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Response of Weaner Pigs to Graded Levels of Sickle Pod (*Senna obtusifolia)* Leaf Meal in Diets

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ABSTRACT: *The experiment was carried out at Bajabure Federal Housing Estate Phase three, Girei Local Government Area of Adamawa State, Nigeria. Twelve (12) weeks feeding trial was conducted to evaluate the effects of feeding Senna obtusifolia leaf meal on the growth performance, of weaner pigs. Five experimental diets were formulated using Senna obtusifolia leaf meals at 0%, 15%, 20%, 25% and 30%. The diets were coded T1, T2, T3, T4 and T5 respectively. Twenty (50) weaner pigs were randomly assigned to the five experimental diets in a completely randomized design (CRD). Each treatment group was replicated five times with two pigs per replicate. Parameter measured were lived weight, average daily feed intake (ADFI), average daily weight gain (ADWG), feed conversion ratio (FRC) The growth performance showed significant (p<0.05) differences. The ADFI, AFWG, ATWG, ATFI, ADWG and FRC, all showed no significant difference (p>0.05) across the treatments. The pigs were fed at 4% bodyweight for twelve (12) weeks. The proximate composition of Senna obtusifolia showed it contains 93.32% dry matter, 25.37% crude protein, 25.37%, crude fibre, 12.16% ash, 4.07% ether extract and 38.14% nitrogen free extract. But T4 and T5 are recommended because of good health states, growth rate at the end of the experiment.*

KEYWORDS*:* sickle pod, Senna obtusifolia, pigs, Bajabure, Girei.

INTRODUCTION

The growing feed crises in the Nigerian livestock industry can be addressed through the legumes such as *Senna obtusifolia*. There is equally concerted effort by researchers to determine the suitability of alternative plants to serve as source of protein, energy and other nutrients for non-ruminants and aquaculture species (Shaahu *et al*., 2010a; Shaahu *et al*., 2010b). The target feed materials are those that have very low human preferences and therefore very cheap (Shaahu *et al*., 2015).

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The need to experiment with local under-utilized plant species that can furnish these vitamins and minerals in livestock diets then came directly to mind. Such under-utilized plants include Sickle pod (*Senna obtusifolia*), fluted pumpkins (*Telfaria occidentalis*), bitter leaf (*Vernonia amygdalina*), basil (*Occinum spp*.), drumstick tree (*Moringa oleifera*), Siam weed (*Chromolaena odorata*) and cassava (*Manihot spp*.). Teguia *et al*., 1993 reported that bitter leaf could replace 300g/kg of maize without affecting feed intake, body weight gains and feed efficiency. Ajibade *et al*., 2006 reported on the rich iron content of fluted pumpkin and its use to combat anaemia in human population. Reports have also shown that the leaves of these plants contain appreciable content of vitamins, amino acids and minerals (Makkar and Becker, 1996; Kakengi *et al*., 2003; Aregheore, 2004; Mensah*et al*., 2008; Aro *et al*., 2013; Ogbe *et al*., 2011) that can adequately replace the conventional vitamin/mineral/amino acid premixes in livestock diets when used either singly or as leaf composites (Adegbenro *et al*., 2011). The use of the leaf meal of these plants could therefore provide cheaper alternatives to the costly conventional vitamin/mineral premixes thereby helping to change the prospect of the livestock industry in the sub-Saharan Africa for the better. Apart from furnishing the essential vitamins, minerals and amino acids in the diets of farm animals, literature is replete with the ethno-medicinal use of these plants (Chiang *et al*., 2005; Egbunike and Nworgu, 2005; Aro *et al*., 2013) and the physiological modulation and conditioning of several systems and organs of the body by the extracts, seed or leaf meals of these plants (Ijeh *et al*., 2004; Duke, 2008; Olugbemi *et al*., 2010).

