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Effect of Feeding Different Levels of Groundnut Seed Oil Industrial Waste (Booza) on Protein, Energy Efficiency Ratio and Carcass Characteristics

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Abstract

A total of one hundred and eight, one -day old, unsexed Hubbard F15 broiler breed chicks were used to investigate the effect of partial replacement of groundnut cake and vegetable oils by groundnut oil production waste (GOPW).Chicks were subjected to four rations groups in a completely randomized design with 27chicks for each group. Energy, protein efficiency ratio, production efficiency factor, liveability and mortality, rate, and some carcass characteristics were evaluated during rearing period of broiler chicken. Chicks were fed with experimental diets for 5 weeks (2, 3, 4, 5, and 6 week). The diets were as follow: 1) starter diet (8-28 d), 2) grower (29-42 d) which groundnut oil production waste entered by. The GOPW was included at 0%, 5%, 7.5%, and 10% in each diet. The diets were adjusted to be iso -nitrogenous and iso -caloric. It was observed that GOPW inclusion to replace groundnut cake and vegetable oils decreased the cost of production and improved some carcass characteristics when compared with chick group fed on control diet. However, The GOPW inclusion up to10% was non significantly reduced efficiency of energy utilization, protein efficiency ratio, production efficiency factor, and some carcass parameters of broiler chicken. However, it is concluded that groundnut oil industry waste can partially substitute till 10% of the broiler diets without any negative feedback and reduce the cost of production and can be used as alternative protein and energy source in poultry industry

Key words: Feed cost, breast, drum

Introduction

The real problem of chicken's nutrition in Sudan lies in poultry feed, where feed is one of the most important requirements of the poultry industry, accounting about 70% of total costs ((Van der Klis *et al.*, 2010: AOAD, 1995). Although Sudan has 90-95% of the feed materials used in poultry feed available locally, however, dura, wheat bran, groundnut seed cake, sesame seed cake are considered the main source of protein and energy for poultry in Sudan (Babiker *et al.*, 2009). Groundnut seed cake is used commercially as the primary source of protein for poultry in Sudan (Ali *et al.*, 2011). Acute competition in food between humans and animals beside imported feed composition increased the total cost of the feed (AOAD, 1989). However.research es were done to find a

new alternative (Jurgen *et al.*, 1988; Mukhtar, 2007). Growth response in broiler chickens has been regarded as the primary criterion for determining the nutrient requirements of feed because the broiler chick is a proper experimental animal with a limited nutrient store, high nutrient demand and rapid growth rate (Ammerman, 1995). Groundnut oil industry waste can improve feed conversion ratio (Shamseldein, *et al* 2016). Protein efficiency ratio is a standard for evaluating the protein quality of foods and is calculated by divide weight gain of a given bird by its intake of a particular food protein during the test period. Ration energy, protein efficiency and protein efficiency ratio were more efficient in the lower-protein diets, (Aletoe *et al.*, 2000). Moreover, changes in protein and energy of ration resulted in small differences in energy efficiency ratio, (Starr, 1982). Feed costs represent more than70% of the cost of broiler production tends to make very important to broiler to use feed efficiently. Thus in the past feed efficiency has been improved through changes in a number of aspects of meat broiler production (Willems *et al.*, 2013). Feed conversion ratio can be defined as the quantity of feed intake per unit of body weight gain (Skinner-Noble, Teeter 2003).

GOPW, is Sudanese traditional name, is the residue of groundnut oil extraction processing in the process of raw oil filtering, composed principally of the kernels, with such portion of the hull, or fibre, and oil as may be left in the ordinary course of manufacture, It is paste (semi dried) in the texture at room temperature, gray in the colour, and as fresh groundnut cake in the odour.

The objective experiment was to investigate the inclusion of GOPW on protein and energy efficiency and some carcass characteristic of broiler chick.

Materials and Methods

Experimental location and duration: The study was conducted in the Sudan University of Science and Technology, College of Veterinary Medicine and Animal Production, during November – January,2014,2015.

