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NUTRIENT DIGESTIBILITY AND REPRODUCTIVE PERFORMANCE OF PREGNANT GILTS FED CASSAVA PEEL AND PALM KERNEL CAKE MEAL BASED DIET

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ABSTRACT

Twenty-four weeks feeding trial was conducted to determine the effect of cassava peel (CP) and palm kernel cake (PKC) meal-based diets on the apparent digestibility and reproductive performance of pregnant gilts. The mixture was achieved on a one- to-one weight basis. The mixture replaced maize at 0 (control), 10, 20, 30and 40% levels. Forty large white breed gilts with average weight (43-45kg) were randomly allocated to the five diets, replicated eight times in a completely randomized design (CRD) with eight gilts per diet. Feed and water were provided as required. Apparent digestibility was significantly ($p<0.05$) affected, while productive performance of average weekly weight gain was significantly ($p<0.05$) higher on diet 0% (2.93kg) compared to diets 10 (2.86), 20 (2.55), 30 (2.83) and 40% (2.42kg). Feed intake was significantly ($p<0.05$) better on diets 20% (18.92kg), 30 and 40% (18.90kg) compared to diets 10 (18.68) and 0% (18.50kg) respectively. Feed conversion ratio significantly ($p<0.05$) differ on diet 0% (6.31) compared to diets (10, 6.53; 20, 7.42; 30, 6.68; 40, 7.80). Protein efficiency ratio (PER) was significantly ($p<0.05$) better on diet 30% (4.60) compared to diets 20 (4.29), 0 (3.42), 40(3.30) and 20% (2.77) in that order. The average weight of piglets at farrowing was significantly ($p<0.05$) higher in 40% (1.20) diet compared to diets 10, 20, 30 (1.10kg) and 0% (0.97kg) respectively. Therefore, 10% diet is recommended since it enhances the reproductive performance of pregnant gilts and compete famously with other diets at total piglets' weight at farrowing.

Keywords: Apparent digestibility; piglets; cassava peels; palm kernel cake

INTRODUCTION

The importance of food in the socioeconomic development of any economy cannot be over-emphasized. Recently, there is a constant threat to human survival in our country in the forms of kidnapping, banditry, terrorism, and herder conflicts that caused a wide deficit in food production compared to the growth of human population (Moseri *et al.*, 2020). There is also increasing evidence of high infant mortality, low disease resistance, poor growth, and development etc., which may be attributable to inadequate protein in the diets of most Nigerians (Aro *et al.*, 2013). However, the need to meet protein requirement from domestic

sources demands intensification of pig production and products. The level of performance in the livestock industry, particularly in the reproductive performance of pigs is on a decline; attributable to high cost of feed resulting from rising prices of conventional ingredients use in feed formulation, adjustments in feed quality and quantity; as well as technical inefficiency in production among pig farmers. Net effects of all these are capacity under-utilization, curtailment of planned expansion programs and in extreme cases liquidation (Adesehinwa *et al.,* 2011). However, to tackle all these problems, there is need to overhaul the pig industry in Nigeria using the local available resources such as cassava peels and palm kernel waste. Research has proved that incorporating cassava peels up to 40% in grower pigs feed, has no deleterious effect (Moseri *et al.,* 2020). However, there is a dearth of knowledge on the uses of cassava peels in the production of pregnant gilts. Pig has high reproductive performance with excellent prolificacy and fertility (Moseri *et al.,* 2020), to sustain this, the needs to harness the available cassava peels becomes a better option due to frequent and unstable nature of conventional ingredients. In Nigeria, large proportion of pig production is restricted to more of indigenous means that does not encourage efficient rearing of pig for better reproductive performance. Therefore, the study determined the apparent digestibility and reproductive performance of gilts fed cassava peel and palm kernel meal-based diets.

