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CARCASS AND SLAUGHTER TRAITS OF WEANLING PIGS FED GRADED LEVELS OF WILD SUNFLOWER (*TITHONIA DIVERSIFOLIA)* LEAF MEAL

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ABSTRACT

Growing pigs were used to assess the slaughter and carcass characteristics, organs and primal cut yields when fed diets supplemented with processed leaves of *Tithonia diversifolia* (wild sunflower) referred to as *Tithonia diversifolia* leaf meal (TDLM). A 63-day feeding trial was conducted with commercially available male Large White growing weanling pigs on four experimental diets containing 19.0% crude protein and a digestible energy value of 2997 kcal/kg. *Tithonia diversifolia* leaf meal (TDLM) progressively replaced soybeans at 10%, 20% and 30% inclusion levels in diets 2, 3 and 4, respectively. Carcass yields for pigs on 10% TDLM were similar ($p>0.05$) to the values obtained for pigs on the control diet without TDLM. Most other carcass parameters such as carcass length, chest width, trochanter width and leg length were similar ($p>0.05$) and variations where they existed were minimal. Slaughter traits such as live weight at slaughter, empty slaughter weight, dead weight and back fat depth were significantly better ($p<0.05$) for pigs on the control diet without TDLM inclusion at 20.2kg, 14.6kg, 19.1kg and 0.9cm, respectively. These values were closely followed by the values obtained for pigs on 10% dietary TDLM inclusion at 15.6kg, 11.5kg, 15.1kg and 0.5cm for live weight at slaughter, empty slaughter weight, dead weight and back fat depth, respectively. Poor values of empty slaughter weight, body mass index, dead weight and back fat depth were recorded for pigs on diets 3 (20% TDLM) and 4 (30% TDLM) ostensibly due to the low feed intake and subsequent poor weight gain and high feed conversion ratio. The above trend was repeated for offals and organs yields. However, reproductive organs were not adversely affected even at 30%. Most determined experimental pig primal cuts were within moderate ranges according to literature and also similar to values obtained for pigs on experimental control diet. Conclusively, pigs on 10% TDLM inclusion level had comparable slaughter/carcass traits, organs and primal cut yields with pigs on the control diet without TDLM and also with most reported values in existing literature. Growing pigs tolerated TDLM and in some cases surpassed the performances of pigs on conventional growing pig diets. Further research studies may be necessary to investigate the nutritional value of TDLM when more adequate processing techniques are employed to reduce its anti-nutrients.

Key words: Carcass, primal cuts, back fat

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INTRODUCTION

Pork production takes a key role in animal agriculture providing over 42% of global meat consumption [1]. Pigs performed well when fed with forage meals, and the conventional protein required for pigs could be reduced by up to 40% when the protein in the diet has the required balance of essential and non-essential amino acids subsequently referred to as the ideal protein which could be complemented by the leaf meal [2]. In addition, pigs have the capacity to consume and digest fibre, and leaves from trees, shrubs and crop plants which are relatively high in fibre [3]. Wild sunflower (*Tithonia diversifolia)* is a shrub in the family *Asteraceae*, it is an annual aggressive weed growing to a height of about 2.5m and adaptable to most soils. In Nigeria, it can be found along major roads, abandoned/waste lands, water-ways and as invader of field crops in the forest savanna transition zone [4]. It can be cultivated by resource poor farmers who manipulate planting density to achieve maximum yield [5]. Little information exist on the effects of wild sunflower (*Tithonia diversifolia*) on the growth performance and carcass traits of poultry birds, rabbits, ruminants and growing pigs. It was reported from a previous study that weaner rabbits can tolerate the inclusion of 15% wild sunflower (*Tithonia diversifolia*) leaf meal in their diet, while the inclusion of up to 20% adversely affected their daily weight gain and ultimately, their final live weight [6]. The aim of this present study was to investigate the carcass qualities, slaughter traits, organ and primal cut yields of weanling pigs when fed varying levels of *Tithonia diversifolia* leaf meal as a replacement for conventional protein supplement. The justification of this study could be derived from the viewpoint of natural abundance and availability of *Tithonia diversifolia* in the forest savanna transition zones in Nigeria.