***Treatments housing*:** Deep litter house was used in this study; the house was divided into twelve floor pens (9 chicks per pen and 10 cm^2 floor space/chick). Feed and water were provided ad libitum. The lighting regimen was continuous with 24 h of light daily throughout the experimental periods.

Experimental birds: A total of one hundred and eight, one day old unsexed broiler chicks (Hubbard F15) fetched from Arabic company for poultry mothers. The chicks were weighed by digital balance and the mean of initial weight was determined and divided into four groups and were kept under the same environmental conditions until experimental started.

Experimental diets: Four experimental diets, identified asT1 (GOPW , 0%), T2, (GOPW , 5%), T3, (GOPW , 7.5%), and T4 (GOPW , 10%), were formulated .Experimental rations were combined from three approximately iso-caloric and iso- nitrogenous diets, firstly was Pre-starter (from 1 to 7 day), secondly the Starter (from 8 to 28day) and thirdly the Grower (from 29 to 42 day).

Nutrients composition of groundnut oil industry waste: The basic nutrients composition of the feed materials was determined according to AOAC (1995). Metabolizable energy (ME) value was estimated according to the equation of Lodhi *et al.*, (1976).

Table 1: Chemical composition of groundnut oil industry waste (Booza)

Item	%
Moisture	1.37
Dry matter (DM)	98.63
Organic matter	95.01
Crude protein (CP)	42.57
Ether extract (EE)	41.96
Crude fibre (CF)	10.15
Total ash	3.62
Ca	0.30
Available	0.58
NFE	0.33
ME (cal/kg)	4093.83

Table 2: Ingredients and nutrient composition of broiler starter and grower diets

Treatment Ingredients	Starter %				Grower %			
	T1	T2	T3	T4	T1	T2	T3	T4
Sorghum	58.37	61.68	61.06	61.22	69.35	70.97	68.76	66.55
Wheat bran	1.8	0.11	1.13	1.79	3.09	2.79	5.19	7.72
G.N.C	30.35	25.11	22.49	19.75	19.64	14.44	11.7	8.93
Lime stone	0.8	0.9	0. 9	0.9	0.9	0.9	0.9	0.85
D.C.P	0.47	0.47	1.13	0.33	0.02	0	0	0
Lysine	0.48	0.57	22.49	0.63	0.5	0.6	0.65	0.65
Methionine	0.04	0.06	0.06	0.08	0	0	0	0
Salt	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Veg.oil	2.39	0.8	0.5	0	1.2	0	0	0
Concentrate	5	5	5	5	5	5	5	5
GOPW	0	5	7.5	10	0	5	7.5	10
Total	100	100	100	100	100	100	100	100
Calculated analysis								
ME (Mj/kg)	13.39	13.39	13.39	13.40	13.39	13.41	13.40	13.39
CP%	23.00	23.00	23.01	23.01	20.00	20.03	20.01	20.00
CF%	4.71	4.57	4.68	4.67	4.10	4.11	4.35	4.61
Ca%	1.02	1.06	1.07	1.04	0.94	0.95	0.95	0.94
Available%	0.45	0.45	0.45	0.45	0.35	0.36	0.38	0.40
Lysine%	1.12	1.13	1.13	1.12	1.01	1.04	1.05	1.01
Metionine%	0.51	0.51	0.50	5.00	0.43	0.41	4.00	0.39

Agriculture National Research Council (NCR, 1994)

Feed quality indices:The quantity of the feed given to birds on dry weight basis was calculated, based on moisture content while moisture-free refusal; was obtained by drying overnight at 100 °C. Feed intake was calculated as the difference between feed given and feed refused, which was further used to compute protein and energy intake. Feed consumption, protein intake, energy consumption and body weight gain were used to calculate the feed conversion ratio, protein efficiency ratio and energy efficiency ratio for each phase. The protein efficiency ratio was calculated as grams of weight gain per gram of protein intake, (Kamran *et al.*, 2008), whereas the energy efficiency ratio was computed as weight gain (g) ×100/total ME intake**,(**Kamran et al., 2008). The production efficiency factor (PEF) was

calculated as described by Lemme *et al.*, (2006)

$$\frac{\text{Live weight (kg) x Liveability (\%)}}{\text{Slaughter age of chicks (days) x Feed conversion efficiency}} \times 100$$

At the end of experiment, 5 birds from each replicate (withno visible abnormalities) were randomly selected and slaughtered, and data on carcass yield were recorded before and after chilled. Mortality of birds was also maintained during the whole experiment.

