Feed intake, rumen metabolite and some blood parameters of yearling Bunaji bulls fed graded levels of palm kernel cake

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Abstract

The need to observe the changes taking place in the animal's body in response to external factors such as nutrition, housing system and microclimate as it affects intake, rumen metabolite, haematological and biochemical parameters cannot be over-emphasized. Against this background, a study was conducted to evaluate the effect of feeding diets containing graded levels of Palm Kernel Cake (PKC) on feed intake, rumen metabolites, haematological and biochemical characteristics of yearling Bunaji bulls. Twenty yearling Bunaji bulls with average weight of 130kg and aged 1-1.5 years were balanced for weight and allotted to five dietary treatments with four bulls per treatment in Completely Randomized Design. They were individually penned and fed diets containing graded levels of PKC at (0, 10, 20, 30 and 40%) and Digitaria smutsii (Wholly finger grass) hay at 4% body weight (2% concentrate and 2% hay). The feeding trial lasted for 90 days. Blood samples were collected at the beginning, middle and end of the feeding trial to determine some haematological and biochemical changes. Rumen fluid were collected at 0, 3, 6 and 9hrs intervals to determine the rumen pH, rumen ammonia nitrogen(RAN) and rumen total volatile fatty acids(TVFA) for the yearling bulls. The CP contents of the experimental diets varied between 14.19 and 17.75% while ME ranged from 11.79 to 11.81MJ/kg DM. The crude fibre varied from 26.36-38.77%. Average feed intake ranged between 5.38-5.61Kg/day with animals on 10%, 20% and 40% PKC being statistically similar ($P>0.05$). Rumen parameters were significantly ($P<0.05$) affected by sampling time, such that at 0hr Rumen pH was highest (7.08) and lowest at 3hrs post feeding (6.66), RAN value was similar at 0hr pre feeding (10.44 mg/100mL) and 3hr post feeding (9.93 mg/100mL) but differ at 6hr (8.25 mg/100ml) and 9hrs post feeding (8.34mg/100mL). There was significant difference ($P<0.05$) among treatments for all the haematological and biochemical parameters measured. Highest urea value was obtained at 0% PKC inclusion, animals on diets containing 20,30 and 40%PKC were statistically similar ($P>0.05$), Total protein ranged from 70.83 - 78.92 g/l and highest value was obtained at 30% PKC inclusion, animals on diets containing 10% and 20%PKC were statistically similar ($P>0.05$) but differ from 40%. The study concluded that up to 40% inclusion level of PKC could be added to the diets of yearling Bunaji bulls with no adverse effect on their feed intake, rumen metabolite and some of their blood parameters.

Keywords: Blood parameters, Feed intake, Palm Kernel Cake, Rumen metabolites, Yearling Bunaji bulls

L'apport alimentaire, le métabolite de rumen et certains paramètres sanguins d'un an Bunaji Bulls de Bunaji Fed Niveaux classés de gâteau au noyau de palme

