# Influence of Fresh and Dry Plantain Leaves Supplement on Growth Indices and Blood Constituents of West African Dwarf Bucks

Running title: Plantain Leaves Supplements on West African Dwarf bucks

**Abstract**

The study was carried out to evaluate the voluntary intake, growth rate, apparent nutrient digestibility and blood constituents of West African Dwarf bucks subjected to three diets: concentrate, fresh plantain leaves and dry plantain leaves in a Completely Randomized Design. Thirty (30) West African Dwarf bucks within the ages of 8-9 months with mean weight of 8.15 kg±0.01 were used for this study. The experiment lasted for 91 days (including 7 days of adjustment period and 84 days for feeding trial). Results showed that there were significant differences ($p < 0.05$) in the daily feed intake (g) and feed conversion ratio, total cholesterol and glucose among the bucks. However, there were no significant ($p > 0.05$) deference in digestibility co-efficient and haematological parameters of the animals in their treatment groups. Bucks fed dry plantain leaves showed the highest daily weight gain of 29.55g/day followed by fresh plantain leaves (28.42 g/day) and concentrate (21.28 g/day). The inclusion of plantain leaves as basal forage in the diets of weaned bucks greatly enhanced growth and thus recommended for use by poor resource farmers.

Keywords*: Fresh and dry plantain leaves; West African Dwarf buck; voluntary intake; digestibility and blood constituents.*

**Word count : 181**

## Introduction

Seasonal shortage of feed sources often poses as a major challenge in livestock husbandry in the tropics (Aregheore, 2000). Nigeria, like most of developing countries, is facing the challenge of feeding its large animal population. The problem can be solved by using unconventional feedstuffs in animal feeding provided that; they are available, of good nutritive value and economical compared with the conventional feed. It has been reported (Adegbola, 2002) that low quality roughages fed to ruminants without supplementation during the dry season caused remarkable weight losses and finally the end of the animal. The cost of conventional sources of protein in livestock ration has risen exorbitantly with the current inflation rise (Akinmutimi, 2004) and this has necessitated the search for cheap alternative feed materials that can meet nutritional requirements of domesticated animals. Again, these alternative feed resources should not be in high demands by humans and should be cheap (Ukanwoko and Ibeawuchi, 2014). In view of this, many studies are shifting interest to the use of feedstuffs such as roots, leaves, tubers and their by-products which can probably reduce feed cost and ultimately the production cost of livestock farming. One of such potential sources that is not realized to its fullest extent is plantain leaves which are generally not used for human consumption except for wrapping. Plantain is one of the most important horticultural crops and it is among the ten most important food security crops that feed the world and has always been a staple food for both rural and urban populace. Plantain is one of the most valuable crops in the tropics. It belongs to the family *Musaceae* and the genus *Musa*. *Musa paradisiaca*, also known as plantain (English), '*Ogede agbagba*' (Yoruba), '*Ayaba*' (Hausa) and '*Ogadejioke*' (Igbo), is a tropical plant that is native to India. The plant consists of long, overlapping leafstalks and bears a stem which is 1.22 to 6.10 metre high (Oladiji *et al*., 2010), with a life span of about 15 years .

## Materials and Method

### Experimental Site

The experiment was carried out at the Small Ruminant Unit of the Teaching and Research Farm Directorate of Federal University of Agriculture, Abeokuta, Ogun State which is located in the tropical rainforest zone in Nigeria within 7010'N and 302'E. The area has an average rainfall of 1100 mm, a mean ambient temperature of about 34 $^{0}$C and an average relative humidity of 82.4 % (Google Earth, 2015).

**Conflict of interest**

There were no conflict of interest whatsoever.

**Care and use of the animals**

All Animals were managed in accordance with the FUNAAB ethics which is believed to be with IACUC compliance

**Management and Feeding of Experimental Animals**

Thirty (30) West African Dwarf goats (Bucks) within the ages of 8 and 9 months with average weight of 8.15 kg±0.01 were procured from farms in Odeda Local Government area and used for this study. The experiment lasted for 91 days (including 7 days of adjustment period and 84 days for feeding trial). The animals were managed under intensive system. Water was given *ad libitum.* The bucks were randomly divided into three diets as concentrate, ConFPL and ConADPL with two replicates per treatment and five animals per replicate. Experimental diets consisted of fresh and dried plantain leaves which were collected on the University Farm and air-dried before feeding them to the goats.