Statistical analysis: The data obtained were analyzed by using one-way analysis of variance (ANOVA), and the means were tested for significance by least significant different (LSD) using the Statistical package of social science (SPSS) version 16.0 (2007) computer program.

Results

According to the chemical analysis GOPW (table 1) is contained high of crude protein (42.57%) and consist of (98.63%) dry matter, (42.57%) crude protein, (41.96%) oils, (10.15%) crude fibre, (3.62%) ash, (0.30%) calcium, (0.58%) available phosphorus, (0.33%) nitrogen free extract, and the metabolizable energy was 4093.83 Cal/kg. Groundnut oil cake was varied in chemical composition according to extraction efficiency.

Protein efficiency ratio (PER) of birds fed on different diets: Results of protein efficiency ratio of broiler chickens fed on the four sets of diets shown in Table (3). The protein content of the experimental diets was similar, with a range between 23.1% in starter diets and 20.3 %, (There was no significant difference ($p<0.001$) in the protein intake of the birds.

Table 3: Protein efficiency ratio (PER) and efficiency of energy ratio (EER) of birds fed on diets containing different level of GOPW

Protein efficiency ratio (PER)					
Treatment Week	T1 M±Std.d	T2 M±Std.d	T3 M±Std.d	T4 M±Std.d	Sig.
2	3.09±0.06	2.75±0.13	2.76±0.12	2.74±0.44	NS
3	2.78±0.02	2.64±0.11	2.60±0.16	2.46±0.14	NS
4	2.84±0.08	2.95±0.18	2.59±0.10	3.04±0.58	NS
5	2.51±0.11b	3.02±0.36a	2.33±0.11b	2.44±0.18b	*
6	2.40±0.02	2.25±0.08	2.27±0.11	2.38±0.03	NS
Efficiency of energy ratio (EER)					
Treatment Week	T1 M±Std.d	T2 M±Std.d	T3 M±Std.d	T4 M±Std.d	Sig.
2	5.89±0.12	5.24±0.24	5.26±0.23	5.23±0.85	NS
3	5.30±0.03	5.03±0.21	4.97±0.30	4.70±0.28	NS
4	5.19±0.14	5.31±0.32	4.72±0.19	5.40±0.84	NS
5	4.17±0.19	4.84±0.71	3.87±0.19	4.23±0.06	NS
6	3.88±0.04	3.74±0.14	3.76±0.19	3.95±0.06	NS

a,b means the mean with different superscript in the same row are significantly different at P<0.05
NS means no significant difference
* Significance different P<0.05

Energy efficiency ratio of birds fed on different diets: Results of energy utilization of broiler chickens fed on the four sets of diets shown in Table (3). The ME content of the experimental diets was similar, with a range between 13.9 and 14.0 MJ kg-1, but efficiency energy intake (EEI) were non significantly higher (p>0.001) in week four and five diet groups than in other diet groups (Table 3).

Production efficiency factor (PEF): Weekly broiler production efficiency factor (PEF) of broiler chicks fed on experimental diets is shown in Table (4). No significant differences among different experimental groups during the experimental period in production efficiency factor.