Résumé

La nécessité d'observer les changements qui se déroulent dans le corps de l'animal en réponse à des facteurs externes tels que la nutrition, le système de logement et le microclimat, car il affecte l'apport, le métabolite du rumen, les paramètres hématologiques et biochimiques ne peuvent pas être surestimés. Dans ce contexte, une étude a été menée pour évaluer l'effet de l'alimentation des régimes alimentaires contenant des niveaux classés de gâteau au noyau de palmier (GNP) sur l'apport alimentaire, les métabolites rumen, les caractéristiques hématologiques et biochimiques des taureaux de Bunaji d'Annulation. Vingt Bunaji Bunaji avec poids moyen de 130 kg et de 1 à 1,5 ans ont été équilibrés pour poids et alloué à cinq traitements diététiques avec quatre taureaux par traitement dans une conception complètement randomisée. Ils ont été individuellement engagés et nourris à des régimes alimentaires contenant des niveaux classés de GNP à (0, 10, 20, 30 et 40%) et digitariasmutsii (à 100% de l'herbe à doigts) à 4% de poids corporel (concentré de 2% et 2% de foin). L'essai d'alimentation a duré 90 jours. Les échantillons de sang ont été collectés au début, au milieu et à la fin de l'essai d'alimentation afin de déterminer des changements hématologiques et biochimiques. Les liquides de rumen ont été recueillis à des intervalles de 0, 3, 6 et 9hrs pour déterminer le pH de rumen, l'azote d'ammoniac rumen (AAR) et les acides gras volatils rumen (AGVV) pour les taureaux yearling. Le contenu du CP des régimes expérimentaux variait entre 14,19 et 17,75%, tandis que je suis allant de 11,79 à 11,81 MMJ/kg DM. La fibre brute variait de 26,36-38,77%. L'admission moyenne d'aliments allait entre 5,38 et 5,61 kg / jour avec des animaux sur 10%, 20% et 40% GNP étant statistiquement similaires ($p > 0,05$). Rumen Les paramètres étaient significativement ($p < 0,05$) affectés par le temps d'échantillonnage, tel que à 0hr rumen Le pH était le plus élevé (7.08) et le plus bas à 3 heures d'alimentation post (6,66), la valeur de AAR était similaire à 0HR pré-alimentation (10,44 mg / 100 ml) et 3hrs post-alimentation (9,93 mg / 100 ml) mais différent à 6h (8,25 mg / 100 mg). et 9 heures après l'alimentation (8h34 mg / 100 ml) était une différence significative ($p < 0,05$) parmi les traitements pour tous les paramètres hématogiques et biochimiques mesurés. La valeur la plus élevée de l'urée a été obtenue à 0% d'inclusion de GNP, les animaux sur les régimes contenant 20,30 et 40% de GNP étaient statistiquement similaires ($p > 0,05$), une protéine totale allait de 70,83 - 78,92 g / l et une valeur la plus élevée a été obtenue à 30% de GNP. L'inclusion, les animaux sur les régimes contenant 10% et 20% de GNP étaient statistiquement similaires ($p > 0,05$) mais différent de 40%. L'étude a conclu que jusqu'à 40% de niveau d'inclusion de GNP pouvait être ajouté au régime alimentaire des taureaux de la Bunaji qui n'y a pas d'effet défavorable sur leur consommation d'alimentation, le métabolite du rumen et certains de leurs paramètres de sang.

Mots-clés: Paramètres sanguins, Prise d'alimentation, Gâteau au noyau de palme, Métabolites rumen, Taureaux Bunaji d'un an

Introduction

The rumen is a complex anaerobic microbial ecosystem, where various microorganisms, including Bacteria, Archaea, protozoa, fungi, and viruses,

interact in ways that have a significant influence on the health of the ruminant; . Fermentation occurs under anaerobic conditions. As a consequence, sugars are metabolized predominantly to volatile fatty

acids (VFAs). Additional major products include lactic acid, carbon dioxide and methane ; from the standpoint of the host animal, VFAs are the important product of fermentation. These small lipids are used for many purposes, but the paramount importance of VFAs to herbivores is that they are absorbed and serve as the animal's major fuel for energy production, serving much the same function that glucose does in human being (Ozutsumi *et al.*, 2005). The health status of animals maintained under different feeding conditions is one of the criteria for welfare assessment . It is important to monitor housing and feeding conditions as these directly influence growth performance and determines the homeostasis or maintenance of the body of the animal . The need to observe the changes taking place in the animal's body in response to external factors such as nutrition, housing system and microclimate as it affects haematological and biochemical parameters cannot be over-emphasized (Scamell, 2006). Testing the physiological parameters of animals is essential to monitoring their health status .

