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EVALUATION AND UTILIZATION OF SPENT HEN MEAL AS FEEDSTUFF IN COMMERCIAL BROILER DIETS

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SUMMARY

Approximately 1800 Kg of mortality losses of hens were collected frozen and stored over a four weeks period. The birds were rendered at a research facility, stabilized and dried. Samples were analyzed for chemical and amino acid composition.

The AME, AMEn, TME, TMEn, apparent and true amino acid availability (AAAA, TAAA) were determined using local mature Dandarawi roosters by force feeding assay. The averages of crude protein and ether extract in rendered whole meal (RHM) were 56.7 and 18.67%, respectively. Means AME, AMEn, TME and TMEn of the RHM were 3.258, 3.216, 3.41 and 3.287 kcal/g, respectively. The average of AAAA and TAAA in rendered whole hen meal ranged from 60 to 76% and 62 to 79%, respectively. The RHM was found to be pathogenic free and has substantial nutritional value for poultry.

A total number of 200 one day-old broiler chicks (*Arbor Acres)* were used in a 42-day trial to investigate the effect of using different levels (0, 4, 8, 12%) of RWHM on the performance and carcass quality.

Corn-soy beanmeal diets were used and all were formulated using linear programming to be isocaloric. The results indicated that diets containing 12% RWHM resulted in greater body gain than that observed with control diets. There were significant differences in body weight and total period feed intake due to level of RWHM in the diet. The birds that received 12% RWHM consumed more amount of feed. No significant differences in feed efficiency, mortality and carcass quality were observed except for breast meat. The breast meat yield (major and minor) was highest in chickens fed 12% RWHM.

The RWHM has substantial nutritional value for poultry and may be used up to 12% in corn-soybean diets.

Keywords: Spent hen meal, chemical composition, performanc, carcass quality

INTRODUCTION

Rendered products have included offal from large animals and poultry as well as feathers. The use of these materials have solved waste disposal problems, environmental pollution, to reduce the feeding expenses to the minimum level by replacing the expensive feedstuffs by cheaper and more abundant sources and providing valuable concentrated nutrients. Previous investigators used poultry by-product meal and found that it acceptable as a suitable ingredient for broiler diets and gave good results (Wisman *et al.*, 1958). Additional studies have been made with products containing various mixtures of offal, feathers and blood (Bhargava and O'Neil, 1975). Little research has been conducted on the use of spent hen meal (SHM) as unconventional feedstuff for broiler chicks. Zimmerman (1993) discussed the disposition and utilization of spent chickens by freezing, storing and subsequent transfer to a rendering facility. Rendering might be the solution to the spent chicken problems (Olejnik, 1995; Christmas *et al.*, 1996). SHM could be included in broiler diets up to 12% without affecting growth performance (Christmas *et al.*, 1996). On the other hand, Douglas *et al.* (1997) reported that growth performance was decreased by SHM when substituted at 15% of the corn-soybean meal. Therefore, the objective of this study was to determine the growth performance and carcass quality of chicks fed diets containing different levels of spent hen meal when substituted for corn-soybean meal diet.

MATERIALS AND METHODS

The present study was carried out at the Poultry Research Farm, Department of Animal Production, Faculty of Agriculture, Assiut University, Assiut, Egypt.

To obtain spent hen meal, arrangements were made with the Research Poultry Farm to collect the daily mortality losses (spent hens of Hy-Line and Dandarawi chickens) in household freezer and stored until adequate numbers were collected. On alternate periods, the frozen materials were moved from the farm to the research facility for rendering. Approximately 1800 kg of the whole hen mortality losses were collected over 6-mo period for the experimental purpose. The rendering process was accomplished in a vertical autoclave using the method described by Christmas *et al.* (1996). Thereafter, the autoclave was opened and the rendered materials were held for 30 min on filter trays to drive off moisture then transferred to an oven and maintained at 110 ^{0}C for at least 2 h in order to drive off as much moisture as possible. The materials were allowed to cool for approximately 30 min. Ethoxyquin was added at the rate of 200 ppm of raw material for stabilizing purposes and was collected in a clean plastic containers. At this time, samples for pathogen determination were taken in double clean plastic bags. After drying, the materials were ground through a hammer mill to reduce monogranular components to meal form. Blended samples were taken for chemical analysis. An additional 200 ppm ethoxyquin was added, and the material was returned to be stored at - 15 °C.

