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Effects of Replacement of Decorticated Sunflower Cake for Sesame Cake in Broiler Diets on Performance, Carcass Characteristics and Economic Efficiency

Mohamed Elamin Ahmed*, Nivien Mustafa Elfaki, and Talha Elsadig Abbas

Department of Animal Production, Faculty of Agricultural Technology and Fish Sciences, Alneelain University, P.O. Box 12702, Postal Code 11121, Khartoum, Sudan.
***Corresponding author:** Mohamed Elamin Ahmed. Email: moha_555@hotmail.com

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Abstract

This study was conducted to evaluate growth performance, carcass yield and economic responses of replacing decorticated sunflower cake for sesame cake in broiler diets. One day-old commercial Hubbard broiler chicks (n=160) were obtained from commercial hatchery. The chicks (44.64 ±0.72 g) were randomly allotted to 20 pens (1x1m) in groups of 8 chicks per each. The chicks were divided into five dietary treatments; each group was replicated four times. Starter and finisher experimental diet in which decorticated sunflower cake DSFC replaced sesame cake SC at 0, 25, 50, 75 and 100% were fed through the period of the experiment (42 days). The experiment was conducted in a completely randomized design. The results showed no significant (P≥0.05) differences in feed intake, live body weight, body weight gain, feed conversion ratio and protein efficiency ratio. However, live body weight, feed intake and body weight gain were steadily increased compared to control, except for 100% replacement. Relative weight of abdominal fat was not significantly (p≥0.05) different among DSFC supplemented groups compared to control. Economic results showed that the highest economic efficiency index EEI and the lowest cost index CI were obtained by birds fed on 100% replacement. It is to be concluded that decorticated sunflower cake can completely replace sesame cake without detrimental effect on overall performance and carcass characteristics.

Keywords: Decorticated sunflower cake, Broiler performance, Carcass, Economics.

Introduction

Feed represents the major cost in poultry industry. So, optimizing cost of poultry feed can be achieved using alternative, locally available ingredients. Sunflower cake is a relatively inexpensive protein source for poultry. It is the by-product of the extraction of oil from sunflower seeds. It can be made from whole or decorticated seeds, and can be mechanically and/or solvent-extracted. The usual process consists of cracking the seeds by the mechanical action of centrifugal or pneumatic. The resulting blend is winnowed to separate the hulls from the kernels. Thereafter, the kernels undergo mechanical pressing through expellers, resulting in a cake containing

15–20% of oil. This cake can subsequently be extracted with a solvent (usually hexane) to yield more oil. Pressing followed by solvent extraction is the most common industrial process (Jovanka *et al*., 2005). The crude protein of conventional sunflower cake usually varies between 33% and 37% (Jovanka *et al*., 2005). Corresponding fiber content may range between 18% and 23%. Obviously, the protein and fiber contents of sunflower meal are negatively correlated (Jovanka *et al*., 2005). Thus, the use of sunflower cake in poultry diet is limited by variations in its chemical composition, high fiber/low energy and low lysine contents (Senkoylu and Dale, 1999). Sunflower seeds contain about 20-30% hulls that are often removed before oil extraction because they reduce the quality of both oil and meal (Kartika, 2005 and Carré, 2009). A major advantage of sunflower cake is that it does not contain anti-nutritional factors such as those found in soybean, cottonseed and sesame meals. So, it is considered to be a safe feed for all species (Senkoylu and Dale, 1999). Ahmed *et al*., (2013) investigated the effect of replacing decorticated sunflower meal DSFM for groundnut meal. They observed increased weight gain, feed intake and protein efficiency ratio in broilers at 75%, 50% and 100% replacement, respectively.

The current study was conducted to investigate the effect of replacing sesame seed cake SSC with DSFC on broiler performance, carcass characteristics, internal organs and economic responses.