The metabolic profile is based on a range of laboratory blood tests and represents the diagnostic starting point for the determination of nutritional and health status of animals. The changes in biochemical and haematological constituents such as total protein, blood urea, blood glucose, and packed cell volume are important indicators of the physiological or pathological state of the animal (Ahmad *et al.*, 2003). Early detection of nutrient deficiency or metabolic disease can contribute to successful diagnosis and faster recovery of animal . The content of blood components varies depending on factors that inhibit or stimulate the circulatory system. The main function of blood is to maintain the body's physiological balance, while the

hematological blood indicators are the main determinant of animals' environmental adaptation and thus their welfare . Biochemical tests evaluate the body's internal condition, the function of different organs (including kidneys and liver) and the course of metabolic changes in the body (Scamell, 2006). Diet is an important factor influencing rumen environment and blood metabolite. Therefore, this study was carried out to evaluate the feed intake as it affects rumen metabolites and some blood parameters in yearling Bunaji bulls fed diets containing graded levels of PKC.

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).

Experimental design and animal management

A total of 20 yearling Bunaji bulls with age range of 1-1.5 years (110- 150kg) were balanced for weight and allotted to five dietary treatments in a Completely Randomized Design. Palm kernel cake was included in the formulated ration at graded levels of 0, 10, 20, 30 and 40% and this constitutes treatments 1 to 5 (Table 1). The bulls were treated against both endo and ecto-parasites before the commencement of the experiment. They were individually

Feed intake, rumen metabolite and some blood parameters of yearling Bunaji bulls

penned and fed diets containing graded levels of Palm Kernel Cake (PKC) and *Digitaria smutsii* (Wolly finger grass) hay at 4% of their body weight, 2% for concentrate

and 2% for hay. The animals were weighed fortnightly and the ration was adjusted in line with changes in their body weight. Water intake was measured and evaporative loss was also determined.

Table 1: Percent gross feed composition of yearling's concentrate diets

Ingredient %	Levels of inclusion(%)				
	0	10	20	30	40
Palm kernel cake	0.00	10.00	20.00	30.00	40.00
Cotton seed cake	22.00	18.50	16.00	13.00	10.00
Poultry litter	25.00	23.50	21.00	19.00	17.00
Rice offal	12.00	12.00	12.00	12.00	12.00
Maize offal	40.00	35.00	30.00	25.00	20.00
Salt	1.00	1.00	1.00	1.00	1.00
Total	100.00	100.00	100.00	100.00	100.00
Calculated Analyses					
Crude Protein(%)	15.25	15.28	15.33	15.36	15.38
Crude Fiber (%)	15.04	14.74	14.71	14.55	14.38
Metabolizable Energy(MJ/KgDM)	11.81	11.80	11.80	11.81	11.79
Total Digestible Nutrients(%)	65.76	65.55	65.40	65.22	65.04
Cost/kg(₦)	38.07	33.47	29.29	24.9	20.51

Rumen fluid sampling

Rumen fluid samples were collected from the yearling Bunaji bulls at the end of the growth at 0hr, 3hrs, 6hrs and 9hrs after feeding. About 50mls of the rumen fluid was drawn from all the Bulls in each of the treatments using a stomach tube. The tube which is about 150cm with a metallic strainer attached to the end was passed through a pipe placed in the mouth of the Bulls into the rumen and a suction pump which was used to draw out the rumen fluid was attached to the other end of the tube. The fluid collected was poured into plastic bottles containing equal quantity of 0.1N H₂SO₄ to trap ammonia. The samples were stored in a refrigerator at -4°C temperature until analyzed. Rumen ammonia concentration was determined by steam distillation with boric acid and thereafter back titrated with 0.01N Hydrochloric acid (HCl), according to the Procedure described by . Rumen fluid pH was determined using Philips digital pH meter (Model 9409).

PCV and serum biochemical analyses

Ten (10ml) of blood samples were collected at the beginning, middle and end of trial

through jugular vein puncture using a disposable syringe and sterile 18G needle. Five millilitres (5ml) of blood was put in vacutainer tubes containing Ethylene diaminetetraacetic acid (EDTA) as anti-coagulant. The remaining 5ml was placed in plain bottle for serum harvest. The blood sample in EDTA bottles was analyzed for Packed cell volume using micro haematocrit. Serum samples were analyzed for urea nitrogen level (BUN) using the procedure of , total protein was determined using refractometer as described in the routine laboratory Procedures while blood glucose was determined by collection of a drop blood from the heparinized blood collection tubes and used to determine the fasting glucose concentration using a calibrated glucometer. The blood sample analyses were done at Ahmadu Bello University Teaching Hospital. Shika Zaria.

