# ASSESSMENT OF PERFORMANCE, CARCASS AND COST BENEFIT OF GROWER PIGS FED SUNDRIED UNRIPE BANANA DURING (*MUSA ACUMINATA*)

**Essien, C. A.**
Department of Animal Science, Faculty of Agriculture
Akwa Ibom State University, Akwa Ibom State, **NIGERIA**
Email: comfortabelessien@gmail.com

## ABSTRACT

A sixty-day feeding trial was conducted to evaluate the effect of graded sundried unripe banana meal (*musa acuminata*) in growing pigs' diets. Forty-eight pigs at twelve week of age were used for the experiment. Four experimental diets were formulated to incorporate sundried unripe banana meal as maize substitute at 0%, 10%, 20% and 30% to form $T_1$, $T_2$, $T_3$, and $T_4$ respectively. The experimental pigs were divided into four groups of twelve pigs. Each group was assigned to one of the treatment diet in completely randomized design. Each group was further divided into three replicates of four pigs each. Feed and water were provided ad libitum and data collected were statistically analyzed. The results of growth performance of the experimented pigs indicated significant ($p<0.05$) difference across treatment groups. The feed intake of pigs across treatment groups was statistically similar. The best feed conversion ratio and efficiency were observed in 30% group. Live weight, dressed weight, dressing %, cut-parts (ham, hand and shoulder, hind legs and trotter) and internal organs (liver, kidney, heart and spleen) indicated significant ($P<0.05$) differences in their values. Feed cost, average cost of feeding, total feed cost were significantly ($P<0.05$) affected by the diet. There were significant ($P<0.05$) reductions in their values as the level of sundried unripe plantain meal increased in the pigs diets. The lowest feed cost per kg weight gain was recorded in 30% group. The result of this study showed that sundried unripe banana meal could replace maize effectively up to 30% level of supplementation in growing pigs diet without any adverse effect on the performance, carcass and organs of the pigs and also provide the lowest cost of feed per kg weight gain.

**Keywords:** Unripe banana, Pigs, Cost Benefit, and Carcass.

## INTRODUCTION

In the last two decades, animal nutritionist has placed great emphasis on research towards the use of alternative feedstuff in livestock nutrition due to the ever-increasing price of maize, the main energy source in livestock feeds. The production of many crops which could serve as a good alternative to maize either partially or completely in livestock feed are seasonal. At this time the supply of this produce is higher than the demand resulting in a surplus that requires to be processed and or stored. Due to inadequate processing and storage facilities, this surplus is left to rot or destroyed by insects and other pests. Incorporating them into animal feed could reduce tremendous losses and wastages which the farmers incur, particularly after the attainment of bumper harvest. Example of these seasonal crops or plants are plantains, banana, yam, cocoyam, potatoes etc.

Banana (*musa spp*) is a major source of carbohydrate. Banana and plantain are the fourth most important food crops in the world after rice, wheat and maize (Pareek, 2016). Banana

fruits are produced all year round in Nigeria, but the major harvest comes in the dry season (November-February) when most other starchy staples are unavailable or difficult to harvest. Banana is a perennial crop with a short gestation period, making it very easy to cultivate. The production of banana is mainly in the southern states of Nigeria where annual rainfall is usually above 1000mm in a year and spread over 7-9 months (Ogazi, 1996). The production of banana remains largely in the hands of small scale farmers in rural areas.

Bananas are consumed as fruit or it can be processed into other forms like banana pan cake, ice cream, yoghurt etc. It is known for its energy boosting effect and its richness in vitamin C which makes it a very good antioxidant source. The antioxidant capacity of banana is reported to be attributed to their gallocatechin content (Shinich, 2002).

Awoyinka, *et. al.,* (2019) reported that banana is low in crude protein, crude fibre and crude fat but are significantly high in potassium, magnesium, phosphorous and dietary energy. The authors further reported that the consumption of banana by children and adult can possibly be utilized as sources of vital mineral and possible scavengers of free radicals thereby preventing the symptoms that are associated with degenerative diseases.