Materials and Methods

Study site and experimental birds: This experiment was carried out at the experimental poultry farm (open-house system) 8x12 meter of Faculty of Agricultural Technology and Fish Sciences, University of Elneelain, Jebal-Awlia, Khartoum. The prevailing temperature was ranging from 23 °C (minimum) to 37 °C (maximum) during experimental period (six week). One day-old unsexed commercial Hubbard broiler chicks were purchased from commercial hatchery. One hundred and twenty chicks were selected on the basis of uniform initial live body weight (44.64 ±0.72 g). The chicks were randomly allotted to 20 pens (1mx1mx1m) in groups of 8 chicks per pen. The chicks were divided into five dietary treatments; each group was replicated four times.

Decorticated sunflower cake and experimental diets: The nutrients composition of decorticated sunflower cake (DSFC) was carried out by Provimi B.V lab. The Netherlands. Feed ingredients prices were used to calculate the cost of different diets. Five isocaloric and isonitrogenous starter and finisher diets were formulated according to nutrient specifications recommended by National Research Council (NRC.1994). In these diets, decorticated sunflower cake DSFC replaced sesame cake SC at 0, 25, 50, 75 and 100%. For the first 3 weeks, the chicks were fed starter diets and then they were allocated to finisher diets. The composition of starter and finisher diets is shown in Tables (1 and 2), respectively. Chemical analysis of the

experimental diets was determined according to A.O.A.C. (1990).

Table 1: Composition of broiler starter diets containing graded replacement of decorticated sunflower cake for sesame cake

Ingredients	Replacement levels of sunflower cake for sesame cake				
	0% (A)	25%(B)	50% (C)	75% (D)	100%(E)
Sorghum	60.15	60.05	59.83	59.47	59.18
Sesame cake	29.60	22.20	14.80	7.40	0.00
Decorticated sunflower cake	0.00	7.40	14.80	22.20	29.60
Wheat bran	1.00	1.00	1.00	0.10	0.10
Super concentrates*	5.00	5.00	5.00	5.00	5.00
Lime stone	0.10	0.10	0.40	0.75	1.10
Dicalcium phosphate	0.30	0.40	0.40	0.45	0.47
Enzymes	0.10	0.10	0.10	0.10	0.10
Lysine	0.20	0.20	0.12	0.08	0.00
Choline	0.10	0.10	0.10	0.10	0.10
Vegetable oil	3.25	3.25	3.25	3.25	3.25
Mycotoxin binder	0.20	0.20	0.20	0.20	0.20
Calculated analysis					
ME (kcal/kg)	3157.05	3159.47	3157.94	3151.78	3147.94
CP%	22.33	22.32	22.29	22.25	22.21
Crude fiber%	4.17	4.22	4.27	4.31	4.36
Ca%	1.05	0.94	0.92	0.92	0.92
Available phosphorous%	0.44	0.45	0.45	0.45	0.45
Lysine%	1.09	1.14	1.11	1.12	1.10
Methionine%	0.64	0.62	0.60	0.58	0.56
Methionine + Cystine%	0.94	0.90	0.86	0.82	0.78
Determined analysis					
DM%	93.12	92.00	92.19	93.03	93.56
CP%	24.70	23.12	23.26	23.01	23.16
Crude fiber%	4.27	4.55	4.17	4.32	4.77
Ether Extract%	5.55	6.10	6.12	6.13	5.97

fiber 2.01%, EE 1.5%, Ash 35%, Ca 6.52%, Av. P 4.8%, Lysine *Cp 38%, ME 2010 kcal/kg, C. 10%, Methionine 3.7%, Methionine+Cystine 4.05%. Vitamin A 250000 IU/Kg, Vitamin D3 50000 IU/Kg, Vitamin E 500Mg/Kg, Vitamin K3 60 Mg/Kg, Vitamin B1/ Thiamin 20 Mg/Kg, Vitamin B2/ Riboflavin 100 Mg/Kg, Niacin Vitamin PP 600 Mg/Kg, Pantothenic acid/ Vitamin B3 160 Mg/Kg, Vitamin B6/ Pyridoxine 40 Mg/Kg, Vitamin B12 300 Mcg/Kg, Biotin/Vitamin H 2000 Mcg/Kg, Choline 10000 Mg/Kg, Vitamin C 4000 Mg/Kg, Folic Acid