The pig is one of the oldest domesticated animals. Majority of the breeds we now know have descended from the Eurasian Wild Boar (*Sus scrofa*). Archaeological evidence from the Middle East indicates domestication of the pig occurs as early as 9,000 years ago while most livestock were utilized initially by nomadic peoples, swine are more indicative of a settled farming community. Pigs have become vital to the economy in parts of the world. (Edwards, 2010), Profitability of pig enterprise depends on efficient use of feed for lean tissue growth and the rate of growth. Growth rate and nutritional requirement of pigs are two essential factors necessary for maximum pork productivity. An ideal nutritional programme should provide adequate nutrients to maximize pig productivity while minimizing excreted nutrients and feed costs. Since 75 % of total feed used in a farrow-finish operation is consumed in the grower-finisher phase (Edwards, 2010),

Nigeria has the second largest population of pigs in Africa which accounts for approximately 4.45 percent of the total meat supply in the country, (Ajala *etal.*, 2006). Swine production plays a vital role in food security, poverty eradication, and employment generation in Nigeria (Nwanta, *et al.*,2011). Pigs contribute a lot to the livestock sector of the Nigeria economy. However, Nigeria imports live animals and animal products to the tune of one hundred eighteen million naira annually. This indicates a serious shortage of meat and other animal products, which leads to malnutrition Taylor (2012). It has been reported that the country imports 30% of the animals slaughtered for consumption annually and currently consumes only about 7 grams of animal protein a day against the required 35 grams Sese (2014), which implies the country must produce

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three times more animals than currently exist Abdulhammid (2009). Pig represents one of the fastest ways of increasing animal protein Adesehinwa (2007). Therefore, there is increased pig production in Nigeria, where majority are Christians and therefore not forbidden from eating pork.

MATERIALS AND METHODS

Experimental site

The study was conducted at Bajabure Federal Housing Estate Girei local Government Area Adamawa State. Girei is located on latitude 9.22^{0}N, longitude 12.33^{0}E in DMS (Degrees Minutes Seconds). It has an average annual rain fall of about 759mm with maximum temperature of 39.7^{0}C. The rainy season run from May through October, while the dry season commences November and ends in April. The driest months of the year are January and February when the relative humidity drops to 13% (Adebayo,1999).

Preparation of Test Ingredients

Fresh leaves of *Senna obtusifolia* were harvested around the experimental site where they grow naturally as weeds. The leaves were clean to remove any visible surface contaminants e.g. pest eggs, bird droppings, dust and soil deposits. They were mixed with other concentrate ingredients and fed to the pigs. The diets were formulated such that, *Senna obtusifolia* leaves were included in the diet, at 0, 15, 20, 25 and 30% to represent treatments $T_{1,}$ T_2, T_3 and T_4 respectively as shown in Table1.

Chemical Analysis

Proximate analysis of *Senna obtusifolia* leaves, Experimental diet, and feaces, were determined as described by AOAC (2012). This is shown in Table 2

Experimental Animals.

A total of fifty weaner pigs with an initial average body weight of 7.2kg were obtained from Kalimango Farms Nigerian Limited in Kali Kasa village of Zah Disrict, Michika Local Government Area of Adamawa State, were used for the experiment. The experiment was conducted and in an area that was contracted in a tropical-type and open-sided pig house roofed with metal roofing sheets. The open sides of the building were covered with expanded metal to prevent illegal entry of persons and iron net to reduce flies and other insects. Each pens (2.30m× 3×30m) housed the replicated pigs.

The pigs were fed the experimental diet twice daily in the morning (8.00-8:30am) and afternoon (3:30 4.00pm). The wallowing trough contained water at all the time while drinking water was provided *ad libitum*. The pigs were treated against ecto- and endo-parasites with Ivomectin injection prior to the start of the study. They were prophylactically administered antibiotics

(Tetracycline LA) injection to ensure good health. Before the start of the experiment, one-week adjustment period (adaptation period) was observed, using a common diet. Thereafter, the pigs randomly allocated to five dietary treatments, with ten pigs per treatment and replicated five times with two pigs per replicate in a completely randomized design (CRD). The feeding trial lasted for twelve weeks (12). Each group was kept in a cemented-floor pen. Water was provided *ad libitum.*

Data Collection

Growth Performance

During the experiment, data on, initial body weight, final body weight, body weight gain, feed intake and mortality were recorded.