MATERIALS AND METHODS

Experimental Site

The research was carried out at the piggery unit of the teaching and research farm, Faculty of Agriculture, Ambrose Alli University, Ekpoma. The farm is located on the latitude $6^0 45^{'}$N and longitude $6^0 08^{'}$E, Esan West Local Government Area Council of Edo State, Nigeria; with an annual rainfall of 1500-2000mm per annum. Relative humidity is 75% and average temperature is 32^0C (Moseri *et al.*, 2020).

Source of Test Materials

The cassava peel and palm kernel cake were obtained from reputable garri processors and markets within Agbor town. Other ingredients for the research were purchased from recognized animal feed dealers in Benin City and its' environ.

Housing, Management of Animals and Experimental Design

The piggery unit is a modified Danish type of housing, with central passage and open exercise yards. The main structural features of the house are low walls of 1.2m, over which are wooden frames and a supporting roof. The roof was made up of asbestos, ideal for heat insulation and protection from the effect of direct solar radiation and control of thermal stress. Pigs were housed on a concrete floor pen, each of which had a concrete in-built water trough and feeding cubicles. A total of 40 large white gilts having average weight (43-45kg) were used for the study. The gilts were divided into 5 groups based on average initial weight and each group contained eight gilts that serve as replicates in a Completely Randomized Design (CRD). 40 large white gilts were crossed with two landrace boars within a period of two weeks, and each was repeated after 24 hours. The gilts were fed twice daily, and water was supplied *ad libitum*.

Experimental Animals

The treatment diets consisted of a mixture of sundried cassava peel and PKC (in a 1:1 ratio, w/w) at 0, 10, 20, 30 and 40% respectively. The 1:1 ratio of cassava peels to PKC was derived by weighing an equal weight (kg) of the two test ingredients in the diet using a manual scale. All diets were formulated to be iso-nitrogenous and iso-caloric (Table1).

Table 1: Composition of experimental diets for breeder gilts (g/100kg)

Ingredients	Inclusion levels				
	0	10%	20%	30%	40%
Maize	40.00	36.00	32.00	28.00	24.00
Cassava peel/PKC	-	04.00	08.00	12.00	16.00
Ground Nut Cake	15.87	17.00	18.13	19.26	20.39
Wheat Offal	38.18	36.05	34.72	33.39	32.06
Bone Meal	1.50	1.50	1.50	1.50	1.50
Limestone	2.00	2.00	2.00	2.00	2.00
Palm Oil	1.00	2.00	2.20	2.40	2.60
Animal care Premix*	0.25	0.25	0.25	0.25	0.25
Salt	0.35	0.35	0.35	0.35	0.35
Ronozyme**	0.20	0.20	0.20	0.20	0.20
Lysine	0.65	0.65	0.65	0.65	0.65
Total	100.00	100.00	100.00	100.00	100.00
Calculated Analysis:					
Crude Protein (%)	16.92	16.54	16.36	16.69	16.87
ME(Kcal/Kg)	2770.86	2774.00	2734.92	2758.48	2737,44
Fat (%)	4.58	6.20	7.8	9.44	11.09
Crude Fiber (%)	5.03	6.66	8.28	9.98	11.51
Ash (%)	5.91	9.01	12.11	15.3	18.53
Calcium (%)	0.80	0.80	0.80	0.80	0.80
Starch (%)	41.00	37.79	34.58	31.34	28.08

*Vitamin-mineral premix/kg diet: Vitamin A–8,000 IU, Vitamins D3 –3,000 IU, Vitamins E–8 IU, Vitamin K – 2mg, Vitamin B1– 1 mg, Vitamin B2–0.2 mg, Vitamin B12–5 mg, Nicotinamide –10 mg, Selenium– 0.1 mg, Ca Pantothenate – 5 mg, Folic acid –0.5 mg, Choline Chloride –150 mg, Iron –20 mg, Manganese –80 mg, Copper – 8mg, Zinc –50 mg, Cobalt –0.225mg, Iodine –2 mg Antioxidant – 0.1ppm Key:- CPM = Cassava peels meal, PKC = Palm kernel cake, GNC = Groundnut cake, C.P. = Crude protein, ME = Metabolizable energy.