Table 2: Composition of broiler finisher diets containing graded replacement of decorticated sunflower cake for sesame cake

	Replacement levels of sunflower cake for sesame cake				
Ingredients	0 %(A)	25%(B)	50%(C)	75% (D)	100% (E)
Sorghum	68.00	68.00	67.80	67.6	67.40
Sesame cake	18.00	13.50	9.00	4.50	0.00
Decorticated sunflower cake	0.00	4.50	9.00	13.50	18.00
Wheat bran	5.00	4.80	4.80	4.80	4.80
Super concentrates*	5.00	5.00	5.00	5.00	5.00
Lime stone	0.30	0.50	0.70	0.90	1.10
Enzymes	0.10	0.10	0.10	0.10	0.10
Choline	0.10	0.10	0.10	0.10	0.10
Vegetable oil	3.30	3.30	3.30	3.30	3.30
Mycotoxin binder	0.20	0.20	0.20	0.20	0.20
Calculated analysis					
ME (kcal/kg)	3182.90	3183.18	3180.06	3176.94	3173.82
CP%	19.22	19.19	19.16	19.14	19.11
Crude fiber%	3.93	3.94	3.97	3.99	4.02
Ca%	0.84	0.83	0.82	0.81	0.81
Available phosphorous%	0.36	0.36	0.36	0.36	0.35
Lysine%	0.84	0.87	0.90	0.93	0.96
Methionine%	0.52	0.51	0.49	0.48	0.47
Methionine + Cystine%	0.76	0.73	0.71	0.68	0.66
Determined analysis					
DM%	92.74	93.12	92.79	94.44	94.17
CP%	20.56	21.75	21.13	20.79	21.09
Crude fiber%	4.52	3.65	4.34	4.61	4.16
Ether Extract%	4.87	5.18	4.98	4.56	5.13

- As shown in Table 1.

Management: The chicks were raised on wood shavings litter. The birds in each pen had continuous access to one metallic drinker and one metallic tubular feeder. Drinkers and feeders were kept clean and leveled using red brick cuboids. Continuous light was provided throughout the experimental period by a combination of natural and artificial light. Artificial light was (12 hours) provided by incandescent bulb lamps of 60 watts. The bulbs were hanged about one feet height from the floor during the first two weeks and then maintained to about 6 feet. Before allocation of chicks, the house was carefully cleaned and disinfected. The birds were vaccinated via mix vaccine (IB+ Newcastle clone) at 5 days of age, and were vaccinated against infections bursal disease

(Gumboro) at 2 weeks of age, and replicated the doze at 3 weeks of age, finally the chicks were vaccinated via Newcastle (clone) at 4 weeks of age.

Experimental procedure: Feed intake and live body weight were determined weekly on a replicate base. Mortality was recorded daily as it occurred. Feed conversion ratio (FCR) was calculated as feed intake per weight gain. While protein efficiency ratio (PER) was calculated as weight gain per protein consumed. At the end of the experiment, birds were fasted from feed for an overnight and then weighed. The birds were manually slaughtered and carcass characteristics were determined. The cost of feed for producing 1 kg of BWG was calculated for each experimental diet. This was done by dividing the total price of feed that was consumed by the birds on each treatment by the overall BWG of the birds fed on that diet as stated by Bellaver *et al*. (1985). Moreover, the Economic Efficiency Index (EEI) and the Cost Index (IC) were calculated according to Fialho *et al*. (1992) as follows:

$$EEI = (MCe/CTei)\times 100$$

$$CI = (CTei/MCe)\times 100,$$

Where MCe is the lowest feed cost per kilogram of weight gain observed among treatments. CTei is the cost of the i treatment.

