	2.58	4.31
SE	3.14	4.25	0.19	2.54	5.89	0.32	1.24	14.21	0.43
P	**	ns	*	**	ns	ns	**	**	**

FCR, Feed Conversion Ratio, Ns= statically the values are not significant, * significant at p< 0.05, ** significant at p< 0.01

and in (2,3, 6-8 wk) period was significant (p<0.05). Feed intake in group 8% wastes was less than other groups, decrease feed intake in group 8% wastes, might be due to the higher amount of metabolizable energy in HW and the highest capability of digestion and absorption of unsaturated fatty acids that exists in HW (as a high content) is the main factor that birds can keep their energy received with reduction of feed consumption. Similar results were reported previously (Zou and Wu, 2005). However non significant observed by replacement of wastes to 4% (Table 3). Barbour *et al.* (1995) reported that feed intake was significantly increased in poults given enzyme-treated whole turkey by-product meal compared with soybean meal. Contrary to this report, feed intake for chicks fed on the hatchery waste supplemented diets were decrease from those of chicks fed on the unsupplemented diets in the present study. Lilburn *et al.* (1997) reported included of 25% hatchery residue in the extruded mixture had an unexplainable yet beneficial effect on feed intake, particularly at the lowest level of dietary protein (16%). Most probably this is due to presence of the same Amount of energy in all supplemented diets and provided the same rate of metabolizable energy to protein in experimental and control diets from 7-56 days of study. Results showed in Feed Conversion Ratio (FCR) significant difference between experimental and control groups during 2, 3 week (p<0.05) and 6-8 week (p<0.01) and no effect (p>0.05) in 3-6 week period of HW were found. The results agree with the findings of Escalona and Pesti (1987), who found no difference in the performance of broilers when poultry by-product meal and hatchery waste was incorporated at the 5% level in to maize-soybean diets when all essential nutrients were equalized. Bhargava and O' Nel (1975) observed equal or significantly superior results in a series of experiments with chicks fed on a poultry by-product and hydrolyzed feather meal combination when compared with feeding an animal protein and wheat-soybean in control diet. Mendonca and Jensen (1989) found that including poultry by-product meal in broiler diets at 100 g kg^{-1} did not significantly affect body weight gain, feed intake or feed

Table 3: Composition of carcass in broiler (% of body weight)

	Trait			
Wastes	Breast	Thigh	Abdominal fat	Wing
0	32.99^{a}	34.01	2.73^{ab}	9.84^{ab}
2%	32.83^{a}	34.52	3.02^{a}	9.51^{bc}
4%	33.54^{a}	33.88	2.77^{b}	10.20^{abc}
6%	32.40^{ab}	33.82	2.49^{bc}	9.77^{abc}
8%	31.57^{b}	33.74	2.30^{c}	9.33^{c}
CV%	3.57	9.06	4.79	8.54
SE	0.84	0.67	0.05	0.11
P	*	Ns	**	**

Ns= statically the values are not significant, * Significant at p< 0.05, ** significant at p< 0.01

conversion ratio in comparison to a maize- soybean diet. Haque *et al.* (1991) reported that broiler chicks fed on a diet with 93 g kg^{-1} extruded poultry by-product meal had similar body weights and feed utilization to those given an extruded, maize- soybean meal control diet. This product may be as part or complete replacement for the fish powder in poultry diets (Reddy, 1988).

Feed conversion ratio for the chicks fed the hatchery waste meal was higher than the maize- soybean meal control diet. Feed conversion efficiency (total period) of birds fed the high hatchery waste content diets was lower than control group (Table 2). According to a study, using the wastes from 8-16% in replacement with soybean meal and meat meal in diets, following causes would be better in quality: Egg producing rate, feed conversion ratio and layer of the eggs (its flexibility and special weight) (Vandepopuliere *et al.*, 1997).

The carcass yield values (Table 3) considered on the basis of the carcass weight was similar among the treatments and ranged from 68-69%. In the present study, with the increase of levels HW in diet were breast (p<0.05) and wing weight (p<0.01) decreased, abdominal fat (p<0.01) increased, but thigh weight not affect with the increase of levels wastes in diet that due to can be high fat and their deposit in body of chick and low feed intake by hatchery waste groups. It showed the best breast's weight in the wastes with 2% and a control groups.

Abdominal fat deposition showed significant effects were with fed waste, corresponding with the results of

Table 4: Meat quality parameters according to different of hatchery wastes levels in diets

	Trait			
Wastes	Flavor	Normal smell	Juiciness	Tenderness
0	4.84	4.60^{a}	3.90	4.40
2%	4.21	4.00^{b}	3.81	4.25
4%	4.29	3.57^{b}	4.01	4.03
6%	4.35	3.48^{b}	4.22	3.69
8%	3.83	3.46^{b}	4.52	3.51
CV%	4.08	5.47	6.88	4.72
SE	0.14	0.18	0.22	0.22
P	Ns	*	Ns	Ns

Ns= statically the values are not significant, * Significant at $p<0.05$

Zolitsch *et al.* (1997) and Lopez-Ferrier *et al.* (2001). Therefore, the present results show that in chicks, diets rich hatchery waste cause increased abdominal fat deposition. Pinchasove and Nir (1992) reported that saturate fatty acids content in the diet, increase fat accretion in chickens and increased the circulating Very Low Density Lipoprotein (VLDL) levels in the blood and effectiveness to boost of fat accretion in arteries, tissues and carcass.

