Effects of feeding diets containing undelinted undecorticated cottonseed cake on carcass characteristics of gilts

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Abstract

Twenty four crossbred (Large White X Hampshire) female weaner pigs of average initial weight of 12.6 kg live weight were raised for a period 126 days from weaner to growing-finishing stage of average weight of 71.0 kg in a trial in which undelinted undecorticated cottonseed cake (UUCSC) was fed at 0, 10, 20 and 30% of the 18% or 16% crude protein diets. Animals were randomly assigned to pens on the basis of initial weight group and there were two pigs per pen in a randomized block design trial. Animals were fed 5% body weight and had free access to drinking water. Gilts were weighed weekly and the trial lasted for 126 days. Twelve of the gilts were randomly selected and slaughtered for carcass analysis. As a result of this study, slaughter and carcass weights of gilts fed 30% UUCSC diet were significantly higher ($P < 0.05$) than those fed 0, 10 and 20% UUCSC diets. The prime cuts (ham, shoulder and loin) were similar across dietary treatments. There was significant linear ($P < 0.05$) reduction in loin-eye area while the back fat thickness significantly ($P < 0.05$) increased as the levels of UUCSC increased in the diets. The gilts fed 30% UUCSC had significantly ($P < 0.05$) lower liver, kidneys and spleen weights as compared to those fed 0, 10 and 20% UUCSC diets. Between the lungs and hearts of the gilts there were no significant differences ($P > 0.05$) among them. There was significant linear ($P < 0.05$) increase in stomach dimension while the gut dimensions were similar across dietary treatments. For good carcass quality, 20% UUCSC can be fed to gilts.

Key words: Carcass characteristics, Gilts, Organ weights, Undelinted undecorticated cottonseed

Introduction The continuous ingestion of gossypol, a toxic polyphenolic compound occurring naturally in cottonseed, has been reported to result in some abnormalities and infertility in pigs. These include hypertrophy and dilation of the heart (Smith, 1957) and changes in electrocardiogram (Albretch *et al.*, 1972). Degeneration of muscles and congestions of the organs (liver, kidney, spleen, lungs and lymph nodes) of the body of the pigs have been reported by Smith (1957), Kornegay *et al.* (1961), Clawson and Smith (1966), Buitrago *et al.* (1970) and Randel *et al.* (1992), Spruill *et al.* (1971) and Eisele (1986) observed that sows fed high levels of cottonseed cake diets had reduced conception rates, abortion and high piglet mortality.

Ikurior and Fetuga, (1985) observed that the percentages of lean meat, fat, bone and head of the pigs were not significantly affected when growing-finishing pigs were fed diets containing varied levels of cottonseed cake. However, the percentage fat increased linearly from 18.12% in the control diet to 20.97% in diet with 100% cottonseed cake. The average weights of the heart, kidney and lungs were unaffected by cottonseed meal substitution in the diets. The liver weight however decreased significantly in diet with 100% cottonseed cake as compared to the other dietary treatments (Ikurior and Fetuga, 1985).

Reports indicated that with growing-finishing pigs fed cottonseed meal, there were no significant differences with regards

to carcass yield or length. With increasing cottonseed cake in the diets, back fat thickness increased linearly and the percentages of ham and loin-eye area were significantly reduced (Moura and Lavorenti, 1979). These workers indicated that a combination of the 50% each of soybean and cottonseed meal as the source of protein was recommended for feeding grower-finishing pigs. Baustad, (1974) observed that the feeding of cottonseed meal (38% crude protein) with 0.11% total gossypol to finisher pigs at 8 and 10% levels did not produce any significant differences in carcass quality compared with the soybean meal control diet.

In the tropics, high levels of undelinted undecorticated cottonseed cake (UUCSC) are not fed to pigs mainly because of gossypol scare and the general uncertainty surrounding its use in diets other than those of ruminants. This study was therefore, to determine the effect of UUCSC based diets on the carcass characteristics of gilts.

Materials and methods

Study location

The trial was carried out at the Teaching and Research Farm of the Department Animal Science, Faculty of Agriculture, Ahmadu Bello University, Samaru, Zaria. Samaru is located within the Northern Guinea Savannah ecological zone of Nigeria between latitudes 11° and 12° North and between longitudes 7° and 8° East (Google Earth, 2011).

