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# PERFORMANCE OF FATTENING BUNAJI BULLS FED DIETS CONTAINING GRADED LEVEL OF PALM KERNEL CAKE

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**ABSTRACT**

A fattening trial was conducted for 90 days using 20 Bunaji bulls with a live weight range of 190-200kg and aged 2-2.5 years to determine fattening performance. The bulls were fed diets containing varying levels of palm Kernel cake (PKC). Four bulls per treatment were allotted to 5 dietary treatments in Completely Randomised Design. Concentrate and basal diets of *Digitaria smutsii* were offered at 2% body weight. The data collected from the experiment were analysed using General Linear Model Procedure of SAS, (2002) The crude protein contents of the experimental diets varied between 15.63 and 20.31% while ME ranged from 11.75 to 11.78MJ/kg DM. The crude fibre varied from 13.92 to 23.31%. Average feed intake ranged between 8.67-9.11Kg/day with animals on 10, 20 and 40% PKC showed significant ($P<0.05$) difference across the treatments. Average daily weight gain was highest (1.33kg) for animal on 10% PKC followed by (1.31kg) on 30% PKC inclusion. No significant differences ($P>0.05$) was observed in average weight gain for animals on diets containing 0 20 and 40% PKC inclusions. All the experimental bulls attained an average weight gain of between 1.13Kg to 1.33Kg. Cost per Kg gain was highest at 0% PKC inclusion and lowest at 40% PKC. Net benefit (NB) and value of weight gain (VWG) were significantly ($P<0.05$) higher for bulls on 10 and 30% PKC inclusion. There was positive net benefit and Return to Investment (ROI) on feed across treatments. The inclusion of PKC lead to reduction in feed cost from N 29389 to a range of N 28857- N 22099 (about 1.8%-24% reduction in feed cost). Therefore, it was concluded that Palm Kernel Cake can be included in fattening diets up to 40%.

***Keywords:*** Bunaji bulls, Palm Kernel Cake, Partial budget, Weight gain.

## INTRODUCTION

Cattle fattening provides a fast source of meat to meet the high demand for high quality protein needed in the diet. This is against the backdrop of inadequate animal protein intake by most Nigerians (Ajayi *et al*., 2007). Rangelands for animals to graze only blossom in the rainy season while in dry season, they become standing hay (Bamigboye *et al*., 2013). Feed accounts for about two-third of the cost of meat production (Vecchiettini and Giardini, 2000) which is about 70-80% of the total cost of fattening bulls (Lamidi, 2005). High cost of conventional feed stuffs has made research efforts to be directed towards harnessing and enhancing the utilization of agricultural by-products and crop residues for livestock feeding. Palm kernel meal is an important feed ingredient and the main by-product from the oil palm (*Elaeis guinensis*) extraction. Palm kernel meal is highly fibrous and has a medium grade protein content which is more suitable in feeding of ruminants and rabbits (Pickard, 2005). Protein content is between 18 - 25% (Onwuka *et al*., 2014). Palm Kernel Cake is deficient in lysine, methionine, histidine and threonine. Palm Kernel Cake is gritty and high in fibre content (at least 9%). The present study attempt to evaluate profitability and fattening performance of Bunaji bulls fed diets containing graded levels of Palm Kernel Cake.

## MATERIALS AND METHODS

### Experimental Site

The experiment was conducted at the experimental pens of the Beef Research Programme of the National Animal Production Research Institute, Shika, Zaria, Nigeria. The study area falls within latitudes 11° 8' 19.56" N and longitudes 7° 45' 51.22" E, with an altitude of 640m above sea level (Google earth, 2017). Shika is located within the Northern Guinea Savannah ecological zone with an average annual rainfall of 1,100mm which starts from late April/early May and ends mid-October, the temperature ranges from 27-35°C depending on the season, while the mean relative humidity during the harmattan and wet seasons are 21%-72%, respectively (IAR., 2017).