Force Feeding Assay

The force feeding assay was applied to determine true metabolizable energy (TME) and true amino acid availability (TAAA) of SHM. Six mature local Dandarawi roosters housed in individual wire cages equipped with automatic waterers, were used for this purpose. The roosters were deprived of feed for an initial period of 24 h and then force fed 30 g of the test ingredient (Sibbald, 1976). Another group of six birds was deprived of feed for a 48-h period following the initial 24-h period. This group served as a control to correct for metabolic fecal and endogenous urinary (MF and EU) losses (Sibbald, 1986). Total excreta were collected individually from all birds for a 48-h period after feeding to ensure a complete passage of the test feed (Sibbald, 1979). The collected excreta were dried, weighed, ground and were analyzed for dry matter, nitrogen, gross energy, and amino acids. Samples of SHM were analyzed for chemical composition using methods of AOAC (1984). Gross energy of the feedstuff and excreta were determined by bomb calorimeter. For amino acid analysis, pooled samples of the feedstuff and excreta were used and hydrolyzed with 6 N HCL as described by Smith *et al.* (1965) to determine their amino acid content. Amino acids were determined by the Central Lab. for Foods & Feeds, Agricultural Research Center, Ministry of Agriculture, Giza, Egypt. The method of Sibbald (1976 and 1986) was used to calculate the AME and TME values, which were corrected to zero nitrogen balance, giving AMEn and TMEn (Sibbald and Morse, 1983). The TAAA values were determined and corrected for MF and EU amino acids, as described by Likuski and Dorrell (1978).

A total number of 200 one day-old broiler chicks (Arbor Acres) in a 42-d trial were used. The chicks were nearly of the same weights and divided randomly into four treatments (50 each). Each treatment was divided into five replicates (10 each). The dietary treatments consisted of 0, 4, 8 or 12% spent hen meal replacing portions of other ingredients particular soybean meal. Corn soybean meal diets were used and all were formulated using linear programming to be isocaloric and isonitrogenous and equivalent in as many nutrients as possible. Strater diets were fed for the first three weeks of age and grower diets were fed for the last three weeks of age. The composition of the strater and grower diets can be seen in Table 4. Birds were supplied with feed and water for *ad libitum* throughout the study. All chicks were floor brooded and were reared under conventional managerial, hygienic and environmental conditions. Mortality was recorded daily, and individual body weights and feed intake were recorded at three week intervals till the end of the experiment. At 6 weeks of age, three birds from each treatment were randomly taken and deprived of feed for 12 hours, then weighed and slaughtered to complete bleeding and weighed, giblets (Gizzard, liver, heart), inedible parts and carcass yield were recorded.

The statistical analysis were conducted using the SAS general linear models procedure (SAS Institute, 1990). Differences among means were determined by Duncan's multiple range test. Significant differences were considered to be exist when $P<0.05$.

RESULTS AND DISCUSSION

The samples were negative for virus isolation and no bacterial pathogens were found upon evaluation.

Chemical and amino acid composition of SHM

The chemical and amino acid composition of SHM are presented in Table 1. The percentage crude protein for SHM in the present study was 56.7%, it was similar to published values (Christmas *et al.*, 1996; Douglas *et al.*, 1997). For ether extract, the present value (18.67%) was similar to that recorded by Douglas *et al.* (1997) and less by about 18.5% than that published by Christmas *et al.* (1996).

The amino acid values for the SHM reported herein fall within the range of values published by Haque *et al.* (1991); Christmas *et al.* (1996) and Douglas *et al.* (1997).

Metabolizable energy values of SHM

The metabolizable energy values of SHM are presented in Table 2. Mean AMEn (Kcal/g) of SHM in the present study was 3.216. It was lower by about 9% than that reported by Christmas *et al.* (1996) but higher by about 8% than that of poultry by-product meal (NRC, 1994). The observed TMEn value reported herein was higher than their corresponding value by Douglas *et al.* (1997) and by NRC (1994) for poultry by-product meal. Published information on metabolizable energy values (AME and TME) in SHM is not abundant as that for other feedstuffs. The present results indicated that the AMEn and TMEn of SHM were higher than those of poultry by-product meal listed in NRC (1994). The corrected TME value was slightly higher than their AME value (Table 2). The difference can be partially explained by the correction for metabolic and endogenous energy losses which was applied in the TME assay (Sibbald *et al.*, 1961).