Statistical analyses: Data were analyzed in completely randomized design using the general linear model (GLM) procedure of SAS version 9.0 for windows (SAS Institute, 2003). Mean values ± standard deviation (SD) were reported. The treatment means with significant differences were compared using the Duncan's multiple range tests (Steel and Torrie, 1980).

Results and Discussion

Proximate and amino acids composition of DSFC are presented in Table (3). Proximate composition values are comparable to those found by Abbas and Yagoub (2008) who reported 41.04% crude protein, 16.8% crude fat and 7.63% crude ash. However, there were marked differences in terms of crude protein and crude fiber (Jovanka *et al*., 2005) who reported the crude protein of conventional sunflower cake usually varies between 33% and 37%. Corresponding fiber contents may range between 18% and 23%. Moreover Rezaei and Hafezian (2007) reported high fiber contents and low crude protein and ether extract. Lysine and methionine were relatively higher compared to the values obtained by Lúcio *et al*. (2011). This variation may be due to differences in cultivar, growth and storage conditions, the processing method and the degree of dehulling or decortication (Golob *et al*., 2002 and Jovanka *et al*., 2005). Moreover, high temperatures associated with processing can damage proteins and reduce the availability of several amino acids, particularly lysine (Dale, 1996).

Table 3: Chemical composition of decorticated sunflower cake

Nutrients	Composition%
Dry matter	94.60
Crude protein	41.60
Crude fat	14.70
Crude fiber	8.9

Crude ash	7.10
Methionine	0.96
Cysteine	0.45
Lysine	1.57
Aspartic acid	4.03
Threonine	1.55
Serine	1.86
Glutamic acid	9.16
Glycine	2.45
Alanine	1.81
Valine	2.25
Iso-Leucine	1.78
Leucine	2.76
Phenylealanine	2.06
Histidine	1.15
Arginine	3.94

Overall performance of broilers as influence by dietary graded replacement of decorticated sunflower cake for sesame cake is shown in Table (4). All performance parameters were not significantly ($p \geq 0.05$) affected by dietary treatments. These findings coincided with Furlan *et al.*, (2001) who reported that dietary sunflower meal at 15% could be fed to broilers from day of hatch without adverse effects on growth and feed utilization. Similarly, Mushtaq *et al*. (2006) did not report any harmful effects of adding sunflower meal up to 30% in young chicks of 14 days of age. However, the present results were disagreed with Tavernari *et al*. (2008) who reported a significant decrease in feed intake in the starter phase and total period at 20% Sunflower meal. However Ahmed *et al*., (2013) found that graded substitution of ground nut meal by decorticated sunflower meal had significant effect on overall performance. On the other hand, live body weight, feed intake and body weight gain were steadily increased compared to control, except for 100% replacement. Similarly, Rama Rao *et al*. (2006) reported that, body weight gain was not influenced by replacement of soybean meal by sunflower meal up to 67% in starter and 100% in finisher diet. Likewise, FCR and PER were consistently improved at 50 and 75% when compared to control and 25% replacement. This result is in agreement with Oliveira *et al*. (2007) who concluded that the dietary inclusion of 15% sunflower meal improves live performance. Furthermore, Kocher (2000) showed improved growth performance and reduced FCR at 35% inclusion rate of SFM. Many studies showed that sunflower meal can successfully replace soybean meal at 50% to 100% in broiler diets (Senkoylu and, Dale 1999). Reports on the use of SFM in poultry diets are not always consistent, probably due to differences in plant variety, chemical composition, processing method, bird age, and feed formulation techniques used in the various studies (Casartelli *et al*., 2006).

