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Effects Of Substituting Maize For Yellow Cocoyam (Xanthosoma Sagittifolium) AsEnery Source For Weaner Pigs

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A B S T R A C T
The research was conducted to investigate the dietary effect of substituting maize for cocoyam (Xanthosoma Sagittifolium) as energy source for weaner pigs. The experiment was conducted at the Swine unit of the Teaching and Research Farm, University of Uyo, Uyo, Akwa Ibom State. The cocoyam was collected and processed by sundring to form a cocoyam corm meal (CCM).A total of 16 weaner pigs of large white were used for the study. The pigs were divided into 4 groups based on average initial weights (20-25kg) and each group of weaner pigs were respectively allocated to each of the four treatment diets using a completely randomized design (CRD). Each treatment group contained 2 replicates of 4pigs, 2male and 2female). These pigs were fed twice daily and water supplied ad-libitium. Four diets were formulated to contain 0%, 20%, 40% and 60% of CCM. Data were collected on growth performance and blood profile. Result revealed that there was significant (P>0.05) differences on all the growth performance parameters measured. No significant differences (P>0.05) were observed on all blood profile parameters measured except the albumin and creatinine. The albumin and creatinine values ranged from 2.63-3.52 g/dl and 0.90- 1.50mg/dl respectively. It can be concluded that weaner pigs fed 20% CCM based diet yielded best results in terms of performance and there was no detrimental effect on their blood profile. Implications and recommendations were made from the findings of the study.

Keywords*: Cocoyam, Growth performance, Weaner pigs.*

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INTRODUCTION
Consistent increase in cost of conventional swine feedstuffs in Nigeria has led to search and utilization of alternative feed sources for swines [1]; [2]. Besides, depending on maize alone as the sole source of dietary energy may be devastating to swine production, because of the frequent drought and locust attack affecting some maize producing areas [3]. Inadequate production of maize which is the major conventional energy feed source to meet the energy requirements for man, livestock and raw material for industries, created the need to look for cheaper, readily available and alternative sources of energy feedstuff for pigs such as yellow cocoyam corm known as “ede uhie” in Igbo[4].

Cocoyam products are recognized as cheaper carbohydrate sources than grains or other tuber crops. Thus, tannia cocoyam (Xanthosoma sagittifolium) is a non-conventional feedstuff that provides readily available energy with easily digestible carbohydrate. Xanthosoma sagittifolium is readily found in all hotand humid areas of the world as is cultivated extensively throughout West Africa [5] as cited in [2]. It was suggested that tannia cocoyam are now more important than taro cocoyam (Colocasia esculenta) being more popular, due to superiority of their corms and cormels in terms of energy, proteins and mineral elements[6].

Cocoyam is a collective name for species of *Colocasia* and *Xanthosoma* genera from family of *Aracea* [7], [8]. Cocoyam is a herbaceous annual and perennial crop with underground roots known as corms which contains high amount of starch. *Xanthosoma sagittifolium* is very nutritious and highly productive and yet it’s corms and cormels are being under utilized as energy feed resources [9], [5], [10]. The cocoyam corm can be processed into fufu and the cormels can also be used in soup thickening or serve as portage with vegetables in Igbo land [9]. It is also a source of dietary energy, proteins, vitamins and as well high in potassium, zinc and nicotic acid [11].

Cocoyam corms contains anti-nutritional factors such as tannins, hydrocyanid, oxalates, antitrypsin inhibitor [12]; [13]. The anti-nutritional factors in the cocoyam corms could be removed through drying, fermentation, cooking and toasting to make the product safe for human and livestock consumption [4], [10]. Ndimantang *et al.* [4], Aboubakar *et al.* [11], Akinmutimi *et al.*[14], Chandra Subhash *et al.* [15] observed that *Xanthosoma sagittifolium* corm meal proved to serve as good food for both man and livestock with its appreciable nutritional profile and higher productivity. Ndimantang *et al.* [4] went further to say that cocoyam corm flour *(Xanthosoma sagittifolium)* contains about 132 calories in a cup of dried and ground corms of 135 grams, 0.347mg copper, 0.32mg of vitamin B6, 31.9gm of carbohydrates, 8.07mg of potassium, 1.32mg of iron, 1.131mg of vit. B1, 0.257mg of manganese and 9.74% protein. Owusu – Darko, *et al.* [5], evaluated the potentials of cocoyam corms and cormels and expressed dismay for an under utilization and under exploitation of this arable crop by consumers. However, Iwuoha *et al.* [16], Sheila [17], Dosumu, *et al.* [18], Zhu[19] reported some anti-nutritional factors in cocoyam corms and cormels especially calcium oxalate and physico-chemical properties which can hinder their utilization as food if not well processed. In other to proffer solutions to these problems posed by these antinutritional factors of cocoyam corms and cormels, Sefa *et al.* [20], observed that calcium oxalate, tannin, hydrocyanid etc could be removed through good processing methods such as drying, soaking or cooking and could make the corm meal safe for consumption and for other industrial uses. Matikiti [6], observed that the proximate nutritional composition of cocoyam were in the range of 65–78% moisture 2–5% ash, 0.2–1.10% fat, 2.5–5% fibre, 14-23% carbohydrates, 390-460mg/100g potassium, 24-43mg/100g calcium, 79-91kcal/cal energy, 4.8% protein and 79-110mg/100g magnesium.