### Fattening Trial and Animal Management

This study that lasted for 90 days was conducted using 20 Bunaji bulls with live weight range value of 190-200kg, average weight of 196kg and age range of 2-2.5 years. Four bulls per treatment were allotted to five dietary treatments in a Completely Randomised Design to compare the effect of levels of inclusion of PKC on fattening performance of Bunaji bulls. Cottonseed cake was the main protein source of the control diet 0% PKC

while the four test diets contain 10, 20, 30 and 40% PKC inclusion. The TDN (%), ME (Kcal/KgDM) and feed cost per Kg were calculated (Table 1). The bulls were housed in individual pens and weighed fortnightly. They were fed concentrate and hay (*digitaria smutsii*) at 2% of their body weight respectively. The ration was adjusted at regular intervals of two weeks in line with changes in live weight.

**Table 1: Percent gross feed composition of matured Bulls concentrate diets**

| | Inclusion Levels (%) | | | | |
|---|---|---|---|---|---|
| Ingredients (%) | 0 | 10 | 20 | 30 | 40 |
| Palm kernel cake | 0.00 | 10.00 | 20.00 | 30.00 | 40.00 |
| Cotton seed cake | 18.00 | 15.50 | 12.00 | 9.00 | 6.00 |
| Poultry litter | 24.00 | 21.50 | 20.00 | 18.00 | 16.00 |
| Rice offal | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 |
| Maize offal | 45.00 | 40.00 | 35.00 | 30.00 | 25.00 |
| Salt | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| **Total** | **100** | **100** | **100** | **100** | **100** |
| | | | | | |
| **Calculated Analyses** | | | | | |
| Crude Protein | 14.65 | 14.70 | 14.70 | 14.72 | 14.74 |
| Crude Fiber (%) | 14.45 | 14.42 | 14.12 | 13.95 | 13.79 |
| Metabolizable Energy (MJ/KgDM | 11.75 | 11.76 | 11.78 | 11.77 | 11.76 |
| Total Digestible Nutrients (%) | 66.12 | 65.97 | 65.76 | 65.58 | 65..40 |
| Cost/kg(₦) | 37.75 | 33.58 | 28.97 | 24.58 | 20.19 |

**Chemical analysis**

Proximate analyses of Concentrate diet was carried out according to AOAC, (2000) procedure. Also, Acid Detergent Fiber (ADF) and Neutral Detergent Fiber (NDF) were determined in all the feed ingredients according to (Van Soest, 1991). Gross Energy (GE) was also determined using an automated bomb calorimeter at the Central laboratory of National Animal Production Research Institute (NAPRI), Shika, Zaria. Metabolizable energy (ME) was determined by the equation of Alderman and Cottrill (1985). ME (MJ/Kg DM) = 11.78 + 0.0064 CP + $(0.000665EE)^2$ - CF (0.00414EE) - 0.0118A. Where ME = Metabolizable energy, DM = Dry matter, CP = Crude protein, EE = Ether Extract, CF = Crude fiber.

**Economic analyses**

The market prices of various feed ingredients as at the time of the studies were used in computing the total cost of feed consumed within the feeding period and feed cost per kilogram weight gain using the Procedure reported by Alimi and Mangong, (2010). The Procedure was used to determine how profitable the inclusion levels of palm kernel cake was in the formulated diets of the finishing Bunaji bulls.

**Data analysis**

The data collected from the experiment were analysed using General Linear Model Procedure of the statistical analysis system, (SAS, 2002) to see the response of the animals to measured parameters. Significant levels of difference among treatment means were compared using Dunnett's test (Dunnett, 1955).

The model is as follow:

$Y_{ij} = \mu + t_i + E_{ij}$

Where $Y_{ij}$= $j^{th}$ observation of $i^{th}$ graded levels of palm kernel cake inclusion.