The zone has two seasons: the wet season starts in April/May and stabilizes by June and ending in mid-October. The mean annual rainfall is 1100 mm and the maximum temperature varies between 27 and 35°C depending on the season with a mean relative humidity of 72%. The dry season lasts from November to April with mean daily temperature ranging from 14 to

36°C and a mean relative humidity between 20 and 37% (Google Earth, 2011).

Animals and experimental design

Twenty four crossbreed (Large White X Hampshire) female pigs of average initial weight of 12.6 kg were obtained from herds of swine in Samaru and Kaduna town in Kaduna State. The weaner pigs were randomly assigned to pens based on initial weight groups. There were three replications for each of the four treatments. The treatments were randomly assigned to the pens within each of the replicates, with two pigs per pen in a randomized block design.

Experimental diets and management of animals.

Four iso-nitrogenous diets were formulated to contain 18% and 16% crude protein for the weaners and young gilts respectively. Undelinted undecorticated cottonseed cake (UUCSC) was incorporated in the diets at 0, 10, 20 and 30% levels with the diet containing 0 per cent UUCSC serving as the control diet (Tables 1 - 4). The diets were mixed in the Feed Mill, National Animal Production Research Institute (NAPRI), Shika - Zaria. Pigs were maintained on concrete floor pens throughout the trial period. All animals were dewormed with Ivomec® at the rate of 1ml. per 33kg body weight prior to the commencement of the trial. The weaner pigs were fed the 18% crude protein diets (Tables 1 and 2) for 42 days while the young gilts were fed the 16% crude protein diets (Tables 3 and 4) for a period of 84 days. The pigs were fed at 5% body weight daily, one half at 8.00 hour and the other half at 16.00 hour. Water was made available to the animals all the time and left-over feeds were weighed and recorded daily. The trial lasted for a period of 126 days.

Table 1: Ingredient composition of weaner diets containing undelinted undecorticated cottonseed cake (UUCSC)

Ingredients (%)	Levels of UUCSC (%)			
	0	10	20	30
Maize	43.45	38.20	32.96	27.71
Groundnut cake	22.15	17.40	12.64	7.89
Cotton seed cake	-	10.00	20.00	30.00
Maize Offal	15.00	15.00	15.00	15.00
Wheat offal	16.00	16.00	16.00	16.00
Bone meal	2.50	2.50	2.50	2.50
Salt	0.35	0.35	0.35	0.35
Premix*	0.25	0.25	0.25	0.25
Lysine	0.20	0.20	0.20	0.20
Methionine	0.10	0.10	0.10	0.10
Total	100.00	100.00	100.00	100.00
Calculated analyses:				
Crude protein (%)	18.02	18.00	18.00	18.00
ME (kcal/kg)	3240	3188	3068	2980
Crude fibre (%)	6.76	8.90	11.05	13.42
Calcium (%)	0.81	0.82	0.83	0.84
Phosphorus* (%)	0.76	0.83	0.85	0.88
Lysine (%)	0.74	0.80	0.84	0.86
Meth + cyst (%)	0.52	0.57	0.62	0.66
Diet cost/kg (N)	57.02	55.46	54.07	52.60

*Biomix grower premix contributed the following per kg of diet: vitamin A, 8,000 iu, vitamin D3, 1,500 iu, vitamin E, 7.0, mg, niacin, 15 mg, vitamin B1, 2.0 mg, vitamin B2, 2.5 mg, vitamin B12, 0.01 mg, vitamin K3 1.5 mg, pantothenic acid, 5.5 mg, folic acid, 0.5 mg, choline chloride, 175 mg, cobalt, 0.2 mg, copper, 3.0 mg, iodine, 1.0 mg, iron, 21 mg, manganese, 40 mg, selenium, 0.2 mg and zinc, 31 mg.

Met + cyst = methionine + cystine

ME = metabolizable energy

* = Available phosphorus

Table 2: Proximate composition of the major ingredients used in the weaner experimental diets

Parameters	Ingredients (%)					Diets			
	Maize	Groundnut Cake	Cottonseed Cake	Maize Offal	Wheat Offal	0 % UUCSC	10 % UUCSC	20 % UUCSC	30 % UUCSC
Dry matter (%)	91.55	91.71	93.50	90.92	91.10	93.00	92.19	91.60	92.04
Crude protein (%)	8.80	44.88	26.02	11.20	16.10	18.01	18.10	18.40	18.50
Ether extract (%)	5.20	7.35	8.50	6.15	4.50	7.42	7.61	7.85	7.95
Crude fibre (%)	2.15	4.65	13.15	10.60	12.00	4.40	7.20	9.16	10.00
Ash (%)	7.15	4.40	6.50	1.20	7.25	5.70	6.40	6.65	6.75
NFE (%)*	68.95	31.20	39.22	61.77	51.24	57.38	52.98	49.54	48.84
Gross energy (kcal/kg)	4430	4090	4240	4090	3960	4150	4280	4250	4360