The study was therefore targeted to investigate the dietary effects of substituting maize for yellow cocoyam (Xanthosoma Sagittifolium) as energy source on weaner pigs.

METHODS AND MATERIALS:

Location of study

The experiment was carried out at the Swine unit of the Teaching and Research Farm, University of Uyo, Uyo, Akwa Ibom State. Akwa Ibom state is in Nigeria. It is located in the coastal southern part of the country, lying between latitudes $4^{0}32^{1}$N and $5^{0}33^{1}$N, and longitudes $7^{0}25^{1}$E and $8^{0}25^{1}$E. The state is located in the south-South geographical zone, and is bordered on the east by Cross River State and Rivers State,, on the west by Abia state, and on the south by Atlantic Ocean and the south-most tip of Cross Rivers State.

Collection and preparation of test ingredients

The cocoyam used for the experiment were gotten from the research farm of University of Uyo, Uyo, Akwa Ibom state. The corms were peeled, washed, cut into pieces and sundried for 15 days so that it could be crispy while milling using a hammer mill. The dried cocoyam corm meal (DCCM) was taken to the laboratory for proximate analysis. Four weaner diets; T1 (control), T2, T3 and T4 were formulated in which dried cocoyam corm meal was added to partially replace maize at 0%, 20%, 40% and 6a0% respectively.

Experimental Animals

A total of 16 weaner pigs of large white were used for the study. The pigs were divided into 4 groups based on average initial weights (20-25kg) and each group of grower pigs were respectively allocated to each of the four treatment diets in a completely randomized design (CRD). Each treatment group contained 2 replicates of 4 pigs (2male and 2female). The experimental animals were dewormed for two weeks before the test was administered. The animals were fed twice daily and water supplied ad-libitium.

Data Collection

Feed Intake and Live Weight Gain**:** At the beginning of the experiment, the pigs were weighed on a daily basis prior to feeding in the morning and evening. The initial live weight was subtracted from the final live weight to determine the weight gained by the animals. Feeds offered and remnants were weighed daily to determine the feed intake of the animals. Both values were used to determine Feed Conversion Ratio (FCR).

Statistical analysis:

Data were subjected to analysis of variance using the procedure outlined by SAS and significantly different means were separated using the Multiple range test by Duncan.

RESULT AND DISCUSSION:

Table1.Composition of Experimental Diet for Weaner Pig

Ingredients	**T1 (0%)**	**T2(20%)**	**T3 (40%)**	**T4 (60%)**
Maize	60.00	40.00	20.00	0.00
Cocoyam corm meal	0.00	20.00	40.00	60.00

Soya bean meal	15.00	15.00	15.00	15.00
Fish meal	4.00	4.00	4.00	4.00
Blood meal	1.00	1.00	1.00	1.00
Wheat Offal	24.10	24.72	24.51	24.25
Palm kernel cake	10.30	10.30	10.30	10.30
Bone Meal	1.50	1.50	1.50	1.50
Limestone	2.00	2.00	2.00	2.00
Weaner Premix*	0.25	0.25	0.25	0.25
Salt	0.35	0.35	0.35	0.35
L- Lysine	0.20	0.20	0.20	0.20
Total	**100.00**	**100.00**	**100.00**	**100.00**
Calculated Analysis:				
Dry Matter	92.00	89.23	88.83	87.28
Crude Protein (%)	**19.00**	**21.00**	**23.00**	**25.00**
Ether extract	**7.48**	**5.19**	**4.58**	**2.60**
ME(Keal/Kg)	**2978**	**2957**	**2935**	**2913**
Fibre (%)	5.35	6.99	8.63	10.26
Ash (%)	5.94	9.11	12.34	15.57
Phosphorus (%)	36.23	40.23	42.48	44.25
Lysine (%)	0.21	0.43	4.06	6.32
Calcium (%)	46.01	34.23	25.28	33.23
Cellulose	34.00	23.98	13.32	22.99
Methionine (%)	6.32	8.86	6.99	13.34