*Concentrate*

ConFPL = *concentrate* + fresh plantain leaves

ConADPL =: *concentrate* + air-dried plantain leaves

**Proximate Analysis**

The proximate composition of fresh, dried *plantain* leaves, concentrate diets and the faecal samples were determined according to the method described by A.O.A.C. (2005). Phosphorus was determined by vanado-molybdate colorimetric method (Ologhobo and Fetuga, 1983) and Calcium was determined spectrophotometrically by using Buck 200 atomic absorption spectrophotometer (Buck Scientific, Norwalk) (Essien *et al.*, 1992) .

**Haematological and Biochemical Analysis**

Blood samples for haematological studies were collected at the beginning and at the end of the experiment from the jugular vein of each of the animals using sterilized needles and syringe. About 3 millilitres were collected into plastic bottles containing an anticoagulant ethylenediaminetetraacetic acid (EDTA) for haematological evaluation. Blood samples were also collected into empty bottles for serum analysis.

**Digestibility Trial**

At the 12th week of the feeding trial, two (2) bucks whose weights are closest to the mean weight at that time were taken from each treatment for digestibility study in the metabolic cages. The wooden metabolic cages were fitted with nets for collection of faeces beneath the slated floor of the cages and tarpaulin fitted directly under the net for the collection of urine. Concentrate, fresh, air-dried plantain leaves and water were offered at 8:00 hours of a particular day to 8:00 hour of the following day. The orts, faeces and urine were measured using weighing scale and measuring cylinder respectively. Aliquot (10 %) of the faeces and urine collected daily over 7 days were bulked. To prevent nitrogen loss from urine via volatilization and bacteria growth, urine collection bottles were rinsed with 10 % $H_2S0_4$(Oxy-tetra-oxo-sulphate VI acid), after which urine was introduced into the bottles, capped and refrigerated in deep freezer before chemical analysis. While grass samples were weighed and oven-dried at 105 $^0$C until constant weight was obtained. The dried samples were milled and stored for subsequent analyses.

**Experimental Design and Data Analysis**

All data collected were subjected to completely randomised design, a one-way analysis of variance (ANOVA) by following the procedure of SAS 9.1 (SAS, 2003). Levels of significance were taken at 5 % probability, while the significant means were separated using Duncan's Multiple Range Test (Duncan, 1955).

**Results**

Table 2 shows the proximate composition of the diets (% DM) used in this study. The residual moisture content of fresh plantain leaves was the highest (63.60 g/100g) which was followed by dry plantain leaves (10 g/100g) and the concentrate had 7.50 g/100g). The crude protein content of concentrate being the highest (9.46 g), followed by fresh plantain leaves (8.38 g), dry plantain leaves had the lowest value of 7.50 g. the carbohydrate or nitrogen free extract of concentrate, fresh and dry plantain leaves were 38.04 g, 5.42 g and 54.72 g respectively. Calcium values for concentrate and fresh plantain leaves were 16.99 mg/L and 56.73 mg/L respectively. The phosphorus values were far apart.

Table 3 shows the performance of West African Dwarf bucks fed fresh and dry plantain leaves supplemented with concentrate diets. Final weight differed significantly ($p < 0.05$), bucks on dry plantain leaves had the highest body weight of 10.22 kg while bucks on fresh plantain leaves had 10.14 kg which was less than that of control group (9.64 kg). The weight gain ($p > 0.05$) of bucks on concentrate, fresh plantain and dry plantain leaves were 1490.00 g, 1990.00 g and 2070.00 g respectively. The feed conversion ratio was significantly different ($p < 0.05$).

Table 4 shows the apparent digestibility of West African Dwarf bucks fed fresh and air-dried plantain leaves supplements. Concentrate intake differs significantly ($p < 0.05$) with the group on concentrate having the greatest voluntary intake of 5300.00 g while groups on ConADPL and ConFPL had 4547.86 g each. Plantain leaves intake, total feed intake and water intake were not significantly different ($p > 0.05$). There was no significant difference ($p > 0.05$) in nutrient digestibility. However, the digestibility of crude protein in Concentrate, ConFPL and ConADPL seems to be similar. Organic matter digestibility was highest in Concentrate (87.13±1.69 %), followed by ConFPL (85.59±1.26 %) and ConADPL had the lowest (81.33±1.01 %). Ether extract showed highest digestibility values of 92.78±2.44 % in ConADPL, 72.27±6.55 % in ConFPL and 73.17±9.50 % in ConFPL.