Table 4: Production efficiency factor (PEF) of birds fed on diets containing different level of GOPW

Treatment	T1	T2	T3	T4	Sign.
Week	M±Std.d	M±Std.d	M±Std.d	M±Std.d	
2	165.60±9.14	131.80±14.06	142.58±11.82	138.89±33.65	NS
3	211.81±3.40	187.63±11.99	187.58±18.49	171.09±22.90	NS
4	159.94±17.78	246.45±5.45	226.09±17.99	255.50±46.88	NS
5	236.05±22.20	271.41±41.41	210.15±17.66	226.23±17.01	NS
6	245.91±11.24	227.19±13.05	230.95±8.57	242.78±19.85	NS

NS means no significant difference

Carcass characteristics: Carcass parameters of broiler chicks fed on experimental diets is shown in Table (5). No significant different were found in dressing%, liver%, heart%, spleen%, abdominal fat%, thigh%, wing%, dorsal (ante)%, and dorsal (post)%. Highly significant different (p<0.01) were found in gizzard% and the drum (p<0.05) which improved by entered 5%, 7.5%, and 10%, while significant different were found in breast% (p<0.05) which 0% was better than other groups.

Table 5: Carcass characteristic of birds fed on diets containing different level GOPW

Treatment	T1	T2	T3	T4	Sign.
Item			**Before chilling**		
Dressing	67.95±1.12	63.81±2.91	64.84±1.51	65.84±7.17	NS
Gizzard	2.48±0.03b	2.67±0.5a	2.71±0.6a	2.79±0.11a	**
Liver	3.45±0.41	3.78±0.20	3.86±0.28	3.45±0.13	NS
Heart	0.85±0.11	0.88±0.08	0.83±0.83	0.80±0.79	NS
Spleen	0.20±0.02	0.19±0.17	0.19±0.19	0.19±0.19	NS
Abdominal fat	1.77±0.18	1.59±0.38	1.71±0.36	1.62±0.05	NS
			Meat cut percent after chilling		
Breast	34.56±2.15a	30.06±0.81b	31.79±0.80b	31.16±1.15b	*
Thigh	16.37±1.12	17.90±1.16	18.07±0.48	18.41±0.60	NS
Drum	12.67±0.85b	14.76±0.75ab	13.85±0.91ab	14.80±0.84a	*
Wing%	11.32±0.71	12.91±1.29	13.20±1.10	12.67±1.33	NS
Dorsal (ante)	11.20±1.27	10.27±0.82	10.00±o.27	9.04±0.55	NS
Dorsal (post)	11.97±11.97	11.35±11.35	12.35±12.35	12.38±12.38	NS

a,b means the mean with different superscript in the same row are significantly different at (P<0.05) and for gizzard (P<0.01). NS means no significant difference, * Significance different P<0.05 ** Highly Significance different P<0.01

Overall broiler performance: The overall broiler performance of broiler chicks fed on experimental diets is shown in Table (6). The overall broiler performance was not affected by the inclusion of booza in the broiler diets.

Table 6: Main overall result of broiler performance and rations cost

Item	T1	T2	T3	T4	Sig.
Live body weight (g)	2151.40±78.27	2114.70±14.36	2140.10±91.74	2137.00±151.33	NS
Weight gain (g)	2025.90±77.49	1989.50±139.72	2014.70±92.84	2011.70±153.98	NS
Feed Consumption(g)	3620.10±86.22	3554.90±474.84	3909.30±139.20	3705.70±244.12	NS
Feed Conversion Ratio	1.79±0.04	1.78±0.112	1.94±0.05	1.84±0.09	NS
WaterConsumption(ml)	14371.00±499.33	14048.00±975.25	14830.00±600.64	13973.00±560.25	NS
PEF	234.95±13.38	226.45±3.16	211.50±12.32	220.60±23.65	NS
Dress. %	67.95±1.12	63.81±2.91	64.84±1.51	65.84±7.17	NS
1Kg Cost/ Pound	2.35b	2.29a	2.29a	2.28a	**