MATERIALS AND METHODS

Preparation of test ingredients

The test ingredients *Tithonia diversifolia* leaf meal (TDLM) was prepared by harvesting daily, the fresh and matured leaves of *Tithonia diversifolia* plants of different ages before flowering. The whole leaves were chopped manually using kitchen knives and then sun-dried. Sun-drying was done for 4 days, and the chopped leaves were manually turned using a rake so as to guarantee even-drying to 12-13% moisture content. Fresh and dried samples of *Tithonia diversifolia* leaves were taken to the laboratory for proximate and chemical analyses even before the inclusion of the dried samples into the diets [7].

Experimental animals

A total of twenty four (24) male growing pigs (about $2^1/_2$ months old) of commercially available crosses with a mean body weight of 13.3±0.5kg were used for this study. The experimental pigs were given adequate medication to prevent piglet anaemia and worms at the first week of their arrival.

Standardization of experimental animals before feeding trial

The 24 male growing pigs were all randomized into separate pens for this pre-feeding trial and each pen housed an experimental pig. They were all served a standard

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growing diet for pigs compounded with conventional feedstuffs as shown in Table 1. Daily feeding rate was 3.30% of the pigs' live weight and the pre-feeding trial was conducted for 10 days. Water was given to the pigs *ad libitum* throughout the period of the trial. The daily feed consumption in g/day was calculated and divided by the average daily weight gain also in g/day to obtain the feed conversion ratio means for all the pigs on the standard pig diet.

The feeding trial was carried out at the piggery unit of the Teaching and Research Farm (TRF) of the University of Ado-Ekiti for a period of 63 days. Four diets (D1, D2, D3 and D4) were formulated to contain about 19.0% crude protein and a digestible energy value of about 2997 kcal/kg. The control diet was a standard growing diet for pigs compounded with conventional feed stuffs e.g. maize, soybeans, palm kernel cake (PKC), oyster shell, bone meal, brewer's dried grains (BDG), wheat offals, fish meal, salt and grower premixes. The other three diets were compounded such that *Tithonia diversifolia* leaf meal (TDLM) progressively replaced soybeans at 10%, 20% and 30% inclusion levels in diets 2, 3 and 4, respectively. Daily feeding rate was 3.30% of the pigs' live weight. Water was given to the pigs *ad libitum* throughout the period of the experiment. The daily feed consumption in g/day was calculated and was divided by the average daily weight gain (g/day), to get the feed conversion ratio means for all the pigs on the four experimental diets.

Slaughter and carcass quality traits, organs weights and primal cuts yields
Eight pigs (two from each experimental diet) were selected for sacrifice at the end of the feeding trial, and the following parameters were measured for slaughter traits as outlined in USDA Farmer's Bulletin [8]: empty slaughter weight, blood weight, dead weight and body mass index. Offals of slaughtered pigs were separated and measured as weight of head, weight of feet from knee, length of front and back legs.

Carcass quality traits were measured in centimetre (cm) using measuring tape except carcass yield which was calculated as percentage of live weight and outlined in USDA Farmer's Bulletin [8, 9] as follows: % carcass yield (the animal weight less head, foot, skin and gut content), carcass length (distance from end of leg to crouch), carcass width (distance from scapular to sternum), trochanter width and leg length.
Organs measured were spleen, lungs, heart, stomach, intestine, liver, kidney, bile and testes using a sensitive digital measuring scale and were expressed as percentage of carcass weight as outlined in USDA Farmer's Bulletin [8]. Primal cuts were assessed as a percentage of hot carcass weight for individual slaughtered animal, and these cuts include the half cut, quarter cut, shoulder, bacon, ham, ribs and loin eye as outlined in USDA Farmer's Bulletin [8].