Table 5 shows haematological and serum parameters of West African Dwarf bucks fed fresh and air-dried plantain leaves treated respectively. Variation also existed in values obtained for packed cell volume, with fresh and dry plantain leaves (30.00%) being the highest, followed by concentrate (27.50 %) which was lower. There were significant differences ($p < 0.05$) in initial total protein of 5.00 g/dL, 4.50 g/dl and 5.60 g/dL for concentrate, fresh and dry plantain leaves respectively. The initial cholesterol level ($p < 0.05$) for Concentrate, ConFPL and ConADPL were 82.50 mg/dL, 67.00 mg/dL, 78.50 mg/dL respectively.

## Discussion

Dry plantain leaves had relatively higher dry matter content compared to fresh plantain leaves. This could be due to the fact that plantain leaves were air-dried before they were offered to the animals. The moisture content of feeds or its processed products gives an indication of its freshness and shelf life, and high moisture content subjects these items to increased microbial spoilage and short shelf life, which can lead to its deterioration (Adepoju and Adeniji, 2008). The values of proximate composition obtained for plantain leaves in this study were slightly different from those reported by Okareh *et al.* (2015) The marked differences might have been caused by difference in age , genetic material and time of harvest since the leaves were not harvested from the same stems. The crude fat content of samples of the plantain leaves was similar to with that of the concentrate and as such may be good sources of fat soluble vitamins and can contribute significantly to energy content of the feeds. The crude protein values obtained in plantain leaves and concentrate supplement were around the 7.50 to 9.46 % were within moderate level required by ruminants for optimum growth performance (Gatemby, 2002). Thus concentrate was included in basal diets to provide fermentable carbohydrate and nitrogen to augment the supplement of nutrients and encourage rumen degradation (Yousuf and Adeloye, 2011). The experimental feed ingredients can be ranked as carbohydrates rich diets due to its relatively high in nitrogen free extract content. Drying which is often characterized with chemical changes appeared not to have qualitatively affected the mineral composition of *Musa paradisiaca* leaves. The substantial amount of Calcium and Phosphorus especially in the fresh leaves plays a critical role in overall teeth and bone formation. Many processes in the body, especially in the brain, nervous system, and muscles, require electrical signals for communication. The movement of Calcium and Phosphorus in and out of the cell is critical in generation of these electrical signals. Nonetheless, too much or too little therefore can cause cells to malfunction, and extremes in the blood levels (too much or too little) can be fatal.

Table 3 shows the performance of West African Dwarf bucks fed fresh and air-dried plantain leaves as basal diets. The total feed intake observed in this study was in the range of 5300.00 g to 5744.29 g. Ososanya (2010) indicated that feed intake is an important factor in the performance of small ruminants. Yousuf and Adeloye (2010) observed that intake of feeds by goats depend on palatability and fibre content of the diets. This shows that plantain leaves are probably more palatable and acceptable to goats. The increase in body weight of farm animals is mainly a reflection of the growth of tissues consisting of lean meat, bone and fat. Growth rate of bucks is strongly influenced by breed and the environment under which they are maintained, including the availability of adequate feed supply in terms of both quantity and quality (Burfening and Kress, 1993; Bathaei and Leroy, 1996). The feed conversion ratio (FCR) which is a measure of feed intake per unit weight gain was significantly different ($p < 0.05$) which showed the highest feed conversion ratio of the fresh plantain leaves . This implied that the animals utilized those feeds with high efficiency which could be attributed to the freshness, palatability and acceptability of fresh plantain leaves.