$\mu$=overall mean

$t_i$ = effect of $i^{th}$ graded levels of palm kernel cake inclusion on performance

$E_{ij}$ = random error.

**RESULTS AND DISCUSSION**

**Chemical Analyses**

Chemical composition of concentrate diets containing varying levels of palm kernel cake fed to finishing Bunaji bulls is presented in Table 2. The CP of the fattening diets range from 15.63% to 20.31%. These fall within the range of (19.00 to 22.91%) reported by Lamidi *et al*., (2007) and 19.69%-22.44% reported by Sani *et al*., (2015) for mature bulls but higher than 13% reported by Rutherglen, (1995). The CF of 20, 30 and 40% PKC inclusion met the minimum level of 17% required for beef cattle (NRC, 2000). The ME of the diets ranged between 11.75-11.78MJ/KgDM which is slightly above the range of 10-11.6MJ/Kg DM recommended for Bulls (Rutherglen, 1995) and 10.85 - 11.16MJ/Kg DM reported by Sani (2014). This implies that these diets have adequate energy content and can be used for fattening of cattle. Differences in the feed ingredients used could have been why the chemical composition of concentrate diets used in this studies differed from the values reported by other authors. Feed composition affects rumen fermentation hence the supply of energy (VFA) and Protein in the form of microbial crude protein (MCP) to the host. Also, feed composition affects rumen residence time that in turn had regulatory effects on feed intake.

Effect of graded level of PKC on the performance of finishing Bunaji Bulls.

Effect of feeding diet containing varying levels of palm kernel cake on performance of finishing Bunaji bulls is presented in Table 3. There was no significant (P>0.05) difference in the average weight gain of animals on 0, 20 and 40% PKC inclusion though, weight gain was significantly (P<0.01) high (1.33kg) for animal on 10% PKC followed by those fed 30% PKC inclusion (1.31kg). The average daily weight gain of 1.14-1.33Kg/day obtained in the present study was similar to Sani *et al*., (2015) 1.11-1.29Kg/day when diets containing graded levels of raw and parboiled rice offal were fed to Bunaji bulls, the weight gain of animals on diets containing 0, 20 and 40% PKC were similar to the AWG of 1.13 kg/d observed by Luziga (2005) in Boran

crosses supplemented with molasses based concentrate but higher than those obtained in earlier studies reported by Lamidi *et al.*, (2007) 0.69-0.91Kg/day, Idowu (2011) 0.40.66Kg/day, Madziga *et al*., (2013), 0.961.01Kg/day and 0.50-0.92kg/day reported by Goska *et al*., (2016) for matured bulls. Also, Feed conversion ratio (FCR) of 6.52-7.57 obtained in this study was similar to 6.26-6.93 obtained by Sani *et al*., (2015)but superior to 9.04-9.55, 13.71-22.4, 9.03-12.05 and 8.31-16.16 reported by Madziga *et a*l., (2013), Idowu (2011) Lamidi, (2005) and Goska *et al*., (2016) respectively but FCR based on rice type (6.26-6.67), inclusion level (6.26-6.72) and interaction between rice type and inclusion level (6.26-6.93) reported by Sani (2014) for fattened bulls was superior to what was obtained in this study. Higher values obtained could probably be due to differences in experimental diets and efficiency of feed utilization. This implies that PKC can be efficiently utilized to improve feed conversion to body tissue .This differences are also in agreement with the report of McDonald *et al*., (2002) which stated that the amount and quality of feeds consumed directly influence the performance of animals in terms of live weight gain. The average dry matter intake obtained in this study is similar to 8.5 kg DM intake reported by Meissner *et al*., (2006) for Holstein Friesian growing steers fed diets based on cereal by-product and 8.84 kg DM/d reported by Mawona, (2010) for cattle fed cotton seed hulls based diets. These data support earlier studies (Hutagulung and Mahyuddin, 1985; Jelan *et al*., 1991) in which inclusion of PKC-based diets or supplements generally resulted in satisfactory animal performance and no negative effects on animal health in finishing crossbred beef cattle and in buffaloes. Another study, Carvalho, *et al*., (2006) reported that solvent-extracted PKM up to 15% in corn silage-based diets did not affect DMI for dairy cows. This is contrary to the observation made by Mwilawa, (2012) who reported 6.1 and 5.7 kg DM per day for Boran and Tanzania Short Zebu (TZSZ), respectively, fed hay and concentrate diet based on conventional feedstuff *adlibitum*. Chamatata, (1996) reported a feed intake of 6.282 kg DM/d of steers fed cotton seed hulls (50%) and hay. The differences in intake may be due to many factors. Emmans, (1997) reported that, animals stop eating to limit metabolic or physical discomfort and energy requirement is considered to be the main intake driver. Similarly, McDonald *et al*., (2002) reported that intake is not only restricted by gut fill but also the animal's requirements. Fernandez-Rivera *et al*., (1994) reported that intake is dependent on animal body size, feed physical structure and fibre content, feed selectivity by free grazing animals and the way in which feed breaks down during digestion. Wan Zahari and Alimon, (2003) also reported that supplementing the traditional rations of beef cattle with 30-50% PKC improved performance and increased Live weight (LW) gain.

