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Research article

Effect of feeding graded levels of hatchery waste meal on the performance and carcass yield of broiler chickens

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Abstract

This study aimed to evaluate the effect of feeding dietary graded levels of hatchery waste meal (HWM) on the performance and some carcass characteristics of broiler chickens. The field trail was carried out in an open sided deep litter poultry house in poultry farm situated at Atbra Town in North Sudan. The experiment for five weeks. One hundred and sixty 7days-old commercial unsexed broiler chicks (Hubbard F15) were utilized in the experiment. They were divided into four dietary treatments with four replicates/each (10 birds / replicate) following the complete randomize design. Four experimental diets contain 0.0, (control), 3%, 6% and 9% HWM were formulated in order to meet the nutrient requirement outlined by NRC (1994). By the end of the field trail four birds per treatment were randomly selected, slaughtered and eviscerated for carcass characteristics. The results showed no significant differences in feed intake (g/bird), weight gain (g/bird) and feed conversion ratio among birds fed 0.0, 3 and 6% HWM dietary treatment. Feeding 9% HWM resulted in a significant ($P<0.5$) lower in feed intake (g/bird), weight gain (g/bird) and poor feed conversion ratio compared to other dietary treatments. Carcass characteristics of bird fed 9% HWM were followed the same trend of the performance parameters. The results also revealed no significant difference in dressing % and drum stick weight between groups fed 0.0, 3 and 6% WHM, Breast and thigh weight were significantly improved by feeding 3 and 6% HWM compared to 0.0 and 9% HWM. Therefore, it can be concluded that HWM can be use as a potential non conventional protein source up to 6% in broiler diet without adverse effects on broiler performance and some carcass characteristics.

Keywords: Hatchery Waste, broiler, performance, carcass

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Introduction

The concurrent rapid evolution in poultry industry worldwide and specially in Sudan through the intensive poultry production and processing has resulted in the production of large volumes of wastes like manure, dead birds, slaughter houses offal, hatchery waste and others. Today poultry companies challenge to produce their own one day old chicks and restrict the importation of fertile eggs and chicks for economical and hygienic reasons by establishing hatcheries with high capacity. As a consequence, huge amount of hatchery waste is produced, which include solid waste (empty shells, infertile eggs, dead embryos, late

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hatchings and dead chicks and waste water. These wastes cause environmental pollution beside the difficulties and cost of disposing. Many researchers collaborated to address this problem by recycling hatchery waste to compose or poultry feed. Das et al. (2002) illustrated that most of the hatchery waste is sent to land fill or composting, which costs the chicken meat industry millions of dollars each year in disposal costs. Some of the hatchery waste is rendered. Land fill hatchery waste will break down naturally and produce methane which escapes to the atmosphere. Capturing and using the methane to prevent its release to air is beneficial to environment since methane has 21 times more global warming capacity than CO_2 (Climate Change Homepage, 2011). On the other hand, Van Slyke et al. (2005) and Van Slyke et al. (2007) studied the different methods of waste treatment, collection and system for separating liquid waste from solid waste in order to obtain a nutritionally valuable and hygienic hatchery waste management (HWM), the raw hatchery waste had been treated by different methods as described by many researchers such as Rendering Salminen et al. (2002), autoclaving, toasting, extruding, cooking (Khan and Bhatti, 2002; Alharthi et al., 2010; Phil et al., 2011; Mahmud et al., 2015), boiling (Kirkpinar et al., 2004 ; Abiola et al., 2004 and Phil, et al., 2011), enzyme or sodium hydroxide treatment (Kim and Patterson, 2000 and Phil, et al., 2011), ensiling and composting (Cambardella, et al., 2003; Phil, et al., 2011) and toasting and formalin treatment (Saima, 2001; Phil et al., 2011).