Table 1. Chemical and amino acid composition of spent hen meal.*

Nutrient	Percentage
Moisture	3.69
Crude Protein	56.70
Ether extract	18.67
Ash	15.26
Crude fiber	1.44
Calcium	4.76
Ava.Phosphorus	3.00
Amino acids	
Asp	5.61
Thr	2.77
Ser	3.36
Glu	10.49
Gly	5.37
Ala	3.97
Val	3.21
Met	**
Arg	**
Ile	2.72
Leu	4.95
Tyr	1.65
Phe	2.65
Try	**
His	1.54
Lys	3.96

* Expressed on air-dry basis ** Not determined

Table 2. The metabolizable energy values of spent hen meal*

Content	Kcal/g
AME	3.258
AMEn	3.216
TME	3.410
TMEn	3.287

* Data are means of six birds

Amino acid availability of SHM

The results of AAAA and TAAA of spent hen meal are presented in Table 3. The average of AAAA values of SHM was 68.3% and ranged from 60.1% for aspartic acid to 76% for leucine. For TAAA, the average was 71.5% and ranged from 62.3 to 79% for aspartic acid and leucine, respectively. The last average was higher by about 11% than that reported by Douglas *et al.* (1997). The present study showed that leucine in SHM was more available than other essential amino acids. The AAAA values were lower than TAAA values, obviously because of the correction for MF and EU amino acid excretion.

Table 3. Apparent and true amino acid availability of spent hen meal*

Amino acid	AAAA%	TAAA%
Asp	60.1	62.3
Thr	66.3	68.1
Ser	61.7	64.9
Glu	62.9	67.8
Gly	61.1	63.8
Ala	65.8	69.1
Val	68.6	71.3
Ilea	74.9	78.3
Leu	76.0	79.0
Tyr	74.2	77.7
Phe	72.8	76.9
Try	**	**
His	69.2	72.8
Lys	74.2	77.8
Met	**	**
Arg	**	**
Mean	68.3	71.5

* Data are means of three pooled samples ** Not determined

Growth performance and carcass traits

The results of growth performance traits of broiler chicks during the periods from 0 to 3, 3 to 6 and from 0-6 wks of age are shown in Tables 5 and 6.

There was a significant effect of SHM level on the body weight of broiler chicks during the strater (0 to 3 wks) and grower (3 to 6 wks) of age. Birds fed the diets with 12% of the SHM had significantly higher body weight than did birds fed diets with 8% of the SHM. At 3 wk of age, birds fed 0, 4 or 12% levels of SHM produced body weights significantly greater than the birds fed the 8% level. The significantly greater body weights with 12% SHM level are in agreement with those obtained by Christmas *et al.* (1996). At 6 wk of age, birds received 12% SHM had significantly greater body weights than either 4 or 8% SHM treatments.

Table 4. Composition of the experimental diets

Ingredient%	Strater diet				Finisher diet			
	Control	4%	8%	12%	ontro l	4%	8%	12%
Corn yellow	59.0	61.0	63.5	63.5	66.5	69.7	71.4	69.6
Conc. 52%*	9.8	9.8	8.8	10.0	9.3	9.5	9.5	6.8
Bone meal	0.4	0.4	0.4	0.4	0.5	0.5	0.6	0.7
Soybean meal	28.3	23.3	18.8	12.5	21.7	15.8	10.3	8.0
Wheat bran	0.0	0.0	0.0	1.6	0.0	0.0	0.0	2.7
Corn oil	2.5	1.5	0.5	0.0	2.0	0.5	0.0	0.0
SHM	0.0	4.0	8.0	12.0	0.0	4.0	8.0	12.0
Sodium chloride	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2
Calculated analysis								
ME, Kcal/kg	3,212	3,212	3,217	3,217	3,193	3,198	3,198	3,199
Crude protein%	22.6	22.7	22.7	22.9	20.0	20.0	20.0	20.0
Ether extract%	4.6	5.5	5.4	5.9	5.3	5.0	5.2	6.0
Crude fiber%	3.5	3.2	2.9	2.7	3.2	2.9	2.5	2.6
Calcium%	0.95	0.99	0.96	1.00	0.92	0.98	1.00	0.94
Ava. Phos.%	0.47	0.47	0.45	0.49	0.45	0.46	0.48	0.44
Lysine%	1.10	1.10	1.10	1.10	1.00	1.00	0.99	0.98
Methionine%	0.44	0.45	0.45	0.48	0.41	0.42	0.43	0.42