Statistical analysis
The data collected in the completely randomized experimental design were subjected to statistical analysis using the Minitab Computer Software package (2005 version).

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RESULTS

Carcass qualities of experimental pigs

The carcass yields (shown on Table 1) of pigs on diets 1 and 2 were similar ($p>0.05$) at 59.3% and 59.1%, respectively. These values were higher and significantly different ($p<0.05$) from the carcass yield values obtained for pigs on diets 3 and 4 which were also similar ($p>0.05$) at 53.9% and 51.4% for diets 3 and 4, respectively. All experimental pigs on all diets had similar ($p>0.05$) average carcass length of 62.6cm, 64.6cm, 62.6cm and 61.6cm for pigs on diets 1, 2, 3 and 4, respectively. Apart from pigs on the control diet 1 which had a significantly higher ($p<0.05$) carcass width of 28.6cm, other carcass width values were similar ($p>0.05$) at 25.3cm, 26.3cm and 26.3cm for pigs on diets 2, 3 and 4, respectively. Chest width values differed significantly ($p<0.05$) among pigs on all experimental diets. Pigs on diet 3 had the highest chest width value of 17.2cm, while pigs on diet 2 had the lowest chest width value of 14.2cm. The trochanter width values were similar ($p>0.05$) for all pigs on the four experimental diets at 21.3cm, 20.3cm, 20.3cm and 20.3cm for pigs on diets 1, 2, 3 and 4, respectively. The leg length value obtained for pigs on the control diet 1 was highest at 33.6cm, but similar ($p>0.05$) to the leg length values obtained for pigs on diets 2 and 3 at 30.6cm and 30.6cm, respectively. Pigs on diet 4 had the lowest leg length of 29.6cm, but also similar ($p>0.05$) to values obtained for diets 2 and 3.

Slaughter traits of experimental pigs

Slaughter traits are presented in Table 2. Apart from pigs placed on the control diet 1 which had a significantly higher ($p<0.05$) live weight at slaughter value of 20.2kg, other live weight at slaughter values were similar ($p>0.05$) at 15.6kg, 14.4kg, and 13.9kg for pigs on diets 2, 3 and 4, respectively. Empty slaughter weight value of pigs on diet 1 was significantly higher and different ($p<0.05$) at 14.6kg from those on diets 2, 3 and 4 at 11.5kg, 9.6kg and 9.6kg, respectively. There were no significant differences ($p>0.05$) in the values of weight of intestine with offal among the pigs on diets 1, 2, 3, and 4 at 4.5kg, 3.5kg, 4.5kg and 4.4.kg, respectively.

Numerically, pigs on diet 1 had the highest blood weight value, but there were similarities ($p>0.05$) among the blood weight values obtained for pigs on all experimental diets at 1.1kg, 0.6kg, 0.7kg and 0.6kg, for diets 1, 2, 3 and 4, respectively. Apart from pigs on diet 1 that had the significantly ($p<0.05$) highest body mass index value of 0.4, all pigs on other experimental diets had similar ($p>0.05$) body mass index value of 0.3. Apart from pigs on diet 1 which had a significantly ($p<0.05$) different and highest value of dead weight at 19.1kg, pigs on diets 2, 3 and 4 had similar ($p>0.05$) dead weight values at 15.1.kg, 13.9kg and 13.5kg, respectively.

Back fat depth value of pigs on diet 1 at 0.91cm was highest and significantly different from diets 2, 3 and 4. However, pigs on diets 2 and 3 had similar ($p>0.05$) back fat depth of 0.5cm and 0.5cm, respectively. Pigs on diet 4 had the significantly ($p<0.05$) lowest back fat depth of 0.3cm.

