NSAP 47th Annual Conference (JOS 2022) CONFERENCE PROCEEDINGS
THEME: SECURING ANIMAL AGRICULTURE AMIDST GLOBAL CHALLENGES

GROWTH PERFORMANCE AND NUTRIENT DIGESTIBILITY OF WEANED PIGS FED DIETS CONTAINING GRADED LEVELS OF CABBAGE (*BRASSICA OLERACEA VAR*) LEAF MEAL

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ABSTRACT
This study was carried out to evaluate the effect of dried cabbage (Brassica oleracea var) residue leaf meal(DCRLM) on the growth performance and nutrient digestibility of pigs. In an eight-week feeding trial, forty-five (45), average of 8 weeks old crossbred weaned pigs were randomly allocated to five experimental treatment diets. Each treatment was replicated thrice having nine (9) per treatment in a completely randomized design (CRD). Dried cabbage residue leaf meal (DCRLM) was prepared and included at graded levels of 0.0 (control), 2.5, 5.0, 7.5 and 10.0 %.in the diets Feed and water were given to the pigs ad libitum. The parameters measured and calculated include initial weight, final weight, weight gain, feed intake, feed conversion ratio and feed cost per kilogram gain. Digestibilities of Dry matter (DM), crude protein (CP), crude fibre (CF), ether extract (EE) and ash were significantly different (P<0.05) between the dietary treatment groups. Cabbage supplementation increased the average weight gain of the weaner pigs but there was no significant increase in the nutrient digestibility of the test diets compared to the control diet containing conventional feedstuff used in this experiment. Thus, dried cabbage residue leaf meal of 10 % can be included in pig diets without adverse effect on performance and nutrient digestibility.

Keywords: Pigs, Cabbage residue, Growth, Nutrient Digestibility

INTRODUCTION
Swine production is a major segment of animal husbandry which involves the raising and breeding of pigs principally for food and sometimes for their skin. Pigs have short generation interval with rapid fecundity and good carcass yield of about 70 % as compared to other livestock such as cattle, sheep and goats. Pigs have approximately 19000 taste buds which is less than cattle that have 25,000 but more than human that have 9000 (Frederick and Van Heugten, 2003) enabling them to eat everything edible including higher levels of dietary fibre diets. This has greatly expanded the range of feed resources for pigs (Frederick and Van Heugten, 2003). The scarcity of conventional feeds has hindered the growth of the livestock industry in Nigeria. The food deficit problem is indeed more serious with protein supply when compared with the availability of calories. According to Obioha (1992) and Ogini (2001), the level of consumption of meat and animal protein in Nigeria is estimated at about 8g per caput per day, more than 20g less than the minimum requirement by the National Research Council of the United States of America. Therefore, the need, to increase the production of such domestic animals such as pigs and poultry which are conventional sources of animal protein. Apart from their high rate of reproduction, pigs and poultry are characterized by the best efficiency of nutrient transformation into high quality animal protein (Smith, 2001; Holness, 2015). This study considered the use of cabbage residue (*Brassica oleracae) as a* cheap, alternative protein source for pigs which is not used by man as food. Therefore, this study evaluates the growth performance and nutrient digestibility of weaned pigs fed diets containing graded levels of cabbage (*Brassica oleracea*) residue leaf meal

MATERIALS AND METHODS

Experimental site

The research was carried out at Piggery Unit Dagwom Farm Division, National Veterinary Research Institute (NVRI), Vom, Plateau State is located in Northern Guinea Savannah zone of Nigeria, which has two distinct (dry and rainy) seasons. The dry season starts in October and ends in March with a temperature range of 13°C - 26°C. The rainy season is from April-September, and the temperature also ranges from 16°C - 28°C. The geographical location of Vom is 8° 45`E, 9° 43`N and 4200 feet (1280m) above sea level. Mean relative humidity ranges from 14-17% (Knudsen and Sohel, 1970 and NVRI, 2006). The environmental temperature ranges from 13.8°C - 28.5°C (Knudsen and Sohel, 1970). Then temperature rises up gradually to as high as 38°C early in April just before the on-set of the rains (NVRI, 2006).

Experimental Animals and Design

Forty-five large white and landrace crossbred weaned pigs of approximately 12 kg initial weights were sourced from reputable farms. The pigs were de-wormed and other routine vaccinations given to them. Forty-five (45) pigs were weighed and randomly distributed into pens of 9 pigs per treatment with three pigs replicate in a completely randomized design. The experimental diets comprised of 5 treatments.

Source and processing of *Brassica oleracae* and experimental diets

Fresh Cabbage (*Brassica oleracea)* residuewas purchased from building material market Bukuru express way, Jos South Local Government Area, Plateau State. The Cabbage residues were air-dried forbetween 5 - 7 days until completely dried after which it was ground into powder and stored in an air tight container for proximate analysis and subsequently mixed with other feed ingredients. Diet 1 contained 0 % cabbage residue meal (CRM)- which served as the control. Diets 2, 3, 4 and 5 contained CRM of 2.5, 5.0, 7.5, and 10 % respectively. The nutrient composition of the experimental diets is shown in Table 1. Clean water and feed were provided *ad libitum* for 56 days.

Growth performance

The growth performance parameters measured were weight gain, feed intake and final weights while feed conversion ratio and feed cost per kg gain were calculated. The pigs were weighed at the beginning of the experiment and allotted into pens in a completely randomized design (CRD). The pigs were weighed weekly to know the weights gained and final weights of the pigs were also recorded at the end of the experiment.