Daily Feed Intake

The experimental diet was offered in the morning(8.00-8:30am) and afternoon (3:30 4.00pm). The pigs were fed at 4 % body weight. After 24 hours feed rejected was weighed. Feed intake was determined as the differences between the leftover and the quantity of feed offered the previous day.

Daily and Weekly Weight Changes

Prior to the commencement of the experiment, the pigs were weighed to obtain their initial body weight using an Avery weighing Balance (Avery® England). Weekly Weight gain was determined as the differences between the final weight at end of the week and the initial weight at the beginning of the week; while the daily weight gain was obtained by dividing the weekly total weight gain per treatment by the number of pigs per treatment, every two weeks.

Feed Conversion Ratio (FCR)

Feed conversion ratio was measured as an index of feed utilization for each treatment group and calculated as the of feed intake and weight gain. By dividing the feed intake of the pigs by the body weight gain.

$$FCR = \frac{Feed\ consumed\ (kg)}{Body\ weight\ gain\ (kg)}$$

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Table1: Compositions of Experimental Diets

Ingredients	T1	T2	T3	T4	T5
Maize	50.05	43.07	37.52	36.73	33.73
Groundnut cake	36.25	28.23	26.78	24.57	22.57
SOLM	0.00	15.00	20.00	25.00	30.00
Rice offal	10.00	10.00	10.00	10.00	10.00
Fish meal	3.00	3.00	3.00	3.00	3.00
Common salt	0.25	0.25	0.25	0.25	0.25
*Premix	0.25	0.25	0.25	0.25	0.25
Lysine	0.10	0.10	0.10	0.10	0.10
Methionine	0.10	0.10	0.10	0.10	0.10
Total	**100**	**100**	**100**	**100**	**100**
Calculated analysis					
Crude protein	20.00	20.00	20.00	20.00	20.00
Crude fibre	3.10	2.66	2.46	2.44	2.14
Calcium	0.17	0.14	0.12	0.14	0.17
Phosphorous	0.54	0.53	0.52	0.53	0.54
Methionine	0.46	0.42	0.39	0.42	0.46
Lysine	1.31	1.08	0.84	1.08	1.31
ME/Kcal/kg	3157.95	3067.70	2977.64	3067.70	3157.95

SOLM (*Senna obtusifolia* leaf meal)
GE: CP= gross energy: crude protein

**Calculated Gross Energy (KJ/100g) = Protein x 23.6KJ/100g + Lipid x 39.5KJ/100g + NFE x 17.2KJ/100g (Blaxter, 1989)

*Vitamin-Mineral premix provides per kg the following: 12.000.000 IU Vitamin A; 2.000.000 IU Vitamin D3; 10g Vitamin E; 2g Vitamin K3; 1g Vitamin B1; 5g Vitamin B2; 1.5 g Vitamin B6; 10g Vitamin B12; 30g Nicotinic acid; 10g Pantothenic acid; 1g Folic acid; 50g Biotin; 250g Choline chloride 50%; 30g Iron; 10g copper; 50g Zinc; 60g Manganese; 1g Iodine; 0.1g Selenium and Cobalt 0.1g.

Data Analysis

All data generated from the experiment were subjected to Analysis of Variance (ANOVA) using SAS 9.4 (2006) version of statistical package in a completely randomized design (CRD) according to Steel and Torrie (1980). Treatment means was separated using Duncan's multiple range test Duncan (1995).