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Organs and offals yield of experimental pigs

Organs and offal yields are shown on Table 3. The value of weight of head obtained for pigs placed on diet 1 at 2.4kg was not significantly (p>0.05) different from pigs on diet 2, and 4 at 2.0kg and 1.8kg, respectively but significantly (p<0.05) different from those placed on diet 3 at 1.5kg which was similar (p>0.05) to pigs on diets 2 and 4. The values of weight of feet from knee for pigs on diets 1, 2, 3 and 4 were similar (p>0.05) at 0.9kg, 0.6kg, 0.7kg and 0.5kg, respectively.

There were significant (p<0.05) differences in the values obtained for the spleen weight of pigs on the four experimental diets. 25.1g was the highest mean value for diet 1, while 19.1g, 13.2g and 17.2g were mean values obtained for pigs on diets 2, 3 and 4, respectively. There were differences (p<0.05) in the weights of lungs of pigs placed on diets 1, 2, 3 and 4 at the values of 194.6g, 145.6g, 167.7g and 171.7g, respectively. The pigs on control diet had the highest value, while those on diet 2 had the lowest value.

The pigs on diets 2, 3 and 4 had similar (p>0.05) values for the weight of heart at 59.6g, 57.7g and 61.7g, respectively. Only pigs on diet 1 had the significantly highest (p<0.05) value of 68.6g. The values obtained for weight of stomach for pigs fed varying levels of TDLM in diets 1 (no TDLM inclusion), 2(10% TDLM inclusion), 3(20% TDLM inclusion) and 4 (30% TDLM inclusion) at 647.6g, 482.6g, 633.7g and 539.7g, respectively were significantly different (p<0.05). Pigs on diet 1 had the highest value, followed by pigs on diets 3, 4 and 2 in that order. The values obtained for the weight of intestine for pigs fed with diets 1, 2, 3 and 4 were similar (p>0.05) at 2.7kg, 2.4kg, 2.7kg and 2.4kg, respectively.

There were significant differences in the average values of weight of liver for all the pigs on diets 1, 2, 3, and 4. Those fed with diet 1 had the highest and significantly different (p<0.05) value at 616.8g followed by those on diets 2, 3 and 4 at decreasing values of 386.0g, 368.0g and 310.5g, respectively.

The average value of kidney weight obtained for pigs on diet 1 was the highest at 64.8g and significantly higher (p<0.05) than other values. Pigs on diets 3 and 4 had similar kidney weight values of 52.0g and 50.2g, respectively. Pigs on diet 2 had the lowest significantly different (p<0.05) value of 44.1g.

With the exception of pigs on the control diet 1 that had a significantly highest (p<0.05) weight of bile value of 37.6g, other bile weight values were similar (p>0.05) at 13.0g, 11.1g and 12.2g for pigs on diets 2, 3 and 4, respectively. The testes weight values of the pigs placed on diets 1, 2, 3 and 4 at 52.6g, 50.7g, 49.7g and 48.8g, respectively were similar (p>0.05).

The values obtained for length of front leg of pigs on diets 1 and 3 were similar (p>0.05) at 15.1cm, but were significantly different (p<0.05) from those placed on diets 2 and 4. The values for pigs on diets 2 and 4 were also similar (p>0.05) at 13.1cm and 13.2cm, respectively. The values obtained for length of back legs of experimental pigs were similar (p>0.05) for pigs on diets 1 and 3 at 20.1cm and 19.1cm, respectively but significantly higher (p<0.05) than the similar values obtained for pigs on diets 2 and 4 at 18.1cm and 18.2cm, respectively.

Primal cut yields of experimental pigs

Primal cut yields of pigs fed varying levels of TDLM based diets are presented on Table 4. The half cut values obtained for pigs on diets 2, 3 and 4 were statistically similar (p>0.05) at 4.7kg, 4.1kg and 3.6kg, respectively. However, the control diet 1 with the highest half cut values of 6.1kg was also similar (p>0.05) to the value obtained for pigs on diet 2.