The nutritive value of end product of HWM had been determined by many researchers. Rasool et al. (1999) reported that HWM contains 44.25% crude protein (CP), 30.01% ether extract (EE), 1.90 % crude fiber (CF), 14.04% ash, 9.80% nitrogen free extract (NFE), 3600 Kcal metabolizable energy (ME)/kg. Sharara et al. (1992) determined the apparent metabolisable energy (AME) of` HWM by 23.9 MJ/kg, and the apparent amino acid availability of the HWM by 73%. Khan and Bhatti (2002) cooked raw HWM with water and mentioned that, HWM contained 32% CP, 16% EE, 0.9% CF,40% ash,11.4 %NFE, 20% Ca and 0.6% available P. AL-Harthi et al. (2010) concluded that HWM contained 36.5% CP, 28.5% EE, 1.2% CF, 27% ash, 18% Ca and 0.75% available P and 2850 kcal ME.

The optimum inclusion rate of HWM in broiler diet for the best performance is varied between researchers. Mehdipour et al. (2009) reported no significant difference in BWG of broilers fed 3, 4 and 4.5 % HWM in the starter and grower and the total periods, but feed effeciency was higher by 4% HWM. Khan and Bhatti (2002) observed no significant difference in body weight and feed efficiency among rations in which HWM replaced the fish meal at 0, 25, 50 and 75 levels in broiler rations in six weeks performance trial. Saima (2001) fed broilers different levels of HWM (2, 4, 6%), and observed that birds fed diets containing 4% toasted HWM gave the highest BWG and FI, while those fed diets with 6% level of cooked HWM showed the lowest BWG. Shahriar et al. (2008) stated that body weight gain and feed intake of broilers reared in different period were significantly affected by inclusion of HWM in their diet.

Additionally, some researchers studied the influence of HWM feeding on the performance of laying hens. Mahmud et al. (2015) fed 0, 4, 8 or 12 % of cooked, autoclaved or extruded HWM, respectively, and showed that the maximum egg production was achieved with 4% HWM processed by autoclaving. Moreover, AL-Harthi et al. (2010) showed that HWM could be fed to laying hens up to 10% without adverse effects on egg production traits and quality of fresh and stored eggs. Sathishkumar et al. (2008) issued that incorporation of HWM in Japanese quail breeder ration in place of fish meal at different levels did not influence daily mean FI and FCR per dozen eggs or per kg egg mass.

Materials and Methods

Hatchery waste collection and processing

Empty shells, infertile eggs, dead in shell chicks and dead chicks were procured from Arabian Poultry Breeder Company (Ommat) hatcheries in Khartoum State. Soon after collection, HWM was ground then toasted without addition of water and oven dried at 160°C for 2 h to obtain a well dried HWM which was packaged for onward milling using Apex® Hammer Mill. The dried product was subjected to microbiological examination to determine the level of contamination of Salmonella and *E. coli* according to the methods reported by McCapes et al. (1989). The HWM was later subjected to proximate analysis according to the methods outlined by AOAC (1990) (Table 1).

Housing and treatment

The study was carried out in the deep litter section of Atabra Veterinary Laboratory Poultry farm at River Nile state for a period of 6 weeks. The housing was well ventilated with a concrete flooring system and wire nettings on either side for proper ventilation. The pen was open sided for easy and proper ventilation while the wood shaving was used as litter material. The housing was fumigated with formalin 10% , two weeks before the arrival of the birds and locked up for two days. It was opened and washed with clean water, four days prior to stocking with birds and ventilated. The feeders and drinkers were washed and clean water for drinking was provided *ad libitum*. The birds were randomly distributed and used for the study.

Birds, diet and health

One hundred and sixty day old *Hubbard* broiler chicks were used for the study. The birds were assigned to four dietary treatments following a completely randomized design (CRD). Four experimental diets were formulated to obtain groups of 0, 3, 6 and 9% of HWM. The experimental diets were formulated to be isonitrogenous and isocaloric to meet the requirements of broiler chicks as outlined by NRC (1994; Table 1). Proper medication and vaccination programs were strictly carried out and good bio-security measure was maintained.