Digestibility study

At the end of the experiment the pigs were weighed and after the weighing, one pig per replicate (3 per treatment, a total of 15 per study) were selected for the determination of apparent nutrients digestibility of the diets. The faecal collection for apparent digestibility was done for a period of seven days. The fresh faeces were collected daily per animal using the digestibility trays which were at the bottom of the wire netting cages and oven dried at 60^0C for seventy-two (72) hours and subjected to proximate analysis. The formula used to calculate apparent nutrient digestibility is given below;

$$\% \text{ Nutrient Digestibility} = \frac{\text{Nutrient intake} - \text{Nutrient voided}}{100} \times 100$$

The faecal samples collected during the digestibility studies were subjected to proximate analysis (AOAC, 2006). Values obtained were then then used to calculate the apparent nutrient digestibility.

Statistical analysis

All data collected were subjected to analysis of variance (ANOVA) as described by Steel and Torrie (1984) using (MINI-TAB Version 2016 software). Where applicable, significant differences between means were separated using the Least Significant Difference option in the same software.

RESULTS AND DISCUSSION

The performances of the pigs are presented in Table 2. The dietary treatments recorded significant differences within the groups in final weights, weight gains with feed cost per kilogram gain of pigs fed diets containing graded levels of dried cabbage residue leaf meal. The feed cost per kilogram gain of pigs fed diets containing cabbage were significantly ($P<0.05$) lower than the pigs fed the control diet. Similar observation was noted for final weight and weight gain for pigs fed experimental diets. However, there was no significant difference ($P>0.05$) among the dietary treatments in feed conversion ration but for slight numerical differences observed. This finding is in agreement with the findings of Marek *et al* (2017) who found significant differences in final weight, feed conversion ratio pigs fed diets with vegetable (inclusion dried pomace strawberry) . The results showed that there were significant differences in the final weights between the five dietary treatments for eight- week trial. This support the findings of Marek *et al* (2017) who reported significant difference increase in the weight of pigs fed diets with vegetable inclusion.

Table 1: Proximate composition of dried cabbage residue meal

Parameter	DCRM
Crude protein	13.78
Fat	5.83
Ash	16.10
Crude fibre	9.45
Moisture	5.99
Nitrogen Free Extract	48.85

DCRM- dried cabbage residue meal

Table 2 Growth Performance of Weaned Pigs Fed Graded Dietary Levels of Dried Cabbage Waste Leaf Meal

	Levels of cabbage Waste Meal inclusion (%)					
Parameters	0.0	2.5	5.0	7.5	10.0	**SEM**
Initial weight(g)	13.20	13.33	13.06	13.26	13.36	0.31
Final weight (g)	38.00^{ab}	40.70^{a}	40.53^{a}	40.46	38.88^{b}	0.77
Weight gain (g)	24.80^{b}	27.36^{a}	27.47^{a}	27.26^{a}	25.51^{ab}	0.54
Feed intake (g)	91.00	91.00	91.00	91.00	91.00	0.00
Feed Conversion Ratio	3.71	3.33	3.32	3.34	3.36	0.07
Feed cost/kg gain	477.85 ^{a}	427.26^{ab}	400.03^{b}	411.07^{ab}	438.56^{ab}	11.08

$^{a\,b\,c}$ = Means in the same row with different superscripts are significantly different at ($P<0.05$)

Nutrient Digestibility of weaner pigs fed graded levels of dried cabbage residue leaf meal

The results of nutrient digestibility are presented in Table 3. There were significant differences (P<0.05) in crude protein digestibilities between the dietary treatments. Cabbage diets had the highest CP, EE, CF and Energy digestibilities which were significantly higher (P<0.05) than value for control except in Ash.

Table 3: Nutrient digestibility of pigs fed different levels of dried cabbage waste (*Brassica oleracea*) leaf meal

Nutrients	Levels of cabbage Waste Meal inclusion (%)					SEM
	0.0	2.5	5.0	7.5	10.0	
Crude Protein	51.56^{b}	60.99^{ab}	66.89^{a}	48.93^{c}	55.85^{b}	2.57
Ether extract	83.74^{a}	81.66^{ab}	86.42^{a}	75.62^{b}	82.32^{ab}	1.25
Ash	17.14^{b}	15.68^{ab}	13.37^{ab}	15.07^{b}	0.38^{ab}	5.84
Crude fibre	21.29^{b}	28.35^{a}	26.66^{a}	26.28^{b}	25.59^{a}	8.43
EnergyMJ/kg DM	67.67^{a}	67.47^{a}	69.0^{a}	62.93^{b}	67.93^{ab}	2.44

$^{a\ b\ c}$ = Means in the same row with different superscripts are significantly different at (P<0.05);

The result of CP digestibility is in line with the reports of Chhay and Preston (2005) and Kambashi *et al* (2014) who found significant difference in crude protein digestibility using tropical forages in pigs diet. Crude fibre digestibility also follows a regular pattern across the treatments with cabbage supplementation diets, but the treatment without cabbage supplementation had the least significant value. Energy digestibility was high and significant across the treatments.

CONCLUSION

From the study, cabbage supplementation was found to increase the average weight gains of the weaner pigs. However, there was no significant increase in the nutrient digestibility of the test diets compared to conventional feed (control) used in this experiment. Considering the result of this study, cabbage residue can be used as an alternative source of protein ingredient for low cost of production at 5% inclusion hence, the use of dried cabbage residue supplementation in pig diet can be recommended.

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