All other primal cuts yields of experimental pigs on all diets were similar (p>0.05). These parameters include quarter cut, shoulder weight, bacon weight, ham weight, ribs weight and loin eye weight. The quarter cut had the numerically highest value of 3.2kg for pigs on diet 1 and lowest for both diets 3 and 4 at 2.1kg. The above trend was true for all other mentioned primal cut yields. Pigs on the control diet always had the highest values followed by 2, 3 and 4 in decreasing order.

DISCUSSIONS

Slaughter and carcass quality traits, organs weights and primal cuts yields

Since carcass quality traits are indication of the quality and utilization of the ration [10], it would seem that pigs on the 30% TDLM inclusion level, poorly utilized their feed as evident by their low values on carcass yield, carcass length and leg length. Interestingly, similar values were observed for carcass length and trochanter width for all diets. High crude fibre in diet could result in poor digestibility of nutrients and this could have negative relationship with metabolisable energy (ME) and digestible energy (DE) contents of the diet, which could limit the availability of energy for muscular growth [11].

Empty slaughter weight, hot carcass weight and body mass index are functions of final body weight [10]. The poor values recorded for pigs on diets 3 (20% TDLM) and 4 (30% TDLM) for empty slaughter weight, body mass index, dead weight and back fat depth in this study may be due to the low feed intake, poor weight gain and high feed conversion ratio. This ultimately had a deteriorating effect on their final body weights [10]. Back fat depth range of 0.3 – 0.9cm recorded in this study was very low compared to other report [12] at 1.92 – 2.75cm when pigs were served rice bran diet with paddy as a replacement for maize and also smaller than another result [13] at 1.15 – 1.32cm when pigs were served diet with biogas slurry (BGS). The observed back fat thickness reduced with increased dietary crude fibre (CF) [14, 15]. This may be an advantage particularly where lean pork is desired.

Offals yields were better for weight of head, weight of feet from knee, length of front leg and length of back leg at 20% TDLM inclusion level. This was similar to the reported trend [13] when biogas slurry (BGS) was fed to pigs.

Concerning organ development, the decrease in the mean values of the weight of spleen and stomach for pigs placed on diet 3 (20% TDLM inclusion), and the decrease in the mean value of weight of liver as the inclusion level of TDLM increased could probably be due to higher physiological activities by these organs triggered by the presence of anti-nutritional factors in *Tithonia diversifolia* leaf meal and their concomitant effects [16, 17].

The similarity observed in this study for testes weight when TDLM was included up to 30%, indicated that male pigs may tolerate up to 30% TDLM without any significant adverse effect on the growth of reproductive organs. This contradicted the previous report [18] that broiler cocks may tolerate up to 10% TDLM without any significant adverse effect on the growth of reproduction organs and also differ from the optimum level of 5% TDLM inclusion recommended for Isa Brown cocks [19]. This is fundamental as the size and weight of testes have been reported to have a positive relationship with sperm production [18, 20-22].

The insignificant differences in the values of intestinal weight obtained on all diets is an indication that inclusion of TDLM in pigs ration up to 30% would have no adverse effect on the development of the intestine of the animals. Although the half cut weight value of pigs on diets 3 and 4 are significantly different from those on control diet, however, the insignificant differences in the weight values of quarter cut, shoulder, bacon, ham, ribs and loin eye of pigs fed TDLM-based diet compared to those on the control diet revealed that TDLM based diets had no adverse effect on primal cut yields. This negated earlier reports [12-13] that there were significant differences in the bacon and loin weights when pigs were served with biogas slurry.

CONCLUSION

At inclusion levels above 20% of TDLM, most carcass qualities and slaughter traits were adversely affected. Some offals yields were, however, better for pigs kept at 20% TDLM inclusion level. The decrease in the mean values of the weight of spleen and stomach for pigs placed on diet 3 (20% TDLM inclusion), and the decrease in the mean value of weight of liver as the inclusion level of TDLM manifested the hyper-functionally of these organs.