Table 4 shows the apparent digestibility of West African Dwarf bucks fed fresh and air-dried plantain leaves supplements. The apparent digestibility values for most of the nutrients were generally high ranging between 66.51 g/100g and 93.42 g/100g. The treatment had no effect ($p > 0.05$), however, the differences between fresh plantain and concentrate for Calcium and Phosphorus which were significantly different ($p < 0.05$). Table 5 shows haematological and serum parameters of West African Dwarf bucks fed fresh and air-dried plantain leaves supplements. There was a general decrease of all the parameters measured except for cholesterol and glucose. Past reports revealed that haematological constituents are always a reflection of animals responsiveness to their initial and external environment (Isikwenu *et al.*, 2012), hence haematology is important in diagnosing the functional status of an exposed animal. The observed PCV values fell within the range of 21.0 - 36.9 % reported for clinically-healthy WAD goats (Taiwo and Ogunsanmi, 2003; Daramola *et al.*, 2005). It should be noted that none of the diets proved to be better plane of nutrition than others. But final PCV values have been regarded (Addass *et al.*, 2010) as signs of healthy and high productive animals. The obtained Hb values fell within the normal range values (7.00 to 15. 00 g/dL) as reported by Tambuwal *et al*. (2002) for WAD goats. Such an observation was regarded by Opara *et al.* (2010) as an advantage in terms of the blood's oxygen-carrying capacity. A deficiency of haemoglobin in the red blood cells leads to anaemia which might be due to iron deficiency (Aaron *et al.*, 2003). Clinically normal goats should have white blood cell range of 4.0 and 13.0 $x10^9$/L as a good defence mechanism against pathogens. However, the highest value of serum protein components was observed in Concentrate (6.25 g/dL). This could be attributed to the degree of protein utilization in the diet compared to ConFPL and ConADPL. Okoruwa *et al*.(2013) reported that nutrient utilization by animals has a direct link with the live-weight gain and haematological indices of that same animals. The difference in physiological and nutritional status of the goats might be responsible for this disparity. Cholesterol of the experimental goats were significantly different ($p < 0.05$) across the treatment groups, indicating that dry plantain leaves in the diets decreases the cholesterol content. Serum cholesterol levels were observed to decrease across board with the exception of ConADPL which was reduced from 78.5 mg/dL to 67.00 g/dL at the end of the experiment. This could suggest that dry plantain leaves inhibit cholesterol biosynthesis, reduce lipid mobilization and deposition of cholesterol in the skin and muscles, and will eventually result in animal products with low cholesterol content. The highest value obtained for serum glucose could probably be due to pancreas overload, which corresponds to hypo-secretion of insulin (a hormone that converts blood glucose to glycogen) or as a result of multiplication of exocrine cells of the pancreas which could lead to hyper-secretion of pancreatic juices that helps in the digestion of carbohydrates component. The highest serum glucose could be the optimal inclusion rate for optimal blood glucose level physiologically that led to the blockage of the biochemical energy pathway.

**Summary**

The inclusion of plantain leaves as basal forage in the diets of weaned bucks greatly enhanced growth and thus recommended for use by poor resource farmers.

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Appendix

**Table1: Experimental Diet Composition ( %DM)**

| Ingredients | % Composition |
|---|---|
| Dry Brewers Grain | 70.00 |
| Soybean Meal | 17.00 |
| Guinea Grass (*Panicum maximum)* | 10.00 |
| Kaun( Local Potash) | 1.00 |
| Salt | 1.00 |
| Bone Meal | 1.00 |

**Table 2: Proximate Composition of the Experimental diets ( %DM)**

| Parameters | Concentrate | Fresh Plantain Leaves | Dry Plantain Leaves |
|---|---|---|---|
| Dry Matter | 92.50 | 36.40 | 90.00 |
| Crude Protein | 9.46 | 7.50 | 8.38 |
| Crude Fibre | 15.00 | 6.48 | 19.39 |
| Ether Extract | 10.00 | 10.00 | 10.00 |
| Ash | 20.00 | 7.00 | 7.50 |
| NitrogenFree Extract | 38.04 | 5.42 | 54.73 |
| Organic Matter | 80.00 | 97.00 | 96.50 |
| Calcium (mg/L) | 16.99 | 56.73 | Na |
| Phosphorus (mg/L) | 1.62 | 11.62 | Na |