**Partial budget analyses of finishing Bunaji bulls fed diet containing varying levels of palm kernel cake**

The economic evaluation is presented in table 4. Bulls on diets containing varying level of PKC had their initial weights improved by 102.25Kg, 119.75Kg, 104.00Kg, 117.50Kg and 106.00Kg for, 10, 20, 30 and 40% PKC inclusion respectively. Feed cost was the major cost monitored during the study because the economic returns were based on this. The calculations of other cost such as capital required for pens, depreciation and purchase of stock and labour were not considered.

The feed cost (concentrate) in Naira per kg declined with increase in PKC levels from ₦37.75/kg to ₦20.19/kg for the fattened bulls. The reason for the lower cost of feed with increase in the level of PKC in the diets might have resulted from the low cost of the feed material used in formulation and also low competition for use of PKC in monogastric animals feed due to its high fiber content. The feed cost to gain ratio was higher at 0% inclusion level (₦ 315.84/ Kg live weight gain) and lowest at 40% PKC inclusion level (₦230.33/Kg live weight gain) which implies that the 40% inclusion was economically better than the control, even though value of gain is higher for animals on 10 and 30%PKC inclusion. Bulls on diets containing varying level of PKC had their initial weights improved by 102.25Kg, 119.75Kg, 104.00Kg, 117.50Kg and 106.00Kg for 0, 10, 20, 30 and 40% PKC inclusion respectively The net benefits were ₦29755.00, ₦40495.00, ₦34571.00, ₦43522.00 and ₦39226.00 for feeding fattened Bunaji bulls on 0, 10, 20, 30 and 40% PKC diets respectively. Net benefit was higher for animals on the diets with 30% inclusion levels of PKC though not statistically significant for those on 10%PKC inclusion. The income over feed cost (net benefit) which is the most important economic factor for the farmers and rate of return to feed investment observed at the levels of inclusion were all positive. The net benefit reported in this study when graded levels of PKC was fed to finishing Bunaji bulls higher than the value reported when Sani (2014) and Yusuf (2016) each fed graded levels of raw and parboiled rice offal and brewer dried grains to fattened Bunaji bulls and yearlings respectively. This differences might have occurred because of differences in test ingredient used in this study and that used by Sani (2014) and Yusuf (2016).