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Table 1: Carcass qualities of pigs fed varying levels of TDLM based diet

	Diets			
	1	2	3	4
	% inclusion levels of TDLM			
Parameters	**0**	**10**	**20**	**30**
Carcass yield (%)	$59.3^{a} \pm 1.21$	$59.1^{a} \pm 1.01$	$53.9^{b} \pm 1.32$	$51.4^{b} \pm 2.01$
Carcass length (cm)	$62.6^{a} \pm 2.03$	$64.6^{a} \pm 3.01$	$62.6^{a} \pm 3.21$	$61.6^{a} \pm 3.23$
Carcass width (cm)	$28.6^{a} \pm 3.24$	$25.3^{b} \pm 2.23$	$26.3^{b} \pm 2.32$	$26.3^{b} \pm 3.01$
Chest width (cm)	$16.2^{a} \pm 2.31$	$14.2^{b} \pm 2.02$	$17.2^{c} \pm 2.31$	$15.2^{d} \pm 2.31$
Trochanter width (cm)	$21.3^{a} \pm 3.01$	$20.3^{a} \pm 2.76$	$20.3^{a} \pm 2.31$	$20.3^{a} \pm 2.34$
Leg length (cm)	$33.6^{a} \pm 2.21$	$30.6^{ab} \pm 2.43$	$30.6^{ab} \pm 2.43$	$29.6^{b} \pm 2.32$

DLM, Tithonia diversifolia leaf meal.
Means with the same superscripts in the same row are not significantly different (p>0.05)

Table 2: Slaughter traits of pigs fed varying levels of TDLM based diets

	Diets			
	1	2	3	4
	% inclusion levels of TDLM			
Parameters	**0**	**10**	**20**	**30**
Live weight at slaughter (kg)	$20.2^{a} \pm 3.21$	$15.6^{b} \pm 3.42$	$14.4^{b} \pm 2.31$	$13.9^{b} \pm 3.43$
Empty slaughter weight (kg)	$14.6^{a} \pm 2.31$	$11.5^{b} \pm 3.01$	$9.6^{c} \pm 3.41$	$9.6^{c} \pm 3.23$
Weight of intestine with offal (kg)	$4.5^{a} \pm 3.42$	$3.5^{a} \pm 3.23$	$4.5^{a} \pm 3.51$	$4.4^{a} \pm 3.31$
Blood weight (kg)	$1.1^{a} \pm 3.01$	$0.6^{a} \pm 2.42$	$0.7^{a} \pm 3.24$	$0.6^{a} \pm 3.01$
Body mass index	$0.4^{a} \pm 3.21$	$0.3^{b} \pm 3.54$	$0.3^{b} \pm 3.02$	$0.3^{b} \pm 3.01$
Dead weight (kg)	$19.1^{a} \pm 3.01$	$15.1^{b} \pm 2.20$	$13.9^{b} \pm 2.10$	$13.5^{b} \pm 2.00$
Back fat depth (cm)	$0.9^{a} \pm 1.01$	$0.5^{b} \pm 0.54$	$0.5^{b} \pm 0.91$	$0.3^{c} \pm 0.78$

TDLM, Tithonia diversifolia leaf meal.
Means with the same superscripts in the same row are not significantly different (p>0.05)

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Table 3: Offals and organs yields of pigs fed varying levels of TDLM based diets