Conc. 52% = broiler concentrate 52% crude protein (supplied the following per kilogram of the diet: Vit. A, 12000 IU; vit. D3, 2000 ICU; vit. E, 10 mg; vit k, 2 mg; vit. B1, 1 mg; vit. B2, 4 mg; pantothenic acid, 10 mg; folic acid, 1 mg; niacin, 20 mg; vit. B6, 1.5 mg; vit. B12, 0.01 mg; biotin, 0.05 mg; choline chloride, 500 mg; Fe, 30 mg; I, 1 mg; Zn, 55 mg; Mn, 55 mg; Cu, 10 mg; and Se, 0.1 mg.

Table 5. Performance of broiler chicks fed different levels of spent hen meal from 0 to 3 wks and 3 to 6 wks of age

	0 to 3 wks				3-6 wks			
SHM	Body weight (g)	Body gain (g)	Feed intake (g/bird)	Feed conversion (g feed/g gain)	Body weight (g)	Body gain (g)	Feed intake (g/bird)	Feed conversion (g feed/g gain)
0	486^a	444^a	750^a	1.77^a	1499^{ab}	1013^a	2178^b	2.18^b
4	487^a	445^a	705^c	1.71^a	1432^b	946^b	2127^c	2.32^a
8	418^b	375^b	640^d	1.81^a	1429^b	1011^a	2129^c	2.14^b
12	497^a	455^a	736^b	1.68^a	1551^a	1053^a	2239^a	2.15^b

a,b Means within a column with no common superscript differ significantly ($P<0.05$).

Table 6. Performance of broiler chicks fed different levels of spent hen meal from 0 to 6 wks of age

	0 to 6 wks		
SHM	Body gain	Feed intake	Feed conversion
%	(g)	(g/bird)	(g feed/g gain)
0	1457^{ab}	2927^{b}	2.02^{a}
4	1391^{b}	2832^{c}	2.08^{a}
8	1387^{b}	2769^{d}	2.02^{a}
12	1508^{a}	2975^{a}	1.99^{a}

a,b Means within a column with no common superscript differ significantly ($P<0.05$)

During the period from 3 to 6 wks of age, birds fed 0, 8 and 12% SHM exhibited greater body gain than those fed 4% SHM level. Birds that received 12% SHM exhibited a significant increase in body gain than those received 8% SHM at 3 wk of age and during the period from 0 to 6 wks of age.

There were significant differences in total period feed intake per bird, with birds fed 12% SHM consuming significantly greater levels of feed than did the controls. The treatment with the greatest body weight and body gain (12%) also had the largest feed intake during the period from 0 to 3 wks of age. The same trend was also shown during the period from 3 to 6 wks of age (Table 5). Birds that received 8% SHM had consumed the least amount of feed during the entire experimental period (Table 6).

Birds that received 8% SHM were significantly more efficient in converting feed to body gain than those birds fed 4% SHM during the period from 3 to 6 wks of age. On the other hand, control birds had significantly better feed conversion than birds fed 4% SHM during the grower period. These results are in contradiction with those by Haque *et al.* (1991) who found that the extruded whole hen diet supported better feed conversion than the control corn soybean meal diet.

There were no significant differences in mortality due to level of SHM in the diet of broiler chicks when recorded during the entire experimental period. Mortality over the trial period was low. Four chicks from groups fed 0, 8 and 12% died, but this was not due to the dietary treatment, since the death of three of them was accidental. However, a lower mortality rate in broiler chicks fed SHM was indicated by Christmas *et al.* (1996).

The results of carcass traits are presented in Table 7. There were no significant differences in carcass traits except breast meat due to level of SHM in the diet of broiler chicks when measured at 42 d of age. Boneless breast meat percentage as related to carcass weights for those birds fed diets containing 0,4 and 12% SHM were significantly greater than those of the birds fed 8% SHM.