NS means no significant difference
** Highly Significance different P<0.01

Discussion

Crude protein of the Groundnut oil industry waste about 42.57%, it between the ranges of groundnut cake (Yousif and Afaf, 1999; Eyo and Olatunde, 1998). Groundnut oil cakes have generally been considered to be a highly digestible energy source (Jorgensen et al., 2000), which it consist 4093.83 ME (cal/kg) and it was very highest than groundnut cake (Yousif and Afaf, 1999). The nutrients composition of Groundnut oil industry waste observed in the present study compare well with the values reported by (Marker and Becker 1997). The similarities in nutrients composition with other finding indicate that surrounding factors such as season, geographical location and stage of maturity play a minor role in determining nutritive value. Good healthy status of experimental broiler chicks observed during the entire period of the present study, the mortality rate was negligible with no differences among all treatment groups. The finding indicate that supplementation by 5% of Groundnut oil waste to broiler chicks significantly ($p<0.05$) improved protein efficiency ratio values compared with others groups; it may be due to the fresh of Groundnut oil cake and the efficiency of oil addition in the feed is well known especially in poultry and pig production and it improves also the metabolism of proteins (Hartel, 1986). There was no significant difference in efficiency of energy utilization values between chicks fed the different levels of Groundnut oil cake compared with the control diet. Broiler industry and farmers around the world commonly use PEF as a performance indicator (Shane, 2013).

The result showed that no significant differences among different experimental groups during the treatment period in production efficiency factor, which it is lowert than the range reported by Tandoğan and Çiçek (2016) in Turkey. The result showed that no significant different were found in Dressing%, liver%, heart%, spleen%, abdominal fat%, thigh%, wing%, dorsal (ante)%, and dorsal (post)% . Highly significant different ($p<0.01$) were found in gizzard%, which may be due to little increased in feed consumption and significant different for the drum

($p<0.05$) which improved by entered 5%, 7.5%, and 10%, while significant different were found in breast% ($p<0.05$) which 0% was better than other groups.

Economically the addition of groundnut oil industry waste improved the weekly performance of broiler chicks, while the overall had no significant different except the price from the diets and resulted in economical benefits. The value of groundnut oil industry waste increase in case of increase in sorghum price or oils price (energy sources), groundnut cake (protein sources).

The lack of performance differences among the experimental birds may be attributed to, the feeds of the same energy and protein and proper management applied to the experiment.

Conclusion and Recommendations:

The study using broilers showed that groundnut oil industry waste can partially substitute till 10% of the broiler diets without any negative feedback and reduced the cost of production.

Considering these results and the high price of raw ordinary ingredients, particularly protein ingredient sources in poultry feeding; the incorporating of the groundnut oil production wastes in the diets of broiler is a real opportunity for stockholders to improve at lower cost, not only the productivity and nutritional status of their birds but also their income.

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اثر استخدام مخلفات صناعة الزيوت (البوظة) في تغذية الدجاج اللاحم على معدل فاعلية البروتين والطاقة و خصائص الذبيحة

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المستخلص:

تم استخدام مخلفات صناعة الزيوت (البوظة)كمكون علفي غير تقليدي في علايق الدجاج اللاحم بالنسب الاتية 0%و5% و 7.5% و 10% تم اجراءالتجربة باستخدام 108 كتكوت لاخم غير مجنس من سلالة(روص) في عمر يوم . وزعت عشوائيا الي 4 مجموعات بكل مجموعة 27 كتكوت, قسمت كل مجموعة الي ثلاثة مكررات متساوية. سجلت جميع الكتاكيت والتي تغدت على المستويات المحتلفة من مخلفات صناعة الزيوت (البوظة) انخفاضا ملحوظا فى سعر الكيلو وتحسن فى خصائص بعض صفات الذبيحة ;كما تلاحظ عدم وجود فروقات معنوية فى معدل فعالية للبروتين والطاقة و للعليقة المستهلكة و الوزن النهائي و الوزن المكتسب والكفاءة التحويلية. واوضحت النتائج عدم وجود فروقات معنوية للمعاملات مختلفة في نسب التصافي, الوزن الحار ,القطع التجارية , التركيب الكيميائي للحم ,الاختبارات الحسية للقطع التجاريةالمختارة(الفخ، الصدر، الساق.. اظهرت النتائج ان اضافة مخلفات صناعة الزيوت (البوظة) في علائق الدجاج اللاحم تحسن الاداء العام في كل المعاملات اقتصادية انه يمكن اضافة مخلفات صناعة الزيوت (البوظة) في علائق الدجاج اللاحم حتى % 10 دون اي تاثيرات سالبة.