*NFE = Nitrogen free extract

Carcass evaluation

At the end of the growing-finishing phase, 12 gilts were randomly selected (one gilt per pen) for carcass evaluation. Prior to slaughtering, the gilts were fasted overnight for 18 hours but had access to water. The carcasses were processed for data collection according to the Procedure of Devendra and Fuller (1979) and Eusebio (1980). Gilts were individually stunned using an Electric Stunner. The electrodes were applied at the back of the head and the current switched on for 10 seconds before the animals were bled. The gilts were bled by severing their jugular veins just below the head. The carcasses were scalded using hot water at 80°C temperature for five minutes and then dehaired using a dehairing machine. The carcasses were then

eviscerated. The visceral organs (lungs, liver, kidney, heart, spleen and pancreas) were excised.

The hind feet were removed from the hind legs 1.5 cm above the hock joint perpendicular to the shank line. The forefeet were also removed 1.5 cm above the knee joint perpendicular to the line of the shank. The ham was removed by a cut between the second and third sacral vertebrae along the axis of the shank. The shoulder was removed by cutting the surface area between the second and third ribs perpendicular to the backline. The loin was removed by cutting across the tenth and eleventh ribs. The belly was also removed by separating the loin through a cut of the tender loin 4 cm from the backbone. All the parts cut were weighed and expressed as

Table 3: Ingredient composition of finisher diets containing graded levels of undelinted undecorticated cottonseed cake (UUCSC)

Ingredients (%)	Levels of UUCSC (%)			
	0	10	20	30
Maize	39.20	33.94	28.69	23.44
Groundnut cake	18.10	13.36	8.61	3.86
Cottonseed Cake	-	10.00	20.00	30.00
Maize Offal	20.00	20.00	20.00	20.00
Wheat Offal	20.00	20.00	20.00	20.00
Bone Meal	2.00	2.00	2.00	2.00
Salt	0.30	0.30	0.30	0.30
Premix*	0.20	0.20	0.20	0.20
Lysine	0.10	0.10	0.10	0.10
Methionine	0.10	0.10	0.10	0.10
Total	100.00	100.00	100.00	100.00
Calculated Analysis (%)				
Crude Protein	16.00	16.00	16.00	16.00
ME, Kcal/kg	2913	2905	2878	2862
Ether extract	5.08	5.38	5.56	5.91
Crude fibre	6.60	8.77	10.90	13.03
Calcium	0.70	0.80	0.81	0.82
Phosphorus	0.77	0.85	0.90	0.92
Lysine	0.60	0.62	0.72	0.81
Methionine + Cystine	0.62	0.74	0.86	0.88
Diet cost/kg (N)	57.01	54.61	51.90	49.20

* Biomix breeder premix contributed the following per kg of diet: Vitamin A, 75.00 iu, Vitamin D3, 14.06 iu, Vitamin E, 0.16 mg, Niacin, 0.25 mg, Vitamin B1, 0.01 mg, Vitamin B2, 0.04 mg, Vitamin B6, 0.02 mg, Vitamin B12, 0.001 mg, Vitamin K3, 0.01 mg, Vitamin B12, 0.04, Vitamin C, 0.28 mg, Pantothenic Acid, 0.06 mg, Folic Acid, 0.01 mg, Biotin H2, 0.001, Choline Chloride, 1.88 mg, Cobalt, 0.01 mg, Copper, 0.02 mg, Iodine, 0.01 mg, Iron 0.13 mg, Manganese, 0.25 mg, Selenium, 0.01 mg, Zinc, 0.19 mg and antioxidant, 0.01 mg.