Table 4: The effect of dietary graded replacement of decorticated sunflower cake for sesame cake on overall performance

Parameter	Replacement levels of sunflower cake for sesame cake					
	0 %(A)	25 (B)	50 (C)	75 (D)	100 (E)	± SEM
Live body W	1830.0±119.50	1853.0±71.08	1900.0±30.75	1986.0±195.58	1876.0±105.24	58.99

(g/bird)						
Feed intake (g/bird)	3261.0±155.36	3311.0±147.22	3323.0±52.64	3365.0±156.56	3217.0±206.20	76.03
Body weight gain (g/bird)	1789.0 ±117.94	1810.0±71.90	1857.0±32.15	1943.0 ±195.49	1833.0±103.19	58.73
FCR (g feed /g Bwt gain)	1.83 ±0.07	1.83 ±0.15	1.79±0.03	1.75±0.19	1.75 ±0.03	0.06
PER (Bwt gain/protein consume)	2.71 ±0.10	2.71 ±0.22	2.76±0.04	2.87±0.32	2.83 ±0.04	0.09

Values are means of 4 replicates per treatment (8 birds/ replicate).
SEM: Standard error of the means from ANOVA d.f 15.

Carcass characteristics and internal organs evaluated in the present experiment (Table 5) were not significantly ($p \geq 0.05$) affected by dietary treatments except for relative weight of liver, length of intestine and relative weight of abdominal fat. However, relative weight of abdominal fat was not significantly ($p \geq 0.05$) different among DSFC supplemented groups compared to control. Similarly, Oliveira *et al.*, (2003) did not observe any significant effect on carcass and cuts yield when included 0, 15, and 30% sunflower meal in broiler diets.

Table 5: The effect of dietary graded replacement of decorticated sunflower cake for sesame cake on carcass characteristics

Parameter	Replacement levels of sunflower cake for sesame cake					± SEM
	0 %(A)	25 %(B)	50 %(C)	75 %(D)	100 %(E)	
Dressing % on hot base	77.14±8.93	78.79±4.03	72.57±6.33	74.10±4.77	78.22±4.55	3.00
Dressing % on cod base	74.14±7.61	75.36±4.77	71.05±6.15	69.96±3.09	75.57±5.16	2.78
Absolute wt of Abdominal fat	31.78 ^{b}±2.87	29.95 ^{b}±3.90	41.53 ^{a}±4.83	41.30 ^{a}±4.22	48.93^{a}±10.64	2.98
Relative wt of Abdominal fat	1.85 ^{ab}±0.35	1.65 ^{b}±0.06	2.05 ^{ab}±0.40	1.99 ^{ab}±0.30	2.56 ^{a}±0.77	0.22
Absolute wt of breast	167.64±22.56	205.15±32.58	205.78±26.42	204.75±30.46	209.81±33.92	14.74
Relative wt of breast	12.58±1.36	14.35±1.23	13.86±0.69	13.19±0.81	13.71±1.15	0.54
Meat bone ratio of breast	4.35±0.43	4.34±0.46	4.15±0.38	4.23±0.23	4.06±0.17	0.18
Absolute wt of thigh	110.40^{b}±8.73	135.75^{a}±11.53	136.53^{a}±24.75	132.38^{ab}±8.38	138.00^{a}±16.73	7.65
Relative wt of thigh	8.34±0.98	9.56±0.58	9.19±1.26	8.59±0.67	9.07±0.98	0.46
Meat bone ratio of thigh	4.43±0.83	5.18±0.45	4.94±0.88	4.79±0.49	5.15±0.51	0.33
Absolute wt of drumsticks	107.50±17.76	105.98±14.59	119.63±10.18	117.05±8.12	120.43±17.66	7.11
Relative wt of drumsticks	8.04±0.70	7.46±0.86	8.11±0.84	7.60±0.63	7.89±0.75	0.38
Meat bone ratio of drumsticks	2.76±0.19	2.40±0.20	2.38±0.52	2.84±0.97	2.37±0.37	0.27

Values are means of 4 replicates per treatment.

^{ab}Means ± SD with different superscripts in the same row were significantly different ($P \leq 0.05$).

SEM: Standard error of the means from ANOVA d.f 15.