*na = not available*

**Table 3: Performance of West African Dwarf bucks fed fresh and air-dried plantain leaves as Supplements**

| Parameters | Concentrate | ConFPL | ConADPL | SEM |
|---|---|---|---|---|
| Concentrate Intake (g) | 5300.00$^{a}$ | 4547.86$^{b}$ | 4567.86$^{b}$ | 39.77 |
| Plantain Leaves Intake (g) | - | 850.84 | 1176.43 | 10.91 |
| Total Feed Intake (g) | 5300.00 | 5398.70 | 5744.29 | 37.96 |
| Initial Weight (g) | 8150.00 | 8150.00 | 8150.00 | 0.01 |
| Final Weight (g) | 9.64$^{b}$ | 10.14$^{a}$ | 10.22$^{a}$ | 0.08 |
| Weight Gain(g) | 1490.00$^{b}$ | 1990.00$^{a}$ | 2070$^{a}$ | 0.08 |
| Average Daily Weight Gain (g) | 21.28$^{b}$ | 28.42$^{a}$ | 29.55$^{a}$ | 1.14 |
| Feed Conversion Ratio | 3.56$^{a}$ | 2.71$^{b}$ | 2.78$^{b}$ | 0.14 |

*a,b,Mean values in the same row with different superscripts differ significantly ($p < 0.05$).*

**Table 4: Apparent digestibility of West African Dwarf bucks fed fresh and air-dried plantain leaves supplements**

| Parameters | Concentrate | ConFPL | ConADPL |
|---|---|---|---|
| Dry matter | 85.67± 1.21 | 82.34±0.39 | 80.29±1.02 |
| Crude protein | 91.68 ±3.17 | 93.42±3.64 | 92.89±3.74 |
| Crude fibre | 79.83±2.67 | 76.2±2.47 | 73.59±1.83 |
| Ether extract | 72.27±6.55 | 73.17± 9.5 | 92.78±2.44 |
| Ash | 78.93±2.23 | 77.32±3.33 | 74.57±4.32 |
| Organic matter | 87.13±1.69 | 85.59±1.26 | 81.33±1.01 |
| Calcium | 83.29±5.81 [a] | 74.65±9.97 | Na |
| Phosphorus | 80.42±8.13 [a] | 66.51±11.93 | Na |

*a,b,Mean values in the same row with different superscripts differ significantly (P< 0.05).na= not available*

**Table 5: Haematological and serum parameters of West African Dwarf bucks fed fresh and air-dried plantain leaves supplements**

| Parameters | Concentrate | ConFPL | ConADPL | SEM |
|---|---|---|---|---|
| PCV Initial ( %) | 27.50 | 30.00 | 30.00 | 2.75 |
| PCV Final (%) | 26.00 | 25.50 | 26.00 | 1.25 |
| Hb Initial (g/dl) | 9.10 | 9.80 | 9.85 | 0.85 |
| Hb Final (g/dl) | 8.60 | 8.50 | 10.30 | 0.30 |
| RBC Initial ($x10^{6}/mm^{3}$) | 11.30 | 12.20 | 12.50 | 1.78 |
| RBC Final ($x10^{6}/mm^{3}$) | 9.35 | 9.80 | 10.85 | 0.55 |
| WBC Initial ($x10^{6}/mm^{3}$) | 11.80 | 12.75 | 9.45 | 1.65 |
| WBC Final ($x10^{6}/mm^{3}$) | 11.25 | 10.85 | 11.25 | 0.35 |
| Total Protein Initial (g/dl) | $6.25^{a}$ | $4.90^{b}$ | $5.00^{b}$ | 0.11 |
| Total Protein Final (g/dl) | $5.00^{ab}$ | 4.50b | $5.60^{a}$ | 0.18 |
| Cholesterol Initial (mg/dl) | $82.50^{a}$ | $67.00^{b}$ | $78.50^{a}$ | 1.85 |
| Cholesterol Final (mg/dl) | 85.00 | 75.00 | 67.00 | 5.02 |
| Glucose Initial (mg/dl) | $49.00^{b}$ | $41.50^{c}$ | $56.00^{a}$ | 1.48 |
| Glucose Final (mg/dl) | $54.50^{ab}$ | $49.00^{b}$ | $60.00^{a}$ | 2.07 |

*a,b,c,Mean values in the same row with different superscripts differ significantly (p< 0.05).*

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