**Ronozyme Composition of the product, sodium sulfate (52.7%), calcium carbonate (15%), kaolin (9%), dextrin and sucrose (8%), cellulose (6%) and vegetable oil (7%). Bulk density of 1,100 kg/m^3. The particle size distribution of the product showed that 98% of the particles are between 150 and 1,200 μm in diameter and less than 1% of particles are below 150 μm.

The experiment was conducted for 24 weeks, covering the prenatal (gilt) and post-natal stages of the sow. The gilts were moved to the farrowing crates two weeks to the end or 100 days of pregnancy. Parameters measured were apparent digestibility, reproductive performance such as weight of gilts at mating, performance of gilts during gestation period, weight of gilts at farrowing (kg), number of live piglets born and average birth weight of the piglets (kg). Two weeks to farrowing or 100days of pregnancy, two animals were randomly selected, housed and allowed to rest for stabilization in a metabolic cage, followed by three days of total faeces collection. The total faeces voided during this period were sundried and later oven dried, bulked and representative samples were taken for proximate analysis

according to A.O.A.C (2000); Digestibility of crude protein, crude fibre, ether extract and nitrogen free extract (NFE) were calculated using the relationship below.

$$\text{Apparent digestibility (\%)} = \frac{\text{Dry Weight of diet eaten – Dry weight of dry weight of faeces}}{\text{dry weight of diet eaten}} \text{ x } \frac{100}{1}$$

Data Collection

Data on feed intake and weight gain were collected from the experimental animals. A known quantity of feed was provided, and the corresponding leftover recovered and quantified. The difference between what was given, and the left over divided by the time interval is the daily feed intake. Pigs from each group were weighed at the beginning of the study and thereafter weekly, to determine the body weight gain. The difference between the initial and final body weight is the weight gain. Feed conversion ratio was calculated as the ratio of feed intake to gain in weight. Protein efficiency ratio (PER) was calculated as the ratio of weight gain to the protein consumed.

Statistical Analysis

The data collected were analyzed using one-way ANOVA as in SAS (2003) package, and differences between treatment means were separated using Duncan's multiple range test (Duncan,1955) as outlined by Obi (2002).

RESULTS

Apparent digestibility of the gilts was significantly ($P<0.05$) affected by the experimental diets Table 2. The highest apparent digestibility of dry matter was recorded in gilts fed 40% (92.60) followed by those fed control diets (91.46), 10 (91.13), 30 (90.57) and 20% (90.66%). Crude protein digestibility was highest in gilts fed 30% (17.50) and least value was obtained in pigs fed 10% (16.17) diet. The digestibility of Nitrogen free extract was highest in gilts fed control diet (58.93) and declined to 57.52, 55.48, 51.61 and 50.16 % for 40, 30, 20 and 10 % levels of test ingredients. Ether extracts apparent digestibility were 26.02, 24.15, 23.25, 22.35 and 20.44 for 30, 20, 40, 0 and 10 % diets. Digestibility of ash increased with increased levels up to 30% and declined in diet containing 40% inclusion.

Table 2: Apparent digestibility of the gilts fed experimental diets

Parameters (%)	Levels of Inclusion (%)					SEM
	0	10	20	30	40	(±)
Dry matter	91.46^{b}	91.13^{c}	90.06^{e}	90.57^{d}	92.66^{a}	0.02
Crude protein	16.32^{d}	16.17^{e}	16.67^{c}	17.50^{a}	16.83^{b}	0.07
NFE	58.93^{a}	50.16^{d}	51.61^{c}	55.48^{b}	57.52^{a}	0.67
Ether extract	22.35^{d}	20.44^{e}	24.15^{b}	26.02^{a}	23.25^{c}	0.02
Ash	12.11^{d}	16.35^{c}	20.05^{a}	20.06^{a}	16.53^{b}	0.03
Crude Fiber	19.73^{b}	19.68^{c}	25.52^{a}	16.50^{e}	16.83^{d}	0.02

a, b, c, d, e means along the same row with different superscripts are significantly ($P< 0.05$) different from each other, SEM: Standard error of mean, NFE: Nitrogen free extract