**Table 2: Chemical composition of concentrate diets containing varying levels of palm kernel cake fed to finishing Bunaji bulls**

| | Inclusion Levels (%) | | | | |
|---|---|---|---|---|---|
| **Parameter (%)** | **0** | **10** | **20** | **30** | **40** |
| **Dry Matter** | 96.30 | 96.06 | 94.66 | 94.18 | 94.67 |
| **Crude Protein** | 15.63 | 16.13 | 20.31 | 19.56 | 17.13 |
| **Crude Fibre** | 13.92 | 15.33 | 17.52 | 23.31 | 21.96 |
| **Ether Extract** | 10.01 | 9.57 | 11.87 | 10.85 | 9.50 |
| **Ash** | 11.38 | 10.42 | 11.15 | 11.05 | 10.99 |
| **Neutral Detergent Fibre** | 26.38 | 32.63 | 27.32 | 39.03 | 42.37 |
| **Acid Detergent Fibre** | 14.49 | 18.38 | 16.60 | 25.37 | 29.80 |
| **Hemi Cellulose** | 11.89 | 14.25 | 10.72 | 13.66 | 12.57 |
| **GE[1]** | 15.26 | 15.64 | 13.81 | 15.64 | 15.60 |
| **ME[1]** | 11.75 | 11.76 | 11.78 | 11.77 | 11.76 |

[1] = MJ/KgDM; ME = Metabolizable Energy, GE= Gross Energy

**Table 3: Effect of feeding diet containing varying levels of palm kernel cake on performance of finishing Bunaji bulls**

| | Levels of Inclusion | | | | | |
|---|---|---|---|---|---|---|
| **Parameters** | **0** | **10** | **20** | **30** | **40** | **SEM** |
| Initial weight (kg) | 196.50 | 198.00 | 192.25 | 197.50 | 197.75 | 3.16 |
| Final weight (kg) | 298.75$^{cd}$ | 317.75$^{a}$ | 296.25$^{d}$ | 315.00$^{ab}$ | 303.75$^{bc}$ | 5.14 |
| ACI (kg/day) | 4.75$^{c}$ | 4.94$^{a}$ | 4.76$^{bc}$ | 4.92$^{ab}$ | 4.83$^{abc}$ | 0.08 |
| AHI (kg/day) | 4.02$^{b}$ | 4.22$^{a}$ | 3.95$^{c}$ | 4.14$^{ab}$ | 4.04$^{b}$ | 0.08 |
| ATFI (kg/day) | 8.73$^{bc}$ | 9.11$^{a}$ | 8.67$^{c}$ | 9.02$^{ab}$ | 8.83$^{abc}$ | 0.15 |
| ADMI (kg/day) | 8.40$^{bc}$ | 8.75$^{a}$ | 8.20$^{c}$ | 8.49$^{ab}$ | 8.36$^{bc}$ | 0.14 |
| AWI (L/day) | 30.64$^{d}$ | 34.69$^{a}$ | 33.16$^{c}$ | 33.75$^{b}$ | 31.60$^{d}$ | 0.55 |
| AWG (kg/day) | 1.14$^{b}$ | 1.33$^{a}$ | 1.16$^{b}$ | 1.31$^{a}$ | 1.18$^{b}$ | 0.04 |
| FCR | 7.57$^{c}$ | 6.67$^{a}$ | 7.17$^{bc}$ | 6.52$^{a}$ | 7.12$^{b}$ | 0.20 |

$^{abcd}$ means within the same row with different superscripts are significantly different (P<0.05)
SEM=Standard Error of mean. ACI = average concentrate intake, AHI=average hay intake, AFI=average feed intake, ADMI=average dry matter intake,AWI=average water intake, AWG=average weight gain, FCR=Feed Conversion Ratio, l=litre