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RESULTS

Proximate Composition of *Senna obtusifolia* leaf meal

The result of the proximate composition of *Senna obtusifolia* leaf meal is presented in Table 2. The result revealed 92.32% dry matter, 25.37% crude protein, 19.13%, crude fibre, 38.14% Nitrogen free extract with 2606.52as Metabolizable Energy.

Table 2: Proximate Composition of sickle pod (*Senna obtusifolia*) leaf

Nutrients	Percentage Composition (%)
Dry matter	92.32
Crude protein	25.37
Crude fibre	19.13
Total ash	12.16
Ether extract	4.07
Nitrogen free extract	38.14
Metabolizable Energy	2606.52 Kcal/kg

Proximate Composition of Experimental diet

The result of the proximate composition of the experimental diets are presented in Table 3. The proximate values for dry matter 75.48 - 89.72%, moisture 6. 98%, Crude protein 17.96–19.81%, Crude fibre5.56%; Total Ash, 7.99 - 9.27%, Ether Extract 3.39 - 4.65%, Nitrogen Free Extract 52.92– 66.39%and ME (kcal/kg ranges from 3080.26 - 3104.83%.

Table 3: Proximate Composition of Experimental Diets

Parameters	Control 0 (%) T1	15 (%) T2	20 (%) T3	25 (%) T4	30 (%) T5
Dry matter	86.75±5.00	89.72±1.83	85.61±4.93	75.48±4.92	82.03±5.08
Moisture	7.90±0.34	6.98±0.09	7.90±0.55	7.76±0.94	8.80±0.71
Crude Protein	19.81±0.25	19.39±0.72	19.53±0.64	19.08±1.40	17.96±1.92
Crude fibre	5.56±0.91	6.18±0.70	6.96±0.80	6.50±0.82	7.19±0.30
Total Ash	9.27±0.38	8.83±0.17	8.49±0.58	8.46±0.59	7.99±1.09
Ether Extract	4.65±0.46	4.28±0.36	3.39±0.71	4.65±0.57	4.04±0.06
Nitrogen Free Extract	52.92±3.38	66.39±9.25	58.95±7.13	56.77±3.85	53.32±3.52
ME (Kcal/kg)	3057.21	3077.79	3079.52	3067.41	3070.53

Mean ± Std on the same row with different superscripts are significantly different (P<0.05)* , ^{ns} = not significant (p>0.05), SEM- standard error of meal.

Growth Performance of weaner pigs fed sickle pod leaf meal
The growth performance parameters of weaner pigs fed *senna obtusifolia* leaf meal based diets are presented in Table 4. The highest and the lowest of the final body weight gain were obtained from T1 and T5 (11.28 and 15.23) respectively. There was significant difference ($p<0.05$) between the tested and the control diets. The highest and the lowest value for total weight gain were from T1 and T5 0.06kg – 7.81kg respectively and have shown significant difference ($p<0.05$). The highest and the lowest values for daily weight gain were seen in diets T1 and T5 (0.14kg – 0.19kg) respectively and there was significance difference ($p<0.05$). The result for total feed intake ranges from (42.97kg – 49.20kg) respectively and have also shown significant different ($p<0.05$). Daily feed intake indicates that pigs across the treatments group shave shown significant different ($p<0.05$) the highest and the lowest values were recorded in the control diet T1 and T5 (0.51kg - 0.59kg) respectively. Results of the final weight gains (FWG) as influenced by dietary levels of *senna obtusifolia* leaf meal (SOML) that the growth is increasing progressively.