Performance of Pregnant Gilts fed Experimental Diets

Performance of pregnant gilts fed the experimental diets is presented in Table 3. Parameters for average final weight, average weekly weight gain, feed conversion ratio and protein efficiency ratio were significantly (P<0.05) affected by the level of inclusion of CP and PKC. Weekly weight gain declined as the levels of CP and PKC meal in the diet increased. Average weekly weight gain ranged from 2.93 kg for diet 0% to 2.42kg in diet 40%. However, diets containing 10% and 40% were statistically the same. Weekly feed intake increased with increasing level of cassava peel/pkc meal in the diet which ranged from 18.50 kg for diet 0% to 18.92 kg for diet 30%. Feed conversion ratio followed the same trend with feed intake increasing with increase in cassava peel/pkc meal in the diet, feed conversion ratio ranged from 6.31 in diet 0% to 7.81 in diet 40%. Significant (P<0.05) difference was observed with regards to protein efficiency ratio which ranged from 2.77 for diet 30% to 4.60 in diet 40%.

Table 3: Performance of pregnant gilts fed experimental diets

Parameters	Levels of Inclusion (%)					SEM
	0	10	20	30	40	(±)
Average initial weight of gilts at mating (kg)	43.50^{c}	45.25^{a}	44.70^{c}	45.00^{b}	45.20^{a}	0.13
Average final weight of gilts (kg)	97.50^{a}	88.00^{b}	83.00^{c}	88.00^{b}	81.50^{d}	0.34
Average total weight gain (kg)	44.00^{a}	42.80^{b}	38.30^{c}	42.50^{b}	36.30^{d}	0.32
Average weekly weight gain (kg)	2.93^{a}	2.86^{b}	2.55^{c}	2.83^{b}	2.42^{d}	0.01
Average weekly feed intake (kg)	18.50^{c}	18.68^{b}	18.92^{a}	18.90^{a}	18.90^{a}	0.04
Feed conversion ratio	6.31^{a}	6.53^{b}	7.42^{d}	6.68^{c}	7.80^{e}	0.02
Protein efficiency ratio	3.42^{b}	4.29^{ab}	2.77^{b}	4.60^{a}	3.30^{ab}	0.73

*means along the same row with different superscripts are significantly (P< 0.05) different from each other.

Reproductive Performance of Pregnant Gilts at Farrowing fed Experimental Diets

Reproductive performance of gilts at farrowing as shown in Table 4, indicated that the diets significantly (P<0.05) affected the parameters evaluated. Average weight of gilts at farrowing ranged from 0 (78.00) to 40% (72.00kg). The number of piglets farrowed was higher in control diet (32.00), followed by 10, 20, 30, and 40 % with values of 31.00, 29.00, 27.00 and 23.00 kg respectively.

Table 4: Reproductive performance of pregnant gilts fed experimental diets

Parameters	Levels of Inclusion (%)					SEM
	0	10	20	30	40	(±)
Average sow weight immediately after farrowing	78.00^{a}	77.50^{a}	73.00^{b}	74.00^{b}	72.00^{c}	0.80
Number of piglets	32.00^{a}	31.00^{a}	29.00^{b}	27.00^{c}	23.00^{d}	0.78
Total birth weight of piglets (kg)	31.04^{b}	34.01^{a}	31.90^{c}	29.70^{d}	27.60^{e}	0.28
Average weight of piglet (kg)	0.97^{b}	1.10^{a}	1.10^{a}	1.10^{a}	1.20^{a}	0.21
Average weight of placenta (kg)	2.80^{a}	2.00^{b}	2.20^{b}	2.20^{b}	2.75^{a}	0.10

*means along the same row with different superscripts are significantly (P< 0.05) different from each other, SEM: Standard error of mean.