Banana is believed to promote wound healing especially burns and prevent substantial number of illness such as depression Pereira and Maraschino (2015). Vijayakunar *et. al.,* (2008) observed that the biological activity of banana is directly related to their chemical composition for instance the antioxidant activity is attributed to their phenolic constituents. It was found that higher content of polyphenols, flavonoids, total dietary fibre, insoluble dietary fibre, lignin, hemicellulose, cellulose, anti-oxidant capacity and free radical scavenging capacity was present in banana pulp (Singh, *et. al.,*, 2016). According to the reports of Seymour (1993) banana peels are rich in many high value health-promoting antioxidant phytochemicals such as anthocyanins, delphinidin and cyanidins.

Banana is classified among other crops with low glycaemic index. Banana releases it energy into the blood stream slowly. According to the international glycaemic index (GI) database, fully ripe banana has a gyycaemic index of 51 which count as low glycaemic index food because the value is less than 55. The Low (GI) glycaemic index of banana help to reduce and protect the body against developing diabetes because of the slow release of glucose in to the blood stream. The chemical composition of peel and pulp of banana comprises mostly of carotenoids, phenolic compounds and biogenic amino (Awoyinka *et. al.,* 2019).

There are several varieties of banana in the world. The popular varieties in Nigeria are Cavendish, lady finger; pisang raja etc. In some rural areas of Akwa Ibom State, there is a particular variety of banana identified as *Musa acuminata*. This Musa species is not popular, the fruits are cheap, and are sometimes left to stand without harvesting. The fruits are shorter and the skin thicker than the fruit of Musa Cavendish. It can be cooked when green and eaten raw once fully ripe. The supply of this variety of banana is lower than the demand, thus, resulting in economic losses of the products.

High post harvest losses are among the major problem that affects the availability of banana in Nigeria. Environmental factors such as temperature, relative humidity and air composition affects the shelf-life of banana, coupled with inadequate storage system and insufficient distribution always results in a large proportion of the produce being wasted.

Pigs are omnivorous animals, they can tolerate all kinds of feeds. They have short generation interval, thus guaranteeing a short term measure of alleviating animal protein deficit especially in areas where there is no religious edict preventing their production and consumption. Thus, the objective of this study was to investigate the effect of sun-dried unripe banana (*Musa acuminata*) specie on the performance, carcass/organ and cost benefit of growing pigs.

**Experimental Site**

The research was carried out at the piggery unit of the teaching and research farm of Akwa Ibom State University, Obio-Akpa Compus. Obio-Akpa is located between latitude $5^{0}17^{l}$N and $7^{0}27^{l}$N, Longitude $7^{0}27^{l}$E and $7^{0}58^{l}$E with an annual rainfall ranging from 3500mm-5000mm and average monthly temperature of $25^{0}$C and relative humidity between 60-90% in the tropical rainforest zone of South South Nigeria (Wikipedia, 2016).

**Sources and Processing Method of Banana**

The unripe bananas were harvested without cost from individual plantain and banana farms in five villages in Uyo Local Government Area of Akwa Ibom State. The banana fingers were washed, chopped into pieces and sun-dried for 5-7days. The sun-dried chips were ran through a hammer mill with 2mm sieve to homogenize the products and produced sundried unripe banana meal. (SUBM).

**Experimental Diets**

Four experimental diets were formulated to meet the nutrient requirement of grower pigs. The diets were formulated to contain varying levels of sundried unripe banana meal replacing dietary maize at 0%, 10%, 20% and 30% as $T_1$, $T_2$, $T_3$, and $T_4$ respectively. Gross composition of the experimental diet is presented in table 1.

**Chemical Analysis**

Sample of the Sun-dried unripe banana meal was subjected to proximate analysis for moisture, crude protein, ether extract, crude fibre, Ash and Nitrogen free extract according to the method of AOAC (2000).