Table 4: Proximate composition of the major ingredients used in the finisher experimental diets

Parameters	Ingredients (%)			Diets					
	Maize	Ground-nut Cake	Cottonseed Cake	Maize Offal	Wheat Offal	0% UUCSC	10% UUCSC	20% UUCSC	30% UUCSC
Dry matter (%)	91.50	91.72	93.82	90.90	91.20	92.65	93.80	93.15	93.20
Crude protein (%)	8.80	44.88	26.02	11.20	16.10	16.00	16.10	16.20	16.26
Ether extract (%)	5.20	7.36	8.50	6.10	4.50	7.45	7.51	7.60	7.70
Crude fibre (%)	2.16	4.60	13.12	10.60	12.01	4.46	7.68	8.70	9.60
Ash (%)	7.15	4.40	6.51	1.20	7.25	5.68	6.35	6.40	6.62
Nitrogen free extract (%)	68.89	30.50	39.72	61.80	51.44	59.06	55.16	54.25	39.84
Gross energy (kcal/kg)	4432	4090	4160	4090	3962	4120	4210	4252	4301

percentages of the carcass weight. Back fat thickness was measured opposite the tenth rib and the junction between the second and third lumbar vertebrae using a 30-cm ruler. Loin-eye area was measured by tracing a cross-section of the right and left longissimus muscles posterior to the junction of the tenth rib (thoracic vertebra) by counting from the anterior end of the carcass (Devendra and Fuller, 1979 and Eusebio, 1980). The weights of the visceral organs (liver, lungs, heart, kidneys, pancreas and spleen) and empty stomachs were taken using a weighing scale. The contents of the gastro-intestinal tracts (small and large intestines) were removed before measuring their lengths with a measuring tape.

Analytical procedures

Chemical analyses

Samples of the major feed ingredients and experimental diets were analyzed for proximate composition and gross energy according to the Methods of AOAC (1995).

Statistical analysis

All the data collected were analyzed using Trend Analysis of the General Linear Model (GLM) Procedure of the Statistical Analysis System (SAS, 2000). Means were separated using Duncan's Multiple (Duncan, 1955).

The design of the experiment was a randomized block design. The model for

the analysis of variance was:

$$Y_{ij} = \mu + t_i + e_{ij}$$

Where

Y_{ij} = observation

μ = overall means of observations of interest

t_i = The fixed effect of i th treatment ($i = 1, 2, 3, 4$)

e_{ij} = Random error (identical and independently normally distributed with zero mean and constant variance).

Results

Carcass analysis

The results of the carcass analysis of the gilts fed 0, 10, 20 and 30% dietary levels of undelinted uncorticated cottonseed cake in their diets are presented in Table 5. There were significant differences ($P < 0.05$) between the dietary treatments in slaughter weights of the gilts. The slaughter weights of pigs in this trial fed 30% UUCSC diet was significantly ($P < 0.05$) higher than those fed 0, 10, and 20% UUCSC diets. Gilts fed the control diet had significantly higher slaughter weights as compared to those fed 10 and 20% UUCSC diets, while those fed 10 and 20% UUCSC diets were similar. The warm carcass weights of the gilts followed the same trend as the slaughter weights. Dressing percentage was not significantly ($P > 0.05$) affected by the

Table 5: Effect of diets containing undelinted undecorticated cottonseed cake (UUCSC) on carcass characteristics of gilts

Parameters	Levels of UUCSC (%)				SEM	Levels of significance
	0	10	20	30		
Slaughter weight (kg)	72.90 ^b	64.93 ^c	64.40 ^c	81.90 ^a	2.12	*
Warm carcass weight (kg)	50.10 ^b	44.99 ^c	44.00 ^c	56.67 ^a	0.84	*
Dressing (%)	68.72	69.29	68.32	69.19	1.05	NS
Ham (%)	24.22	23.09	23.06	25.01	1.65	NS
Shoulder (%)	46.42	46.30	46.86	45.10	0.82	NS
Loin (%)	12.76	12.47	12.91	13.30	1.04	NS
Loin eye area (cm ²)	25.10 ^a	23.27 ^b	23.23 ^b	23.00 ^b	1.29	*
Back fat thickness (cm)	2.30 ^b	2.32 ^b	2.37 ^b	2.50 ^a	0.32	*

*^{abc}: Means within the same row bearing different superscripts are significantly different ($P < 0.05$)

* = $P < 0.05$.

NS = Not significant

SEM = Standard Error of Means.

dietary treatments.