Total birth weight of piglets was higher in 10 % than 20, 0, 30 and 40 % with values of 34.01, 31.04, 29.70 and 27.60kg. Average weight of piglets at farrowing was significantly ($P<0.05$) better in diet 40%, but similar in diets 10, 20 and 40% while the lowest average weight of piglets at farrowing was obtained at 0% (0.97kg). Average weight of placenta values of 2.75, 2.20, 2.20 and 2.50 kg were recorded for 0, 40, 30, 20 and 10 % respectively.

DISCUSSION

The dry matter apparent digestibility ranged from 92.66 to 90.06.50 % for the gilts fed the experimental diets. These values were higher than values of 87.40 and 89.50 % reported by Adesehinwa *et al.* (2011) and Aro *et al.* (2013). The increase above these authors report could be attributed to the condition of the gilts that required more energy to meet up the nutrient needs of the fetus. Digestibility of crude protein ranged from 17.50 to 16.32 which is in conformity with earlier reports of Adesehinwa *et al.* (2011), whose values range from 18.20 to 17.33 %. Nitrogen free extracts increased with increasing levels of the test ingredients diets in the experimental diets (50.16-58.93 %). They fall within the values of 51.40 and 54.15 % as reported by Adesehinwa *et al. (*2011) and Aro *et al.* (2013) respectively. Ether extract digestibility was higher than values reported by Adesehinwa (2007) 0.75, 1.4 and 4.69 % in the study of cassava peels and palm kernel cake. Ash digestibility was in contrary to the reports of Nwokoro *et al.* (2005); Adesehinwa *et al.* (2011) and Aro *et al.* (2013). Digestibility of crude fiber ranged from 16.83 to 25.52 % was similar to the reports of Ubalua (2007); Adesehinwa *et al.* (2008, 2011) and Aro *et al.* (2013). These authors reported a crude fiber digestibility range from 10-30 %. Thus, results in apparent digestibility in this study showed that pregnant gilts were efficient at digestion and elimination of waste.

Weekly weight gain of the pregnant gilts reduced with increase in levels of CP and PKC meal in the diet while average weekly feed intake, feed conversion ratio increased gradually as the level of inclusion increased. This is concomitant with works of Igene (2006) and Ekenyem (2007) who reported that inclusion of cassava peels above 60 % will have a deleterious effect on the performance of pigs. This result also corroborated with Tewe and Iyayi (1995); Sonaiye and Omole (1997) and Moseri *et al* (2020) who opined cassava peel at levels between 30 – 50 % could be fed to grower-finisher pigs without adverse effect on growth rate. Consequently, a threshold of 40% inclusion level of cassava peel was recommended for grower pigs. Performance of gilts at farrowing and piglets fed cassava peel/pkc meal-based diets is in line with Borges *et al.* (2005) who reported a significant increase in the weight of sow at farrowing, piglet weight and live weight at birth. This also falls within the range reported by Quiniou *et al.* (2002) and McPherson *et al.* (2004) that reported a tremendous increase in weight of gilts during gestation period. This study also aligned with the reports of Coma *et al* (1996); Sauber *et al.* (1999) that opined sow weight gain during pregnancy, piglet weight gain and piglet average weight were affected in the reproductive cycle. However, this study conforms with Miller *et al.* (2001); Shelton *et al* (2009), that posited the benefits of increasing feed allowances especially for pregnant gilts, for maintenance of sow body reserves before parturition and enhancing the level of survival of piglets during farrowing.

CONCLUSION

This study has shown that cassava peel and palm kernel meal-based diets fed to pregnant gilts up to 30% has no hazardous effect on the sow piglet at farrowing. However, 10% diet is recommended because it has no obvious reduction in the reproductive performance of pregnant gilts and compete famously with control (0%) in total weight gain of gilts and piglets at farrowing.

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