**Experimental Animals and Management**

A total of forty eight (48) pigs (land race/large white) at 12 weeks of age with average initial weight of twelve kilogram were selected and distributed into four groups of twelve pigs and each group further replicated three times with four pigs per replicate. Each group was assigned to one of the four experimental diets in a completely randomized design. The pigs serving as replicate group were housed together in a naturally ventilated pen of floor area of $12m^2$ that is furnished with concrete feeders, drinkers and wallowing bath. Routine management practices were carried out daily. Medications were administered routinely as scheduled on the farm. Feed and water were provided *ad libitum*. The experiment lasted 60 days.

**Carcass and Organ Evaluation**

At the end of the sixty days feeding trial, four pigs from each treatment were randomly selected, weighed, tagged according to their replicate, and fasted overnight of feed to reduce the gastro-intestinal contents. Slaughtering was done by manual exsanguinations by severing the jugular vein, carotid arteries and trachea with a knife after stunning. The slaughtered animals were skinned, the head, trotter, tail, intestinal contents and organs were removed. The

remaining carcass was weighed and weight expressed as percentage of the live weight. The weights of the organs were also recorded.

**Cost benefit Analysis**

The economic analysis was done to determine the economic advantage for substituting sun-dried unripe banana for maize in the diet of growing pigs. Cost of feed was calculated based on the prevailing cost of ingredient per kg as at the time the experiment was conducted by summing the price per kg of feed ingredient, multiplied by their proportions in the feed formula then dividing by 100.

Average feed cost (AFC) was gotten by multiplying cost per kg feed by daily feed intake, while the total feed cost (TFC) was gotten by multiplying total feed intake by cost per kg feed. The cost per kg body weight gain was calculated by multiplying cost per kg feed by feed conversion ratio.

**Table I: Gross Composition of the Experimental Diets**

| Ingredients | $T_1$ (Control) | $T_2$ 10% SUBM | $T_3$ (20% SUBM) | $T_4$(30%SUBM) |
|---|---|---|---|---|
| **Maize** | 55.00 | 45.00 | 35.00 | 25.00 |
| **SUBM** | 0.00 | 10.00 | 20.00 | 30.00 |
| **Soya Bean meal** | 20.00 | 20.00 | 20.00 | 20.00 |
| **Wheat of fat** | 11.00 | 11.00 | 11.00 | 11.00 |
| **Palm kernel cake** | 11.00 | 11.00 | 11.00 | 11.00 |
| **Bone meal** | 4.00 | 4.00 | 4.00 | 4.00 |
| **Vit/premix** | 0.25 | 0.25 | 0.25 | 0.25 |
| **Common salt** | 0.25 | 0.25 | 0.25 | 0.25 |
| **l-lysine** | 0.25 | 0.25 | 0.25 | 0.25 |
| **l-methionine** | 0.25 | 0.25 | 0.25 | 0.25 |
| **Total** | 100 | 100 | 100 | 100 |
| Calculated the chemical composition (%DM) | | | | |
| **Crude protein** | 18.93 | 18.80 | 18.67 | 18.63 |
| **Crude fibre** | 4.11 | 3.98 | 3.85 | 3.72 |
| **Ether extract** | 4.04 | 3.98 | 3.72 | 3.46 |
| **Ash** | 2.80 | 2.95 | 2.91 | 2.93 |
| **NFE** | 70.12 | 70.29 | 70.85 | 71.26 |
| **ME/Kcal/kg** | 26949 | 28699 | 28698 | 28714 |

SUBM-sundried unripe banana meal

**Data Collection**

The initial weights of the pigs were taken and subsequent live weights were recorded weekly. The weight gain was calculated by subtracting the initial weight from the final weight using a 100kg capacity weighing balance. Feed intake was obtained as the difference between the total quantity of feed offered and the quantity not consumed.

Feed conversion ratio was calculated by dividing the daily feed intake by daily weight gain. Mortality (%) this was obtained by dividing the numbers of dead pigs by the total number of pigs multiply by 100.

**Statistical Analysis**

Data obtained in all the parameters determined in this study were subjected to analysis of variance using SAS statistical package (SAS 2002) and means were separated using Duncan Multiple Range Test (DMRT) 1955.