Data analyses

The data collected from the growth trial was analysed using General Linear Model Procedure of to see the response of the animals to measured parameters. Significant levels of difference among

treatment means was compared using Dunnett's test . Data from feeding trials of yearling was analyzed using one way ANOVA while rumen fluid and the blood samples data were analyzed using repeated measure analyses. The models used in this study were as follows:

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

Where

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

μ = overall mean

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

E_{ij} = random error .

$$Y_{ijk} = \mu + \tau_i + \delta_{ij} + t_k + (\tau * t)_{ik} + \epsilon_{ijk}$$

where:

Y_{ijk} = j^{th} observation of the i^{th} graded levels of palm kernel cake;

μ = overall mean

τ_i = the effect of the i^{th} graded levels of palm kernel cake ($i = 0, 10, 20, 30$ and 40%);

t_k = the effect of k^{th} sampling period ($k = 0$ hr before feeding, 3hrs, 6hrs and 9hrs post feeding for rumen fluid, beginning, middle and end of experiment for blood);

$(\tau * t)_{ik}$ = interaction effect between the i^{th} graded levels of palm kernel cake and the k^{th} sampling period;

δ_{ij} = random error with mean 0 and variance $\sigma^2\delta$, the variance between animals

(subjects) within treatment and it is equal to the covariance between repeated measurements within animals

ϵ_{ijk} = random error with the mean 0 and variance σ^2 , the variance between measurements within animals

Analytical techniques

Proximate analyses of concentrate diets were carried out according to procedure. Also, Acid Detergent Fiber (ADF) and Neutral Detergent Fiber (NDF) were determined in all the feed ingredients according to . 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 . $ME (MJ/Kg DM) = 11.78 + 0.0064 CP + (0.000665 EE)^2 - CF (0.00414 EE) - 0.0118A$. Where ME = Metabolizable energy, DM = Dry matter, CP = Crude protein, EE = Ether Extract, CF = Crude fiber.

Results and discussion

Chemical analyses

The CP of the yearling diets ranged from 14.19-17.75% which falls within the range of 15.38-16.18% reported by , 13-16% and 16% CP recommended by for growing Bulls. However, it is higher than 13% reported by but lower than the value of 19.64- 22.44% reported by , 19.63% by and 19.00 to 22.91% reported by for matured Bulls. The CF ranged from 26.36% for diet containing 10% PKC inclusion to 38.77% for the treatment with 40% inclusion level of PKC which are higher than the minimum level of 17% required for maintenance by beef cattle (.NRC, 2000).

Table 2: Chemical compositions of concentrate diets containing varying levels of palm kernel cake fed to yearling Bunaji bulls

Parameter (%)	Levels of inclusion(%)				
	0	10	20	30	40
Dry Matter	97.74	97.81	98.25	98.13	98.8
Crude Protein	17.75	15.82	17.44	17.44	14.19
Crude Fibre	26.50	26.36	29.35	34.93	38.77
Ether Extract	18.41	20.57	13.31	12.46	11.36
Ash	6.43	6.79	7.46	6.75	6.40
Neutral Detergent Fibre	44.52	52.64	49.24	57.78	54.46
Acid Detergent Fibre	27.27	33.92	36.45	33.78	32.85
Hemi Cellulose	17.25	18.72	12.79	24.00	21.61
GE(MJ/KgDM)	14.86	14.36	13.47	14.34	15.71
ME(MJ/KgDM)	11.81	11.80	11.80	11.81	11.79

Where ME = Metabolizable energy, GE= Gross energy DM = Dry matter, CP = Crude protein, EE = Ether Extract, CF = Crude fibre and A = Ash.,,NDF=neutral detergent fiber, ACF=Acid detergent fiber,HC=hemicellulose. ME=Metabolizable Energy. ME was determined by quation of Alderman and Cottrill, 1985. $ME (MJ/Kg DM) = 11.78 + 0.0064 CP + (0.000665EE)^2 - CF (0.00414EE) - 0.0118A$.