The cost efficiency of experimental diets is listed in Table (6). It was found that the cost of starter and finisher feed was linearly lowered with the increase of replacement levels of DSFC. According to Senkoylu and Dale (1999), using of sunflower meal for poultry diets may be cost-effective in countries where soybean meal is not available or too expensive. Cost (SDG) of feed to produce 1 kg meat decreased proportionally with the increased levels of DSFC. Furthermore, the results showed that the highest EEI and the lowest CI were obtained by birds fed on 100% replacement. This is inconsistent with the results obtained by Furlan *et al*., (2001) and Tavernari *et al*., (2008). This could be due to low fiber content of DSFC in the present study.

Table 6: The effect of dietary graded replacement of decorticated sunflower cake for sesame cake on organs

Parameter	Replacement levels of sunflower cake for sesame cake					± SEM
	0 %(A)	25 %(B)	50 %(C)	75 %(D)	100 %(E)	
Absolute wt of liver	39.58±4.36	42.28±4.59	37.20±1.00	39.83±3.51	43.85±6.16	2.14
Relative wt of liver	2.28 ^{ab}±0.19	2.36 ^{a}±0.41	1.83 ^{b}±0.16	1.91 ^{ab}±0.17	2.27 ^{ab}±0.47	0.15
Absolute wt of gizzard	42.60±4.85	45.65±2.81	42.25±6.90	41.60±5.77	42.43±9.99	3.26
Relative wt of gizzard	2.49±0.53	2.55±0.40	2.08±0.43	2.01±0.40	2.18±0.47	0.22
Absolute wt of heart	11.30±1.25	9.90±0.91	11.05±1.32	11.73±4.06	11.35±0.97	1.04
Relative wt of heart	0.65±0.05	0.55±0.01	0.54±0.02	0.56±0.19	0.59±0.08	0.05
Length of Intestine	161.75^{b}±2.36	174.25^{ab}±8.92	176.75^{ab}±10.44	179.50^{a}±7.59	176.00^{ab}±15.36	4.94
Absolute wt of head	55.55±11.22	52.60±5.27	57.75±10.72	59.00±4.40	59.33±4.70	3.94
Relative wt of head	3.27±0.97	2.94±0.54	2.87±0.77	2.83±0.07	3.06±0.36	0.31
Absolute wt of shanks	38.50 ^{b}±173	40.50 ^{b}±5.88	49.80 ^{a}±6.72	43.00 ^{b}±1.41	40.80 ^{b}±0.42	2.06
Relative wt of shanks	2.23±0.26	2.24±0.22	2.46±0.47	2.07±0.17	2.10±0.18	0.14

Values are means of 4 replicates per treatment.

^{ab}Means ± SD with different superscripts in the same row were significantly different (P≤ 0.05).

SEM: Standard error of the means from ANOVA d.f 15.

Table 7: The effect of dietary graded replacement of decorticated sunflower cake for sesame cake on economic efficiency

	Replacement levels of sunflower cake for sesame cake				
Parameter	0% (A)	25 %(B)	50 %(C)	75 %(D)	100 %(E)
Cost (SDG) of 1 kg starter feed	3.228	3.153	3.077	3.004	2.927
Cost (%) of 1 kg starter feed	100	97.677	95.322	93.061	90.675
Cost (SDG) of 1 kg finisher feed	3.09	3.049	3.007	2.965	2.923
Cost (%) of 1 kg finisher feed	100	98.673	97.314	95.955	94.595
Feed cost (SDG)/1kg BWG	5.704	5.636	5.426	5.166	5.147
Economic efficiency index (EEI)	90.23	91.33	94.86	99.64	100.00
Cost index (CI)	110.82	109.49	105.42	100.36	100.00

Conclusion

This study indicated that decorticated sunflower cake can completely replace sesame cake without detrimental effect on overall performance and carcass characteristics. Birds fed on 100% replacement showed the highest economic efficiency index and the lowest cost index.

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