Table 2: Proximate Composition of Cocoyam corm meal

Ingredients	**Composition**
Crude fibre (%)	5.60
Crude protein (%)	8.10
Ash (%)	3.89
Ether EXtract (%)	5.00
Moisture	79.00
Dry Matter	80.10
Nitrogen Free Extract	47.87
ME (Kcal/kg)	2421.98Kcal/kgDM

Metabolizable = (37 × %CP) + (81.8 × %FAT) + (35.5 × %NFE) ME metabolizable

Table 2 shows the proximate analysis of dried cocoyam corm meal *(Xanthosoma sagittifolium)* used for this study. The crude fibre, crude protein, ash, ether extract moisture, dry matter, nitrogen free extract and metabolizable energy are: 5.60%, 8.10%, 3.89%, 5.00%, 79.00%, 80.10%, 47.87% and 2421.98Kcal/kgDM respectively. These values were in line with the values obtained by Sarla *et al.*[21] and Okonkwo [2].

Table 2: Growth Performance characteristics of pigs fed experimental die*t*

Levels of inclusion (%)					
	0	**20**	**40**	60	
Parameters	**1**	**2**	**3**	**4**	**SEM (±)**
Ave. initial weight(kg)	9.05	8.98	9.00	9.01	
Ave. final weight(kg)	28.84^{b}	30.67 ^{a}	25.00 ^{c}	38.50 ^{d}	0.46
Ave. total weight gain(kg)	12.52 ^{b}	23.79 ^{a}	16.00 ^{d}	30.50 ^{cd}	0.44
Ave. daily weight gain(kg)	2.07 ^{b}	2.40 ^{a}	2.06 ^{c}	1.78 ^{cd}	0.64
Feed intake(kg)	35.00	35.00	35.00	35.00	0.01
Feed conversion ratio	2.31 ^{c}	2.16 ^{d}	2.69 ^{b}	2.80 ^{b}	0.68
Protein efficiency ratio	2.18 ^{b}	2.52 ^{a}	1.95 ^{c}	1.88 ^{cd}	0.08
Mortality (%)	-	-	-	-	-

a , b, c, d, e means along the same row with different superscripts are significantly (p< 0.05*) different from each at her, Ave: Average, SEM: Standard error of mean* and Makikiti [6].

The result of the performance of layer hens fed dried cocoyam corm meal are shown in Table 3. Feed intake increased as the levels of dried cocoyam corm meal increased in the diets though there were no significant (P>0.05) difference among the treatment groups, T4 had the highest (P<0.05) feed intake among other groups while T1 had the least (P<0.05). The results of feed intake obtained in this study are in agreement with observations of Esonu [22] and [23], Ndimetang *et al.* [4] who reported that cocoyam corm meals were very rich in nutrients and very palatable and therefore increases its acceptability in swine diets. On body weight gain, pigs placed on diets 2 (T2) had significance (P<0.05) least weight gain among the treatment groups, T1 group and T3 were the same (P>0.05) while T4 had the highest (P<0.05) weight gain among other groups. This obviously implies that cocoyam corm meal (*Xanthosoma sagittifolium)* improved adequate weight gain that are required for maximum meat production. This is in agreement with Okonkwo [2] who stated that growth require synthesis of new body tissues and the raw materials for growth have to be provided through feed and feedstuffs that are adequate for it. In weaner pigs that are reared for other purposes, production however is influenced by growth which has to be attained to a particular point (1.5 to 2kg). Moreso, higher feed intake of T4 pigs did not match the meat production value recorded in this study. This experiment showed that 20% inclusion of cocoyam corm meal supported meat production, body weight and feed efficiency more than 20% inclusion (T4). On feed conversion efficiency, T4had the highest (P<0.05) (2.80) among other groups followed by T3(2.69) and then T1(2.31) and T2 (2.16) which had the lowest (P<0.05), though there were no significant (P>0.05) difference among the treatment groups on feed conversion ratio. This is in line with Iheukwumere *et al.* [24] and Esonu [23] who stated that weaners pig diets should be adequate with regard to essential nutrients to improve feed efficiency and feed utilization. Also, Effiong *et al.* [25], Singh *et al.* [26] reported positive influence on pig day production, body weight and feed efficiency on pigs fed adequate diets in terms of quality and quantity. It is important to state here that as at the time this experiment was carried out, very little information was available on the inclusion of yellow cocoyam corm meal *Xanthosoma (sagittifolium)* as feed ingredient in weaner pig diets.