Effect of palm kernel cake on the rumen metabolite of yearling Bunaji bulls

Figure 1 shows the effect of sampling time on the rumen metabolite of yearling Bunaji bulls fed graded level of palm kernel cake. There were significant ($P<0.05$) differences at different sampling time across all the rumen metabolites measured. The lowest rumen pH recorded in this study is 6.66 at 3 hrs post feeding and the highest was 7.08 at 0 hr before feeding. At 0hr, the pH of the rumen fluid was slightly above seven but within the range of 6.2-7.2 reported by . The ruminal pH fluctuation is in agreement with) who reported that ruminal pH is the highest pre-concentrate feeding and lowest post-concentrate feeding. At 3hrs, 6hrs and 9hrs after feeding, the pH of the rumen fluid fall within the normal range of 6-7, while at 3hrs and 9hrs after feeding, the pH of the rumen fluid fall within the normal range of 6.2 – 6.9 and 6.55 to 6.77 in Holstein calves. So the pH is adequate for normal rumen function. Rumen digesta pH is variable in the assessment of fermentation in the rumen. The growth of fiber digesting bacteria is favoured when the rumen digesta content pH is within 6.00-6.80. This result

implies that the values of pH obtained in the present study favour the fiber digesting bacteria. Likewise, the rumen digesta pH of the bulls in this study was above 5.60 -5.80 reported to cause diet- induced acidosis in ruminants. There was no significant difference in pH of rumen fluid of all the Bulls in the yearling bulls irrespective of the level of inclusion of PKC (Fig 2). the pH values (6.89-6.92 and 7.03-7.15) for yearling bull were above the minimum of 6.0 below which cellulolytic digestion in the rumen could be inhibited but it fall within the normal range of 6-7 and 5.8-6.4 . This finding is also in agreement with the report of).) reported a pH value of 6.18-6.31 when goats where fed diets containing varying levels of PKC. The pH of rumen fluid obtained in the yearling study showed significant difference at varying levels of PKC inclusion and at different sampling time (fig 3). At 0hr, the pH of the rumen fluid was slightly above 7 across treatment except for animal on diets containing 30% PKC levels. This was similar to the values obtained by at 0hr before feeding diets containing brewers grain to young bulls. This result could be due to a kind of conditioned reflex displayed by much

salivation into the buccal cavity in expectation of the morning feeding regime. At 3hrs post feeding across treatment, the pH value fall within the normal range of 6-7 (Mould and Orskov, 1984) and 6.2 – 6.9 (Reddy and Reddy, 1999) and this signifies that the pH is adequate for normal rumen function., at 6hrs post feeding, the pH value is within the range of 6.98 – 7.13 by . This is in line with the report of who observed that pH can vary due the nature of the diet, but typically found between 5.5 and 7.0 when ruminants are fed with predominantly on forage diet.

Effect of experimental diets on the performance of yearling Bunaji bulls

There was significant difference ($P<0.05$) on the performance of animals fed diets

containing graded levels of PKC in some of the parameters measured (Table 3). The average concentrate intake (ACI) ranged from 2.71 -2.81Kg/day and the hay intake ranged from 2.27 -2.79Kg/day. Average feed intake (AFI) and average dry matter intake (ADMI) were not significant ($P>0.05$) across treatment.

There was significant difference ($P<0.05$) on the performance of animals fed diets containing graded levels of PKC in some of the parameters measured. The ACI of 2.71 - 2.81Kg/day is higher than 2.55-2.76Kg/day and 2.54 -2.78Kg/day reported by and while the hay intake of 2.27 -2.79Kg/day is lower than 3.49-3.71Kg/day by AFI and ADMI were not significant across treatment.