**Results and Discussion**

The proximate composition of fresh and sundried unripe banana is presented in table 2. The result of the proximate composition of unripe banana showed increase in values for nitrogen-free extract and ash of processed unripe banana by sun drying over fresh or raw banana. This result indicated that processed unripe banana through sun drying improved the energy and mineral content of unripe banana.

**Table 2:proximate composition of fresh and sun-dried banana**

| Parameter | Fresh | Sundried |
|---|---|---|
| **Moisture** | 53.71 | 14.21 |
| **Crude protein** | 6.13 | 8.31 |
| **Crude fat** | 1.71 | 2.41 |
| **Crude fibre** | 2.11 | 3.02 |
| **Ash** | 3.53 | 4.68 |
| **Nitrogen Free Extract** | 42.81 | 67.37 |

The result of the performance parameters of the experimental pigs are presented in table 3. The weight gain of the experimental pigs increased significantly ($P<0.05$) with elevated levels of Sundried unripe banana meal. Thus, the magnitude of response to diet containing graded levels of sundried banana meal was more pronounced with increasing supplementation. Pigs fed diet containing 30% of Sundried unripe banana meal recorded the highest significant ($P<0.05$) weight gain value followed by pigs on 20% sundried unripe banana meal, and 10% group. 10% and 0% groups had similar statistical values. The significant increase ($p<0.05$) observed in the weight gain of the experimental pigs as the level of sundried unripe banana meal increased in the diet could be attributed to a rich nutrient content of the test material which help to improve the quality of the feed such as energy, and minerals (iron, calcium, magnesium and potassium). Iron is essential component of hemoglobin which is critical to the proper functioning of the immune system and production of energy. More so, the significant increase ($p<0.05$) obtained in the final body weight gain of pigs in $T_4$ and $T_3$ could suggest that grower pigs on these treatment obtained adequate intake of nutrient required to sustain rapid growth and development. This report agrees with the findings of Ebuka and Eke (1990) who reported that higher energy diets support growth in pigs and efficient feed utilization than the low energy diets.

The feed intake of the experimental pigs were statistically similar ($p>o.05$)
The non significant value obtained across the treatment group for feed intake ;implied that the diets supplied sufficient energy to meet the animals requirement, since animal eat to satisfy their energy requirement. More so, the non-significant value obtained across the treatment group could suggest consumption of diet low in crude fibre as earlier reported by Awoyinka, *et. al.,* (2019) that banana is low in crude fibre. This result is contrary to the report of Akande and Agbetuyi (2020) where feed intake of broilers decreased with increased level of unripe plantain peels in the diets.

The feed conversion ratio was better in pigs fed 30% and 20% sundried unripe banana. The results shown in this study revealed that pigs fed 30% and 20% of sundried unripe banana meal required less feed (2.43kg and 2.63kg respectively) to gain 1kg weight, indicating that sun-dried banana meal could be incorporated in growing pigs diet as a good energy feed alternative to maize. Feed efficiency of the growing pigs followed the same trend, pigs fed 30% sundried unripe banana meal had the best feed efficiency value followed by 20% groups. The feed efficiency value increased as the level of the sundried unripe banana meal

increased in the diet, thus indicating a good utilization and assimilation of nutrient in the feed by the animals.

**Table3: Performance of growing pigs fed graded level of sundried unripe Banana meal**

| Parameter | $T_1$ | $T_2$ | $T_3$ | $T_4$ | Sem |
|---|---|---|---|---|---|
| **Initial weight (kg)** | 12.75 | 13.00 | 12.65 | 13.03 | 0.07 |
| **Final weight (kg)** | $44.54^c$ | $45.65^c$ | $46.72^b$ | $49.05^a$ | 0.55 |
| **Weight gain (kg)** | $31.79^c$ | $32.65^c$ | $34.07^b$ | $36.02^a$ | 0.51 |
| **Daily weight gain (kg)** | $0.53^c$ | $0.54^c$ | $0.56^b$ | $0.60^a$ | 0.02 |
| **Feed intake** | 87.78 | 87.96 | 87.96 | 87.88 | 1.04 |
| **Daily feed intake** | 1.46 | 1.47 | 1.47 | 1.46 | 0.03 |
| **Feed conversion Ratio** | $2.75^a$ | $2.72^a$ | $2.63^b$ | $2.43^c$ | 0.05 |
| **Feed efficiency** | $0.36^c$ | $0.37^c$ | $3.38^b$ | $0.41^a$ | 0.01 |
| **Mortality** | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

abc – Means in a row with different superscript differ significantly (P<0.05)
SEM- Standard error of the mean