The broiler chicks purchased at day old were weighed on arrival at the farm and weekly thereafter. The chicks were brooded for two week. Data collection started from the first week to the fifth week of the study. The experimental birds were weighed at the beginning of the experiment and this marked the initial weight of the birds before the commencement of the study. The birds were then randomly allotted according to the bodyweight uniformity for the different treatments which were replicated three times. Birds were given 24 hours of free access to clean water (*ad libitum*) daily lighting regimen of 24h of light was maintained.

Data collection and analysis

The feed intake was measured by subtracting the feed remaining from that supplied the previous week. The birds were also weighed for weekly body weight using Camry® electronic digital scale 0.01g. Initial weight was subtracted from the final weight to get the weight gain. The feed conversion ratio (FCR) was obtained by dividing the average weight gain (g) by the feed intake (g). Mortality was also monitored for any death in the flock within the data collection period. No bird was culled.

Carcass characteristics

At the end of the 6th weeks, birds were weighed and starved overnight (except for water). Four birds (2male and 2 female), from each replicate were slaughtered without stunning, then scalded, manually plucked, washed and allowed to drain on wooden table. Evisceration was performed by a ventral cut and visceral as well as thoracic organs were removed. Eviscerated carcasses were weighed and then chilled for 12 hours, cold carcasses weighs were recorded and dressing percentage was calculated. Two carcasses (one male and one female) were randomly selected from each replicate for determination of carcass cuts (Breast, thigh and drum stick) relative weight.

Statistical analysis and experimental Design

A completely randomized design (CRD) was used in the experiment. Collected data were subjected to analysis of variance and the significant differences among different treatment means were determined by least significant differences (L.S.D) tests (Steel et al., 1997).

Results and Discussion

The determined chemical analysis of the HWM (Table 1) indicated that HWM contained 21.87% crude protein and 8.6% ether extract. However, these values were lower than that obtained by AL-Harthi, et al. (2010), Sohail and Bashir (2002) and Rasool et al. (1999) who determined CP of HWM as 35.5, 36.8, 44.25% respectively, mean while they found the following values for E.E. of HWM 28.5 ,16%, 30.01%,

Table 1: Determined chemical composition of HWM

Dry matter%	98.60
Crude protein%	21.87
Crude fiber%	1.40
Ether Extract %	8.60
Ash%	3.00
ME , MJ/ Kg*	15.50
Calcium %	24.00
Phosphorus %	1.25

*ME: value was calculated according to the equation of Lodhi, et al (1976).

Table 2: Composition and calculated analysis of the experimental diets

Ingredient	Hatchery waste	Inclusion rate	(%)	
	0.0	3	6	9
Sorghum	63.2	59.5	56.2	51.8
Ground nut cake	28.0	31.5	33.0	36.3
Concentrate*	5.0	2.5	2.0	0.0
Hatchery waste	0.0	3.0	6.0	9.0
DCP	1.2	1.3	1.1	1.5
Lime stone	0.9	0.0	0.0	0.0
L.Lysine	0.1	0.4	0.4	0.5
DL.Methaionine	0.1	0.1	0.2	0.2
Veg.Oil	1.3	1.6	0.9	0.5
Salt	0.1	0.1	0.1	0.1
Mycotoxin binder	0.1	0.1	0.1	0.1
Total	100	100	100	100
Calculated analysis				
Crude protein(%)	23.36	23.11	24.0	24.5
Crude fiber (%)	3.98	4.16	4.24	4.68
Lysine %	1.2	1.2	1.2	1.2
Methaionine %	0.51	0..5	0.5	0.5
Calcium %	1.1	1.2	1.5	2.6
Av.phosphrus %	0.45	0.45	0.45	0.41
ME(MJ/kg)	13.39	13.39	13.39	13.14

*Concentrate composition: Crude protein 35%, Crude fiber 6.0%, Crude fat 2.5%, Calcium 5.0%, Av. Phosphorus 4.4%, Lysine 10.0%, Methionine 3.0%, Meth+Cyst 3.41% and Metabolizable energy 2000Kcal/kg.