Table 7. Carcass components of broiler chickens fed different levels of spent hen meal at the end of the experiment

Item	Control	4%	8%	12%
Live weight, g*	1705^{a}	1750^{a}	1552^{b}	1861^{a}
Feather%	5.90^{a}	4.90^{a}	4.90^{a}	5.00^{a}
Abdominal fat%	1.11^{a}	1.07^{a}	1.18^{a}	0.80^{a}
Dressing%	83.70^{a}	82.30^{a}	82.90^{a}	82.60^{a}
Giblets%	6.33^{a}	6.67^{a}	6.67^{a}	6.67^{a}
Boneless breast meat%	11.60^{a}	10.30^{a}	8.70^{b}	10.30^{a}
Bonless thigh meat%	10.40^{a}	11.90^{a}	10.60^{a}	11.00^{a}
Boneless drumestick%	10.40^{a}	9.80^{a}	11.10^{a}	10.70^{a}

a,b Means within a row with no common superscript differ significantly ($P<0.05$).
*Average of three birds per each treatment at the end of the experiment.

Therefore, the results of the present study indicate that up to 12% SHM could be included in broiler diets without affecting growth performance. Birds that received 12% SHM had the greatest body gain and slightly better feed conversion. The SHM has good nutritional value for poultry and may be used to replace a portion of corn soybean meal. The use of these materials may solve waste disposal problems, environmental pollution and reduce the feeding expenses to the minimal level by replacing the expensive feedstuffs by cheaper and more abundant sources.

Based on the reported findings that SHM contains approximately 56.7% CP, accordingly, the 12% level of SHM could save about 6.804 unit of CP representing about 29.58% to 34.02% of protein content of starter and grower diets, respectively.

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تقييم واستخدام مسحوق الدجاجات النافقة كمادة علف فى علائق كتاكيت اللحم التجارية

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إستخدام فى الدراسة ١٨٠٠ كجم من الدجاجات النافقة ، حيث جمع النفوق اليومى ووضع فى مجمد حتى يتم جميع الكمية المطلوبة واستمر التجميع لاكثر من ستة شهور . تم نقل هذه الكميات الى معامل بحثيه حيث تتم عملية الطبخ والتجفيف والتثبيت. أخذت عينات للتحليل الكيماوى وتقدير الاحماض الامينية . كما تم تقدير الطاقة الممثلة بصورها المختلفة AME, AMEN, TME, TMEN باستخدام نظام Force feeding مع طيور الدندراوى . كما قدرت قيم كل من الاستفادة الظاهرية والحقيقية للاحماض الامينية (AAAA, TAAA) .

اوضحت الدراسة أن هذه المادة بها نسبة بروتين تقدر بـ٥٦,٧٪ نسبة الدهن ١٨,٦٧ ٪ وكان متوسط قيم الطاقة لكل من AME, AMEN, TME, TMEN على الترتيب كالتالى:٣,٢٥٨ ، ٣,٢١٦ ، ٣,٢٨٧، كليو كالورى / جم وكان متوسط الاستفادة الظاهرية والحقيقية للاحماض الامينية يتراوح كالتالى:٦٠ – ٧٦٪،٦٢ –٧٩٪ على الترتيب. كما اوضح التحليل أن هذه المادة خالية من اى بكتريا ممرضه او فيروس .

بعد ذلك استخدم ٢٠٠ كتكوت تسمين عمر يوم (اربرايكرز) لمدة ٤٢ يوم (مدة التجربة)بهدف دراسة تأثير أستخدام مستويات مختلفة (صفر، ٤٪، ٨٪، ١٢٪) من مسحوق الدجاجات النافقة على معدل اداء وجودة الذبيحة للطيور المغذاه عليها. واستخدم فى الدراسة عليقة الذرة – كسب فول الصيويا كعليقة اساسية. ثم تم تكوين أربعة علائق متزنة لتغذية الكتاكيت عليها .

أظهرت الدراسة أن أضافة المسحوق بنسبة ١٢٪ ادى إلى زيادة فى وزن الجسم عن مجموعة الكنترول كما وجدت فروق معنوية فى كل من العلف المستهلك طوال التجربة ووزن الجسم راجعة إلى إضافة هذه المادة ، حيث أن الطيور التى تناولت ١٢٪ من هذا المسحوق استهلكت كميات أكبرمن العلف

ووضع أيضا أنه لا يوجد فروق معنوية فى كل من الكفاءه الغذائية والتفوق وجودة الذبيحة فيما عدا عضلات الصدر حيث وجد ان محصول اللحم (عضلات صغرى وكبرى) كان أعلى في الطيور المغذاه على عليقة بها ١٢٪ من المسحوق. أشارت النتائج أن هذه المادة لها قيمة غذائية لحد ما ويمكن أستخدامها حتى ١٢٪ في علائق (الذره- كسب فول الصويا) عند تغذيتها لدجاج التسمين.