Meat quality parameters: Table 4 showed the objective quality Meat parameters of the breast samples of chicks at various concentrations of HW. Different amounts of HW in diets indicated significantly differences in meat quality parameter as normal smell.

The breast meat of 8% HW group had least normal smell ($p<0.01$) and flavor of meat increased in control group. The grille breast meat of males was dainty than females between groups ($p<0.05$). The breasts of males that fed HW had no significantly more juiciness. Juiciness is associated with the retention of water within the muscular fibers of raw meat (Grashorn, 1995). On the other hand, with replacing HW in diets, were not significantly decreased the tenderness of the breast meat samples. One consideration in the use of HW as the n-3 and n-6 fatty acid source is it' s off flavor in bird diets and the reduced shelf life of the chicken meat. A combination of preserving agents and antioxidants may be used to increase shelf life and conceal the distasteful flavors (Farrell, 1995).

Biochemical parameters of the blood: Cholesterol of the serum in 35 and 56 day Cholesterol rate hadn't significant difference in serum of broiler fed of different levels as wastes in 35-day age, but it was significant due to age increasing in 56-day age ($p<0.05$). Wastes level increasing in feed caused to increase the blood's cholesterol (Table 5). That was as a result of the feed influence on the serum rate in greater ages. In following stage, animal's metabolism increased with metabolism of the fats.

Ohadi hayeri (1993) reported, with adding the fat into the broiler diets, the cholesterol will increase. Mohammad

Table 5: Serum characters between groups (mg dL^{-1})

	Trait			
			GLU	
Wastes	TG 56 day	CHOL 56 day	35 day	36 day
0	94.17^{a}	131.24^{c}	196.72^{b}	205.11^{c}
2 %	94.24^{a}	134.02^{cb}	199.12^{b}	206.23^{c}
4 %	93.63^{a}	134.81^{b}	202.41^{b}	210.02^{c}
6 %	90.72^{b}	138.30^{a}	215.50^{ab}	227.31^{b}
8 %	88.57^{c}	139.66^{a}	222.14^{a}	239.71^{a}
SE	0.21	0.92	1.06	1.19
P	*	*	*	*

TG = Triglyceride, CHOL = Cholesterol, GLU = Glucose, * Significant at $p<0.05$

Nezhad (1998) found cholesterol rate hasn't significant differences both at the ages 21-42 days. It had similar results with present study in age 35 day. The results in age of 56 day showed cholesterol concentration were high with increasing the age in the broilers. Except of the age, environmental, genetic factors or feed factors, also sexuality hormones role had been influenced on cholesterol rate increasing.

Triglyceride of the serum in 35 and 56 day: Blood's TG concentration hadn't significant difference between the treatments (35 day), but in age of 56 day, it was significant ($p<0.05$) (Table 5). Wastes level increasing in the feed caused to decrease TG concentration. The results agree with the findings of Pour Reza *et al.* (2005) and Peebles *et al.* (1997). No increasing in TG levels and VLDL in the Blood may be related to extra fat as a result of over compensate in physiological systems. This over compensate is related to reduce regulation of lipoprotein lipase enzyme. So, high TG levels and VLDL rates don't take place for the birds with full fat feeding. They could remove extra fat from blood's circulation system effectively.

Glucose of the serum in 35 and 56 day: Glucose of the serum in groups fed with the wastes was significant in ages of 35 and 56 day ($p<0.05$) (Table 5). Ritchie and Harrison (1994) reported glucose of the serum in young broiler is low than old. Stuarkie (1965) found out glucose level of hens is low than roosters. The results of this experiment towards other experiments of scientists were agreed in Blood's glucose and low differences in its concentration. Hatchery wastes adding with high fat in diets, caused to increase rate of metabolism or β-oxidation of fatty acids and glucose concentration in the birds rather than control group. So, glucose rate in plasma may be as form of substitutive by fatty acids or fats in diets, it is controlled by glycogen or glycogen to insulin (Sturkie, 1965).

CONCLUSION

Hatchery wastes had suitable protein value in compare to Soybean meal and meat meal. The results of present experiment indicated that HW is rich sources of protein and energy. Using of HW in the diets cause to increase protein and Calcium. Protein of the waste had biological value and high digestibility rate (Lilburn *et al*., 1997). It had good quality, because of unknown factors in growing and low rate of crude fiber (Ristic and Kormanjas, 1988) also using level in the feed was restricted with high rate of Ca in the wastes (Wiseman, 1964). Dietary HW in broiler effected in performance and with the increase of levels wastes in diet were weight gain decreased. HW may be from 2.5-10% used in poultry diets (a suitable feed for them) (Gupta, 1988). Ilian and Salman (1986) reported, normal level of HW is 2.5% in broiler diets. Performance of Chicken in diets of 2.5 and 5% as from of produced HW was as same as both. Reddy (1988) reported powder of HW, male chicken powder are good sources for the protein. We could be adding 15% of HW into the layer hen diets without of any influence on behavior in 15% level. This by-product will supply about 4% protein and 3% Ca in the feed (Vandepopuliere *et al*., 1997). So, wastes and rests of the hatchery institutes are no considered rather than soybean meal and fish meal, carrying and producing costly. Therefore using from these wastes to 4% level with keeping the infection and pollutions of the environment could be decrease the expense of broiler diets.

ACKNOWLEDGEMENT

Financial support for this study (Islamic Azad University, Shabestar Branch) was provided.

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