Table 3: Effect of feeding graded levels of (HWM) on the performance of six weeks old broiler chicks

Treatment / Parameter	Hatchery waste meal (HWM) Inclusion rate (%)				
	0.0	3	6	9	Level of sig.
Initial body weight (g/bird)	255.8	251.9	260.4	260.8	NS
Total weight gain (g/bird)	1722±63[a]	1700±45[a]	1602±52[a]	1188±33[b]	*
Final live body weight (g/bird)	1977.8±33[a]	1951±27[a]	1862.4±26[a]	1448.8±26[b]	*
Total feed intake (g/bird)	3071±18[a]	3063±9[a]	3074±11[a]	2898±10[b]	*
Feed conversion ratio (g feed/g gain)	1.78±0.07[a]	1.80±0.04[a]	1.92±0.07[a]	2.44±0.07[b]	*

Means within the same row with different superscript letters are significantly. LS = Level of significance * = Significant (P≤0.05), NS= Not significant.

Table 4: Effect of feeding graded levels of (HWM) on some carcass characteristics

Treatment / Parameters	Hatchery waste meal (HWM) Inclusion Rate (%)				
	0.0	3	6	9	Level of Sig.
Dressing percent (%)	74.4±1.09[a]	76.9±2.06[a]	75.1±1.07[a]	70.7±1.16[b]	*
Breast weight (g)	273±70 [b]	353±89 [a]	380±95 [a]	227±58 [c]	*
Thigh weight. (g)	180±45[b]	286.7±74[a]	246.7±65[a]	180±49[b]	*
Drumstick weight (g)	110±[a]	100±[a]	100±[a]	80±[b]	*

Means within the same row with different superscript letters are significantly. LS = Level of significance * = Significant (P≤0.05).

42.15 respectively, mean while they found the following values for E.E. of HWM 28.5 ,16%, 30.01%, 42.15 and 27% according to the sequence of mentioned authors (respectively). Moreover, the recorded energy of HWM in this study was 15.5 MJ (3690 Kcal) /kg ME, which is lower than that determined by Rasool et al. (1999) 4572 kcal ME/kg, but higher than 2850 Kcal /kg ME, which mentioned by AL-Harthi, et al. (2010). These differences in HWM chemical analysis can be attributed to persons and methods involved in the treatment of HWM. Irrespective to the difference in the chemical composition of HWM, it may be a good source of energy.

Table 3 showed the overall performance results. The results showed that feeding 3 and 6% (HWM) resulted in no significant differences compared to the control treatment 0.0 (HWM) in all overall performance parameters. The birds fed the diet containing 9% (HWM) showed a significantly (P<0.05) lower weight gain (g/bird), final live body weight (g/bird), feed intake(g/bird) and poor feed conversion ratio compared to other dietary treatments.

The significant (P<0.05) improvement in weight gain (g/bird), feed intake (g/bird) and feed conversion ratio (g feed/g gain) for birds fed 0.0, 3 and 6% (HWM) compared to those fed diet containing 9% (HWM). This result might be due to the optimum protein efficiency ratio, apparent protein digestibility, biological value and protein utilization provided from 3 and 6% (HWM) as optimum inclusion rates described by (Saimia, 2001; Medipour, et al., 2009). It can be seen that the improvement of amino acids profile due to the well balance played an important role in the above mentioned significant improvement of overall performance results.

Birds fed 9% HWM dietary treatment were significantly (P<0.05) lower in dressing percent (%) and drum stick weight (g) compared to those birds fed other dietary treatment. Breast weight and thigh weights of birds fed 3 and 6% HWM were significantly (P<0.05) improved compare to those fed the control diet and 9% HWM.

Conclusion

This study has shown that hatchery waste meal is a potential as an non conventional protein source and can be used up to 6% in broiler diets without noticeable adverse effects on broiler performance and some carcass characteristics.

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