The carcass characteristics of growing pigs fed graded levels of sundried unripe banana meal are presented in Table 4. Dietary inclusion of sun-dried unripe banana meal in the experimental diet significantly (P<0.05) affected the live weight, dressed weight and dressing percentage of the slaughtered pigs. Pigs fed (30%) sundried unripe banana meal had the highest significant (P<0.05) value with respect to the three parameters followed by 20% and 10% groups. The lowest live weight, dressed weight and dressing percentage value was obtained in 0% group. The highest dressed weight obtained by pigs fed 30% sundried unripe banana meal in this study agree with the report of Nwokocha *et. al.,* (2003) who confirmed that heavy pigs produced greater dressed weight. The result obtained in this study for live weight, dressed weight and dressing percentage indicated a progressive increase in values as the level of the test ingredient increased in the diet. The ham, hand and shoulder, trotters and hind legs were significantly affected (P<0.05) by the treatment diet. Pigs fed 30% sundried unripe banana meal recorded the highest significant (P<0.05) values for all the cut-parts mentioned. This could be a resultant effect of highest live weight gain values obtained by pigs in 30% group. This result is in tandem with the reports of Latorre *et. al.,* (2008); Njoku *et. al.,* (2015) who reported an increase in these cut-parts with increased live weight.

Back fat thickness and abdominal fat of the slaughtered pigs were not significantly (P>0.05) affected by the treatment diets. Back fat thickness is used as an index to measure the degree of fatness in pigs. The result obtained in this study reveal that the values of back fat thickness and abdominal fat reduces as the level of sundried unripe banana increased in the diet. This observation could be attributed to the potentials of unripe banana as possessing antioxidant properties which could help in lowering cholesterol and triglyceride levels in the blood, thereby preventing the storage of excess fat in the body. Diet high in antioxidant may reduce the risk of many diseases which include heart disease and certain cancers. Singh *et. al.,* (2016) reported that banana has antioxidant and free radical scavenging properties. Shinichi *et. al.,* (2002) also reported that the antioxidant capacity in banana is attributed to their gallocatechin content.

The organs (heart, liver, kidney and spleen) of the slaughtered pigs were significantly (P<0.05) affected by the diets. Pigs fed 30% sundried unripe banana meal recorded the highest significant values for the above-mentioned organs followed by 20%, 10% and 0% groups. The values for 10% and 0% groups were statistically similar. Certain factors may influence visceral organ size, such factors include body weight, feeding level, diet

composition and age. The result obtained in this study suggests that variability in live weight may have contributed to the differences observed in the visceral organs since the animal with the highest live weight and dressed weight recorded the highest value in all the organ parameters determined.