Table 4: Haematological indices of parameter of weaner pigsfed with Cocoyam corm meal (CCM) Based Diet

Parameters	T1 (0%)	T2 (20%)	T3 (40%)	T4 (60%)	SEM
HB(g/dl)	11.97	11.77	11.68	11.73	0.88
PVC (%)	33.08	31.63	31.88	31.88	2.66
RBC(x106/UL)	2.56	2.59	2.69	2.53	0.27
MCV (fl)	131.98 ^{a}	125.18 ^{b}	126.85^{ab}	126.85^{ab}	5.23
MCH (pg)	38.88 ^{a}	38.88 ^{b}	37.53 ^{b}	37.53^{b}	1.19
MCHC (%)	29.03 ^{b}	31.02 ^{a}	29.33 ^{b}	29.55^{ab}	1.38
PLT (x103/UL)	22.67 ^{a}	20.83 ^{a}	18.33 ^{a}	20.50 ^{a}	1.37
WBC (x103/UL)	83.78 ^{a}	73.13 ^{ab}	82.00 ^{ab}	75.33 ^{b}	6.15
LYM(%)	77.67 ^{c}	83.83 ^{abc}	81.00 ^{bc}	87.67^{ab}	7.76
NEUT (%)	22.33 ^{a}	16.17 ^{abc}	19.00 ^{ab}	12.33^{bc}	8.00

a,b,c Means in the same row with different super script are significantly different

The results of haematological analysis of weaner pigs fed dried cocoyam corm meal are shown in Table 4 above.

Hematological parameters such as hemoglobin, packed cell volume, red blood cell volume tend to decrease as the levels of cocoyam corm meal increased in the diets but did not follow a definite order. Moreso, all the values obtained were within the normal range for pigs which were in line with Merck, [27]. The mean cell haemoglobin concentration increased (P<0.05) for pigs fed high inclusion levels of cocoyam corm meal in their diets. T2 had the highest (P<0.05) cell hemoglobin concentration (31.02pg) followed by T4 (29.55pg) which differed significantly (P<0.05) from T1 (29.03pg). The white blood cell count values did not differ significantly (P>0.05) among the treatment groups and all the values. These indicate the normal body functions of hens and the absence of infection in all the treatment groups. This is in line with Awuyobi *et al.* [28], [29], Iheukwumere *et al.* [24] who stated that haematological parameters are an index and reflection of the effects of dietary treatment on the animal in terms of type quality and quantity ingested to meet the physiological, biological, biochemical and metabolic necessities of the body. In this study, none of the haematological parameters evaluated had any adverse effect on the weaner pigs as well as meat production, and an indication that the dried cocoyam corm meal is an ideal feed ingredient and could replace maize in weaner pigs diets up to 20% level in their diets without any deleterious effect on the overall performance.

CONCLUSION

This study was conducted to evaluate the dietary effects of substituting maize for yellow cocoyam (Xanthosoma Sagittifolium) as energy source for weaner pigs. A total of 16 weaner pigs of large white were randomly selected at the Swine unit of the Teaching and Research Farm, University of Uyo, Uyo, Akwa Ibom State and used for the study. The pigs were divided into 4 groups based on average initial weights (20-25kg) and each group of grower pigs were

respectively allocated to each of the four treatment diets in a completely randomized design (CRD). Each treatment group contained 2 replicates of 4 pigs (4male and 4female). These pigs were fed twice daily and water supplied adlibitium. The treatment diets consisted of the following of pineapple waste mixed with malted sorghum meal at 0 (controlled), 20, 40, 60% replacement of maize in the control diet were formulated. The study utilized a randomized design and the statistics used in analyzing the result in the study were mean+stem and one way Analysis of variance (ANOVA).

Data were collected on growth performance and blood profile. There was a significance difference (P> 0.05) of cocoyam corm meal on the growth performance of weaner pigs. This implies that feeding weaner pigs with dried cocoyam corm meal *(Xanthosoma sagittifolium)* based diets improved feed intake, body weight gain, body weight and feed conversion efficiency.

No significant differences (P>0.05) were observed on all blood profile parameters measured except the albumin and creatinine. The albumin and creatinine values ranged from 2.63-3.52 g/dl and 0.90- 1.50mg/dl respectively. It can be concluded that grower pigs fed 20% MSPW based diet yielded best results in terms of performance and there was no detrimental effect on their blood profile. Finally, on a general note, the result of this study showed that 40% of cocoyam corm meal *(Xanthosoma sagittifolium)* could be included in the diets of weaner pigs without any adverse effects on the performance and blood parameters. It is therefore recommended that cocoyam corm meal;

i. Should be encouraged in the feeding of pigs to reduce over dependence of maize feeds by our farmers which have led to high cost of raising monogastrics specifically pigs which thereby discouraged farmers from investing in the swine business.
ii. For swine farmers and swine nutritionists whose target is primarily on improvement of feed efficiency and body weight weaner pigs, the result of this study showed that 20% dried cocoyam corm meal replacement of maize will meet that need, hence, it is recommended.

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