**Table 4: Partial budget analyses of fattened Bunaji bulls fed diets containing graded levels of palm kernel cake**

| | Levels of Inclusion(%) | | | | | |
|---|---|---|---|---|---|---|
| **Parameters** | **0** | **10** | **20** | **30** | **40** | **SEM** |
| TWG (Kg) | 102.25$^{b}$ | 119.75$^{a}$ | 104.00$^{b}$ | 117.50$^{a}$ | 106.00$^{b}$ | 3.32 |
| AWG (Kg) | 1.14$^{b}$ | 1.33$^{a}$ | 1.16$^{b}$ | 1.31$^{a}$ | 1.18$^{b}$ | 0.04 |
| V G (₦) | 61350.00$^{b}$ | 71850.00$^{a}$ | 62400.00$^{b}$ | 70500.00$^{a}$ | 63600$^{a}$ | 1993.14 |
| CI (Kg) | 427.07$^{b}$ | 444.79$^{a}$ | 428.08$^{b}$ | 443.06$^{a}$ | 434.69$^{ab}$ | 7.06 |
| HI (Kg) | 361.90$^{bc}$ | 379.73$^{a}$ | 355.69$^{c}$ | 372.55$^{ab}$ | 363.42$^{bc}$ | 6.90 |
| TFI (Kg) | 785.43 | 819.94 | 780.04 | 811.47 | 794.34 | 13.52 |
| TWI (Litres) | 2757.40 | 3122.50 | 2984.40 | 3037.10 | 2843.70 | 49.68 |
| TCC (₦) | 16122.00$^{a}$ | 14936.00$^{b}$ | 12401.60$^{c}$ | 10890.40$^{d}$ | 8776.30$^{e}$ | 200.41 |
| Cost of hay (₦) | 13267.20$^{bc}$ | 13920.80$^{a}$ | 13039.70$^{c}$ | 13657.80$^{ab}$ | 13322.90$^{bc}$ | 253.00 |
| Cost of feed (₦) | 29389.00$^{a}$ | 28857.00$^{a}$ | 25441.00$^{b}$ | 24548.00$^{c}$ | 22099.00$^{d}$ | 437.20 |
| CW (₦) | 2205.90$^{c}$ | 2498.00$^{a}$ | 2387.50$^{b}$ | 2429.70$^{a}$ | 2274.90$^{c}$ | 39.75 |
| TCF and W (₦) | 31595.00$^{a}$ | 31355.00$^{b}$ | 27829.00$^{c}$ | 26978.00$^{d}$ | 24374.00$^{e}$ | 461.87 |
| Cost conc/Kg (₦) | 37.75 | 33.58 | 28.97 | 24.58 | 20.19 | |
| C/KgG (₦/Kg gain) | 315.84$^{a}$ | 265.53$^{b}$ | 270.27$^{b}$ | 230.38$^{c}$ | 230.33$^{c}$ | 7.38 |
| Net Benefit (₦) | 29755.00$^{d}$ | 40495.00$^{ab}$ | 34571.00$^{c}$ | 43522.00$^{a}$ | 39226.00$^{b}$ | 1765.07 |
| RIF | 0.94$^{c}$ | 1.28$^{b}$ | 1.24$^{b}$ | 1.62$^{a}$ | 1.62$^{a}$ | 0.06 |

CI= concentrate intake,HI= hay intake, TFI=total feed intake, TWI=total water intake, TWG=total weight gain AWG=average weight gain, l=litre. $^{abcde}$ means within the same row with different superscripts are significantly different (P<0.05) SEM=Standard Error of mean., *Digitaria smutsii* hay=₦36.66/kg,price of water= ₦ 0.8/l, Price of weaner/liveweight=N600/kg. value of gain(VG)= total weight gain×N600,Net benefit=value of gain - total cost of feed and water consumed, Return to investment on feed-= net benefit/cost of feed and water.

## CONCLUSION

The following conclusions were made from these studies:

1. Farmers can fatten their Bulls with Palm Kernel Cake inclusion at 30% of the diets and still attain an average weight gain 1.31Kg per day.
2. There were economic advantages in feeding Palm Kernel Cake to fattened Bunaji bulls at 30% inclusion levels which resulted to an increased positive Net Benefit, return to investment on feed, superiority of feed conversion ratio and average weight gain.

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