The percentages of the ham, shoulder and loin were not significantly ($P > 0.05$) affected by the levels of cottonseed cake in the diets of the pigs. There was a significant reduction ($P < 0.05$) in loin-eye area with increase in the level of UUCSC in the diets of the gilts (Figure 1). The gilts fed the 30% UUCSC diet had the least value of loin eye area. The back-fat thickness also increased linearly ($P < 0.01$) as the level of cottonseed cake increased in the diets of the gilts (Figure 2). The gilts on 30% cottonseed

cake diet the highest back fat thickness.
Organ weights and gut dimensions

The results of the effect of feeding diets containing undelinted undecorticated cottonseed cake on soft organ yields and gastro-intestinal dimensions are shown in Table 6. The liver yield decreased ($P < 0.05$) as the level of UUCSC was increased from 10 to 30 percent (Figure 3). Liver yield of the gilts fed 30% UUCSC was lowest ($P < 0.05$) as compared to the gilts on other UUCSC diets. There were no significant differences ($P > 0.05$) in liver yield of the gilts fed 0, 10 and 20% UUCSC diets. Lung

Table 6: Effect of diets containing undelinted undecorticated cottonseed cake (UUCSC) on organ yields and gut dimensions of gilts

Measurements	Levels of UUCSC (%)				SEM	Levels of significance
	0	10	20	30		
Liver (%)	0.23 ^a	0.24 ^a	0.22 ^a	0.17 ^b	0.02	*
Lungs (%)	0.74	0.74	0.70	0.69	0.03	NS
Heart (%)	0.40	0.40	0.39	0.39	0.01	NS
Kidneys (%)	0.27 ^a	0.26 ^a	0.23 ^a	0.20 ^b	0.01	**
Spleen (%)	0.18 ^a	0.18 ^a	0.17 ^a	0.15 ^b	0.01	**
Empty Stomach (%)	0.77 ^b	0.87 ^a	0.88 ^a	0.88 ^a	0.04	*
Small Intestine (cm)	137.00	138.10	138.33	140.00	4.43	NS
Large Intestine (cm)	41.10	41.10	41.30	41.60	0.51	NS

a, b: Means within the same row bearing different superscripts are significantly different ($P < 0.05$), ($P < 0.01$)

* = Significant at $P < 0.05$

** = Significant at $P < 0.01$.

NS = Not significant

SEM = Standard error of means.

Figure 1: Lean-eye area as affected by different levels of UUCSC diets (%)

Figure 2: Back fat thickness as affected by different levels of UUCSC diets (%)

Figure 3: Liver yield, as affected by different levels of UUCSC diets (%)

Figure 4: Kidney yield, as affected by different levels of UUCSC diets (%)

yields (0.74, 0.74, 0.70 and 0.69) were similar in diets containing 0, 10, and 20% and 30% UUCSC diets respectively.

There was no significant difference ($P>0.05$) in heart weights for all the dietary treatments. Kidney yield decreased ($P<0.01$) as the level of UUCSC increased in the diets of the gilts (Figure 4). Kidney yield of the gilts fed the 30% diet of UUCSC was significantly lower ($P<0.01$) than the gilts fed the three other diets of UUCSC. Spleen yield also decreased ($P<0.05$) as the level of UUCSC increased in the diets of the gilts (Figure 5). Spleen yield, in grams, of gilts fed 0, 10 and 20% UUCSC diets were not significantly different ($P>0.05$) from each other but significantly higher ($P<0.05$) than for gilts fed 30% level of UUCSC (Table 6).

Weight of empty stomach yield in grams increased ($P<0.05$) as the level of UUCSC increased across the dietary treatments (Table 6). The gilts fed the control diet had significantly lower ($P<0.05$) empty stomach yield compared with the gilts on 10, 20 and 30% UUCSC diets. There were no significant differences between the lengths of the small intestine and large intestine. The lengths of the guts (137.00, 138.10, 138.33 and 140.00 cm) and (41.10, 41.10, 41.30 and 41.60 cm) for small and large intestines respectively were not significantly different ($P>0.05$) as the level of UUCSC increased in the diets. Gilts fed 30% UUCSC diet had the longest guts compared to gilts on other gilts fed the 30% UUCSC diets.

Discussion

Carcass analysis

The significant differences ($P<0.05$) observed in slaughter and carcass weights of all the dietary treatments might be due to the increased crude fibre content of the diets as the level of cottonseed cake increased in

the diets. This is in line with the findings of Kenneley and Aherne (1980) who observed that pigs fed high fibre diets had lower average growth rate as compared to those fed the control diet. The results obtained in this study in terms of dressing percentage and percent ham, shoulder and loin are similar to those reported by Moura and Laverenti (1979) and Ikurior and Fetuga (1985).