Table 4 Growth Performance of Weaner Pigs fed *Senna obtusifolia* Leaf Meal

Parameters	Control T1 (0%)	T2 (15%)	T3 (20%)	T4 (25%)	T5 (30%)	SEM	P-VALUE
Initial weight gain (kg)	7.22 ± 0.05^{b}	7.32 ± 0.05^{ab}	7.37 ± 0.05^{ab}	7.32 ± 0.05^{ab}	7.42 ± 0.05^{a}	0.001	0.205
Body weight gain (kg)	11.28 ± 0.80^{b}	13.99 ± 0.80^{b}	11.91 ± 0.80^{b}	15.08 ± 0.80^{a}	15.23 ± 0.08^{a}	0.32	0.051
Total weight gain (kg)	4.06 ± 0.78^{b}	6.67 ± 0.78^{ab}	4.54 ± 0.78^{b}	7.76 ± 0.78^{a}	7.81±0.78a	0.31	0.052
Daily weight gain (kg)	0.14 ± 0.01^{b}	0.17 ± 0.01^{a}	0.14 ± 0.01^{b}	0.18 ± 0.01^{a}	0.19 ± 0.01^{a}	0.05	0.057
Total feed intake (kg)	42.97 ± 1.13^{c}	46.76 ± 0.13^{abc}	43.88 ± 0.13^{bc}	47.81 ± 0.13^{ab}	49.20 ± 0.13^{a}	0.64	0.046
Daily feed intake (kg)	0.51 ± 0.01^{c}	0.56 ± 0.01^{abc}	0.53 ± 0.01^{bc}	0.57 ± 0.01^{ab}	0.59±0.01a	0.07	0.049
Feed conversion ratio(kg)	3.83 ± 0.15^{a}	3.34 ± 0.15^{ab}	3.369 ± 0.15^{ab}	3.18 ± 0.15^{b}	3.27 ± 0.15^{ab}	0.01	0.108

Mean ± Std on the same row with different superscripts are significantly different $(P<0.05)^{*}$, $(P<0.001)^{***}$, ^{ns} = not significant ($p>0.05$), SEM- standard error of mean,

DISCUSSION

Proximate composition of *Senna obtusifolia* leaf meal

The proximate composition of *Senna obtusifolia* leaves are presented in Table 2. Showed that, the dry matter obtained in this study is (92.32%) and is higher than the values (90.50%) reported by Augustine *et al*., 2017 and lower than the value (93.51%) reported by Yakubu *et al.* (2017). The crude protein values (25.37) was similar to 25.37% reported by Yakubu *et al.* (2017)

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but higher than 21.10% reported by Adjoudji *et al*., (2005) and (18.46%) reported by Ismaila *et al*. (2011). However, lower than (27.40%) reported by Ayssiwede *et al.* (2012).

The *Senna obtusifolia* leaf had crude fibre value content (19.13), less than the value (14.95) reported by Augustine *et al*., 2017and similar with the value (19.14%) reported by Yakubu *et al*. (2017). The metabolizable energy (2606.52Kcal/kg) was lower than the energy value of soya bean (3440 Kcal/kg) reported by Aduku (1993). Studies have attributed variations in nutrient composition of leaf meals to the age of leaves at harvesting, climatic conditions, edaphic factors as well as the laboratory analysis (Taiwo *et al*., 2005).

Proximate Composition of Experimental diets

The Proximate Composition of Experimental diets are presented in Table 3. It showed adequate level of dietary protein and energy in the diets. The Crude protein ranges (17.96 – 19.81%) is in agreement with the recommended dietary crude protein 18- 20% for growing pigs by Aduku (2004) and Amaefule (2006) and lower than the values (25.17%) reported by Nuha *et al.*, 2010. The crude fibre (CF) content of the experimental diets ranges from 5.56- 7.19%, the value is lower than 7.05 -8.35% recommended by Brain *et al.* (2013) growing pigs and Nuha *et al.*, 2010 that obtained 18.72%. It is also in contrast with the opinion of Olomu (1995) that it is necessary to maintain fibre level at 3.5% - 5% in the diets of animals. High fibre levels in diets can decrease the voluntary feed intake of the animals because of gut fill, compromising the energy intake of pigs (Da Silva *et al*., 2012). Fibre containing diets could increase feaces output (Hansen *et al.*, 2006)