	Diets			
	1	2	3	4
	% inclusion levels of TDLM			
Parameters	**0**	**10**	**20**	**30**
Weight				
Head (kg)	$2.4^{a} \pm 2.01$	$2.0^{ab} \pm 2.21$	$1.5^{b} \pm 2.03$	$1.8^{ab} \pm 1.94$
Feet from knee (kg)	$0.9^{a} \pm 2.31$	$0.6^{a} \pm 1.90$	$0.7^{a} \pm 0.98$	$0.5^{a} \pm 1.01$
Spleen (g)	$25.1^{a} \pm 0.04$	$19.1^{b} \pm 0.34$	$13.2^{c} \pm 0.31$	$17.2^{d} \pm 0.32$
Lungs (g)	$194.6^{a} \pm 0.78$	$45.6^{b} \pm 0.98$	$67.7^{c} \pm 0.72$	$171.7^{d} \pm 0.49$
Heart (g)	$68.6^{a} \pm 0.34$	$59.6^{b} \pm 0.76$	$57.7^{b} \pm 0.87$	$61.7^{b} \pm 0.97$
Stomach (g)	$647.6^{a} \pm 0.67$	$482.6^{b} \pm 0.76$	$633.7^{c} \pm 0.45$	$539.7^{d} \pm 0.76$
Intestine (kg)	$2.7^{a} \pm 0.76$	$2.4^{a} \pm 0.75$	$2.7^{a} \pm 0.56$	$2.4^{a} \pm 0.75$
Liver (g)	$616.8^{a} \pm 0.54$	$386.0^{b} \pm 0.56$	$368.0^{c} \pm 0.84$	$310.5^{d} \pm 0.53$
Kidney (g)	$64.8^{a} \pm 0.52$	$44.1^{b} \pm 0.43$	$52.0^{c} \pm 0.24$	$50.2^{c} \pm 0.34$
Bile (g)	$37.6^{a} \pm 0.21$	$13.0^{b} \pm 0.42$	$11.1^{b} \pm 0.32$	$12.2^{b} \pm 0.43$
Testes (g)	$52.6^{a} \pm 0.32$	$50.7^{a} \pm 0.41$	$49.7^{a} \pm 0.24$	$48.8^{a} \pm 0.31$
Length				
Front leg (cm)	$15.1^{a} \pm 0.24$	$13.1^{a} \pm 0.31$	$15.1^{a} \pm 0.34$	$13.2^{b} \pm 0.32$
Back leg (cm)	$20.1^{a} \pm 0.41$	$18.1^{b} \pm 0.52$	$19.1^{a} \pm 0.32$	$18.2^{b} \pm 0.31$

TDLM, Tithonia diversifolia leaf meal
Means with the same superscripts in the same row are not significantly different (p>0.05)

Table 4: Primal cut yield of pigs fed varying levels of TDLM based diets

	Diets			
	1	2	3	4
	% inclusion levels of TDLM			
Parameters	**0**	**10**	**20**	**30**
Half cut (kg)	$6.1^{a} \pm 2.01$	$4.7^{ab} \pm 2.11$	$4.1^{b} \pm 2.01$	$3.6^{b} \pm 2.31$
Quarter cut (kg)	$3.2^{a} \pm 2.00$	$2.5^{a} \pm 2.01$	$2.1^{a} \pm 1.32$	$2.1^{a} \pm 2.01$
Shoulder weight (kg)	$3.4^{a} \pm 2.31$	$3.0^{a} \pm 2.01$	$2.5^{a} \pm 2.41$	$2.4^{a} \pm 2.21$
Bacon weight (kg)	$1.5^{a} \pm 2.21$	$1.0^{a} \pm 2.11$	$0.9^{a} \pm 2.01$	$0.8^{a} \pm 2.11$
Ham weight (kg)	$3.7^{a} \pm 3.01$	$3.1^{a} \pm 2.01$	$2.5^{a} \pm 2.01$	$2.4^{a} \pm 2.11$
Ribs weight (kg)	$2.9^{a} \pm 2.01$	$2.4^{a} \pm 3.21$	$2.0^{a} \pm 2.21$	$2.1^{a} \pm 3.01$
Loin eye weight (kg)	$0.8^{a} \pm 3.12$	$0.7^{a} \pm 2.41$	$0.7^{a} \pm 2.01$	$0.8^{a} \pm 2.31$

TDLM, Tithonia diversifolia leaf meal
Means with the same superscripts in the same row are not significantly different (p>0.05)

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