Loin-eye area is a measure of the meatiness or leanness of the carcass of an animal. The significant decrease ($P<0.05$) in loin-eye area is an indication of reduced meatiness of the pigs as the level of UUCSC increased in the diets of the gilts. In this study, the value of the loin-eye area in the control diet (25.10cm^2) was significantly higher ($P<0.05$) than for the average value for 10, 20 and 30% UUCSC diets (23.17cm^2). Thus, the inclusion of UUCSC in the diets of the gilts reduced the meatiness of the carcass by 7.7%. Ikurior and Fetuga (1985), however, observed that the percentage of lean meat (meatiness), bone and head of pigs were not significantly affected by diets containing UUCSC. The results obtained in this study were not in agreement with this observation.

The significant increase ($P<0.05$) in back fat thickness of the gilts as the level of UUCSC increased in the diets is an indication of the increased fattiness of the gilts on UUCSC diets. The value of the back fat thickness for the 30% diet (2.50 cm) was significantly higher ($P<0.05$) than the average value of 0, 10 and 20% UUCSC diets (2.33 cm). Therefore, the inclusion of 30% UUCSC in the diets of gilts increased the fattiness of the carcass by 6.8%. Ikurior and Fetuga (1985) observed that the percentage fat increased linearly ($P<0.05$) as the level of UUCSC increased in the diets fed to gilts. The results of the present study were found to be in agreement with this

observation made by these writers.

In summary, the inclusion of up to 30% undelinted undecorticated cottonseed cake in the diets of female gilts had no adverse effect on percent ham, shoulder and loin. However, the meatiness and fattiness of the gilts were significantly reduced and increased respectively with increasing level of UUCSC in the diets of the gilts.

Organ yields and gut dimensions.

The significant decrease ($P < 0.05$) in the liver, kidney and spleen yields of the gilts fed 30% UUCSC diets as compared with those gilts fed 0, 10 and 20% might be due to the effect of gossypol on the organs. In several studies on the pathology of gossypol poisoning in the pigs, Buitrago *et al.* (1970) and Ikurior and Fetuga (1985) reported that there were severe congestions of the liver, kidney, spleen and lungs of pigs and concluded that there was an inverse relationship between free gossypol and liver weight in pigs.

Although the relatively low levels of free gossypol might be contained in the glandular type of UUCSC in the tested diets of this study, it is possible that some toxic gossypol effects might have manifested in the livers, kidneys and spleens of the gilts fed the diets containing the highest level of UUCSC (30%).

Since gossypol poisoning also affects pig spleen, the lower average spleen weight obtained for gilts fed 30% UUCSC diet may be associated with the dietary free gossypol. The fact that only the percent liver, kidney and spleen yields, among the organs studied, appeared to have been affected in the present study was found to be consistent with the findings of Buitrago *et al.*, (1970) and Ikurior and Fetuga, (1985) who reported that gossypol is released from tissues and deposited in the liver and spleen, from where slow depletion occurs. In the

present study, the mean values of percent liver, kidney and spleen for 0, 10 and 20% were not significantly different ($P > 0.05$) but were significantly higher than 30% level inclusion of UUCSC. The 30% UUCSC diet value amounted to reductions of 26.09, 20.00 and 16.67% yields in the liver, kidney and spleen of the gilts respectively.

The significantly heavier ($P < 0.05$) empty stomachs of the gilts fed UUCSC diets compared to those on the control diet in this study might be due to the increased level of dietary fibre in the diets. This observation agrees with the findings of Pond *et al.* (1981) who observed increases gut dimensions as the level of crude fibre increased in the diets of gilts. This suggests an adaptation mechanism by pigs in an attempt to accommodate more of the large quantities of bulky feedstuffs in their diets. In the present study, the average value of empty stomach yield for 10, 20 and 30% UUCSC level of inclusion (0.88%) was significantly higher than for the value of the control diet (0.77%). This suggests an increase of 11.36% in the stomach dimensions of the gilts fed the diets containing UUCSC. The numerical increases ($P > 0.05$) in the length of the small intestine as the level of UUCSC increased in the diets might be due to the increased level of dietary fibre in the diets. This observation agrees with the findings of Pond *et al.* (1981) who observed increases in gut dimensions as the level of crude fibre increased in the diets of pigs.

Conclusion

The inclusion of more than 20% UUCSC in the diets of gilts increased the meatiness and fattiness of the carcass. Increasing the level of UUCSC above 20% in the rations of gilts resulted in increased stomach dimension and reduction in liver, kidney and spleen yields of gilts. The feeding of up

to 30% UUCSC diets to gilts had no adverse effect on their lungs, hearts and gut dimensions. It is concluded that undelinted undecorticated cottonseed cake should be fed only up to 20% in order to obtain good carcass quality.

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