**Table 4: Carcass and organ evaluation of pigs fed graded level of sundried unripe banana meal**

| Parameter | $T_1$(0%) | $T_2$(10%) | $T_3$(20%) | $T_4$(30%) | Sem |
|---|---|---|---|---|---|
| **Liveweight (kg)** | 44.23 | 45.12 | 46.51 | 49.01 | 0.54 |
| **Dressed weight (kg)** | $26.23^{d}$ | $27.62^{c}$ | $29.51^{b}$ | $33.01^{a}$ | 0.41 |
| **Dressing Percentage (%)** | $59.30^{d}$ | $61.21^{c}$ | $63.38^{a}$ | $67.35^{a}$ | 0.59 |
| **Trotters** | $3.61^{c}$ | $4.13^{b}$ | $4.54^{b}$ | $4.89^{a}$ | 0.01 |
| **Hind leg** | $3.03^{c}$ | $3.57^{b}$ | $4.01^{a}$ | $4.54^{a}$ | 0.41 |
| **Hand and shoulder** | $28.41^{d}$ | $30.11^{c}$ | $34.54^{b}$ | $36.01^{a}$ | 0.41 |
| **Ham%** | $26.11^{d}$ | $27.15^{c}$ | $28.15^{b}$ | $29.41^{a}$ | 0.14 |
| **Back fat thickness %** | 2.17 | 2.15 | 1.91 | 1.71 | 0.05 |
| **Abdominal fat %** | 2.31 | 2.11 | 1.81 | 1.65 | 0.02 |
| **Internal organs % LW** | | | | | |
| **Heart** | $0.67^{c}$ | $0.70^{c}$ | $0.81^{b}$ | $0.96^{a}$ | 0.03 |
| **Liver** | $2.10^{c}$ | $2.34^{b}$ | $2.41^{b}$ | $2.81^{a}$ | 0.01 |
| **Kidney** | $0.31^{d}$ | $0.43^{c}$ | $0.51^{b}$ | $0.81^{a}$ | 0.03 |
| **Spleen** | $0.21^{c}$ | $0.25^{b}$ | $0.31^{a}$ | $0.38^{a}$ | 0.01 |

abcd – means within the same row with different superscript differ significantly ($P<0.05$)
SEM-standard error of the means.

**Cost Benefit Analysis**

The cost benefit of feeding growing pigs diet containing graded level of sundried unripe banana meal as replacement for maize is presented in table 5. Significance difference ($P<0.05$) existed across treatment groups in the values for feed cost, average cost of feeding, total cost of feeding and feed cost/kg weight gain. Pigs fed 30% sundried unripe banana meal had the lowest feed cost, average cost of feeding, total cost of feeding, which was significantly lower ($P<0.05$) than 20% groups. Significant progressive ($P<0.05$) reductions existed in the values of the above mentioned parameters across treatment. Thus, the cost of feeding decreases significantly ($P<0.05$) as the level of sundried unripe plantain increased in the diet. This could be attributed to the affordability of banana compared to maize as at the time this experiment was conducted. The least feed cost per kg weight gain was recorded in 30% group followed by 20% and 10% while 0% group recorded the highest significant ($P<0.05$) price value. The result obtained in this study showed that the feeding of the pigs on $T_4$, $T_3$, $T_2$, to attain their body weight was at a lower cost. Also, this result showed that the banana specie (*Musa acuminata*) is rich in nutrients and can efficiently and effectively enhance growth.

**Table 5: cost benefit analysis of feeding pigs graded level of sundried unripe banana meal**

| Parameter | $T_1$(0%) | $T_2$(10%) | $T_3$(20%) | $T_4$(30%) | SEM |
|---|---|---|---|---|---|
| **Feed cost/kg (₦)** | $135.00^{a}$ | $125.55^{b}$ | $115.55^{c}$ | $105.55^{d}$ | 1.12 |
| **Total feed intake (kg)** | 87.78 | 87.96 | 87.96 | 87.88 | 0.08 |
| **Total cost of feeding (₦)** | $11,745.00^{a}$ | $11,043.38^{b}$ | $10,163.78^{c}$ | $9.275.73^{d}$ | 3.61 |
| **Average cost of feeding (₦)** | $195.75^{a}$ | $184.06^{b}$ | $169.40^{c}$ | $154.60^{c}$ | 1.04 |
| **Feed cost / kg wt gain** | $371.25^{a}$ | $341.50^{b}$ | $303.90^{c}$ | $256.49^{d}$ | 1.31 |

abcd – means within the same row with different superscript differ significantly ($P<0.05$)

## CONCLUSION

It can be concluded based on the findings of this study that sundried unripe banana meal could conveniently replaced maize in the diets of growing pigs up to 30% level of inclusion without any adverse effect on the performance, carcass and internal organs of the pigs. It could also reduce the cost of feeding pigs.

The relative availability and minimal cost of the banana species (*Musa acuminata*) used in this study during bumper harvest could be a sustainable replacement option to maize as an energy source in monogastric animals feeding.

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