When dietary crude fibre exceeds 10-15% of the diet, may depress feed intake because of excessive bulk and reduced palatability (Adesehinwa, 2008). Wilfart *et al*. 2007reported that the output of fecal dry matter increased as fiber increased. The value of crude fibre however, did not impair the performance of the weaner pigs in this research. All the parameters measured have all shown not significant different across the treatments.
The metabolizable energy (ME) ranged from 3065.05- 3191.34 (kcal/kg) the values agreed with the earlier report by NRC (2012) that recommended a level of 3177 – 3300 kcal/kg but higher than 2600 – 3000 kcal/kg recommended by Aduku (1993) for pigs. The variations probably could be because of the variation in the ingredients used in feed formulation and their quantities.

Growth Performance of weaner pigs fed sickle pod leaf meal
The result of the growth performance of weaner pigs fed experimental diets are presented in Table 4. The growth performance and nutrient utilization as observed revealed significant increase in the growth performance as *senna obtusifolia* leaf meal inclusion level increases. It was observed that pigs fed control diet perform less than the experimental diet which in an agreement with the report of Njoku *et al*., 2015; Okwori *et al*., 2016 and Yakubu *et al*., 2017 had earlier opined that biological

indicators such as growth performance, survival, feed ultilization efficiency, nutrient availability, gross or sub-clinical abnormal signs and basic means employed in determining the efficacy and adequacy of diets fed.

The final weight gain recorded in this study was higher than that of Yakubu *et al*., 2017 and Adjoudji *et al.* (2005). The average daily feed intake of weaner pigs fed diets T5, T4, and T2, were significant different (P<0.05) lower than those on the T1 and T2. The results obtained for daily weight gain in this study was higher than that of Yakubu *et al*., 2017 who evaluated the effects of *Cassia obtusifolia* leaf meal on poultry and recorded the ADWG (g/b/d) 40.39, 39.91, 38.00, 36.81and 31.99 respectively. This result was also lower than that of Njoku *et al*., 2015; Okwori *et al*., 2016when fed graded levels of Dietary Guava Leaf Meal on growth performance, carcass yield and organ weight on growing pigs respectively. The body weight of the pigs fed the control diet 0.13kg was less than those fed the experimental diets which were almost similar(P>0.05) statistically. This was in agreement with the report of Augustine *et al.* (2017) for *Senna obtusifolia* seeds. Adjoudji *et al.* (2005). Further buttressed that high dry matter content of leaves is an advantage for the conservation of the dry leaves.

The protein content of *Senna obtusifolia* leaves obtained in this study ranges from 25.37% higher than the value (18.23%) reported by Kubmarawa *et al.* (2011) Adjoudji *et al.* (2005) and Nuha *et al*. (2018) with the value (25.17%). The variations in some of the proximate composition might be attributed to differences caused by environmental and genetic factors as earlier reported by Santosh *et al.* (2017). The crude protein content of *Senna obtusifolia* leaves are close to the range of (21-30%) for many leafy vegetables as reported by Lucas (1988) and Falade *et al.* (2004).

The total feed intake reported in this study is higher than the value (38.23%) reported by Kubmarawa *et al.* (2011) and (29.90%) reported by Adjoudji *et al.*, (2005). And lower than the value 57.07% reported by Kubmarawa *et al.* (2011). The variation in the nutrient content of the leaves might be attributed to the stage at which the leaves were harvested which is consistent with the findings of Adjoudji *et al*. (2005) for *Senna obtusifolia* leaves.

CONCLUSION

This work has revealed that *Senna obtusifolia* leaves has good nutritive values, which can compare favorably with leaf meal as a source of plant protein. It can be deduced that the sample has high quality essential minerals and vitamins. The results obtained from this study equally indicated that pigs can also feed on the fresh leaves of *Senna obtusifolia* as a good source of plant protein without deleterious effects on growth and the heamatological indices of the pigs.

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