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

Parameter	Levels of inclusion(%)					SEM
	0	10	20	30	40	
Initial weight(Kg)	119.00	124.25	122.50	118.75	122.25	2.84
Final weight(Kg)	186.75	187.25	182.00	180.25	185.50	4.49
ACI(kg/day)	2.76 ^b	2.81 ^a	2.72 ^{bc}	2.71 ^c	2.81 ^a	0.02
AHI(kg/day)	2.71 ^a	2.78 ^a	2.68 ^a	2.27 ^b	2.79 ^a	0.07
ATFI (kg/day)	5.47	5.58	5.40	5.38	5.61	0.14
ADMI(kg/day)	5.35	5.46	5.30	5.28	5.54	0.14
AWI(L/day)	16.51 ^a	15.88 ^{ab}	15.61 ^b	16.51 ^a	16.43 ^a	0.32
AWG(kg/day)	0.75 ^a	0.70 ^b	0.66 ^b	0.68 ^b	0.70 ^b	0.02
FCR	7.11 ^a	7.85 ^b	8.08 ^b	7.80 ^b	7.98 ^b	0.17

^{abcd} means within the same row with different superscripts are significantly different ($P<0.05$).

where 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, SEM=Standard Error of mean. l=litre

Fig : Effect of Sampling Time on the Rumen Metabolite of Yearling Bunaji Bulls Fed Graded Levels of Palm Kernel Cake

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Fig :Effect of Levels of Inclusion of Palm Kernel Cake on The Rumen Metabolite of Yearling Bunaji Bulls

Fig : Effect of Levels of Inclusion and Sampling Interval on the Rumen Metabolite of Yearling Bunaji Bulls Fed Diets Containing Palm Kernel Cake.

The critical Rumen Ammonia Nitrogen (RAN) level for optimum rumen function has been reported to be 5mg/100mL . The RAN values obtained in the yearling study were higher than what Satter and Slyter (1974) reported but is within the normal range of 5-20mg/100mL) for optimum Rumen Ammonia Nitrogen (RAN) level required for maximum rumen function. Rumen ammonia nitrogen is a measure of the extent of rumen microbial protein degradation. The rumen $\text{NH}_3\text{-N}$ values in this study were also higher than the value of 2-8 mg/100mL reported for high producing

ruminant livestock but lower than the value of 11.42 -14.43mg/100mL reported by and 19-25mg/100mL . The differences observed in the present study and other workers may be due to differences in the protein contents of the diets fed and the animals involved. This is also in line with the report of . Rumen Ammonia Nitrogen of 8.41-10.15 reported for yearling bulls falls within the normal range of 5-20mg/100ml (Leng and Nolan, 1984) but lower than the value of 14.14-16.71mg/dL reported by when goats were fed diets containing varying levels of PKC. It was also lower than the value of

(12.31-33.95mg/100mL) based on rice offal type, inclusion level (10.98-33.95mg/100mL) and interaction between rice offal type and inclusion level (10.93-33.95mg/100mL) reported by RAN of 13.51-15.30 obtained in the fattening trials falls within the normal range of 5-20mg/100mL (Leng and Nolan, 1984) for optimum rumen ammonia nitrogen (RAN) level required for maximum rumen function and the values obtained for fattened Bunaji bulls by .

The TVFA value obtained in the yearling bulls were higher than the values (10.5-12.8mm/l) reported by . There was an increase in volatile fatty acids at 6 hours post feeding, this could be associated with the digestibility of the feed material (;, since the volatile fatty acids are products of degradation of feed in the rumen. The slight decline in TVFA values at 9 hours post feeding across inclusion levels agrees with the work of , who reported that the concentration of rumen volatile fatty acids decline with time, since volatile fatty acids are the major source of energy and are always absorbed through the walls of the rumen. Similar trend was also observed by . The ability of cattle to digest solid feed material in the rumen is a function of the age of the animal, development of the rumen and quality of feed that is provided from liquid and solid feed. This gave a positive indication of the energy value of the experimental diets and signifies better utilization by the animals. The amounts and proportions of the TVFA produced are variable, depending on the nature of the diet, the time after feeding and the age of the animals (Stewart *et al.* 1958). TVFA concentrations gave an indication of the energy value. All the values obtained in the yearling trial for animals on different levels

of inclusion was lower than 96.1 - 111.9Mmol/L reported by but within the value reported by based on rice offal type (11.19-92.87Mmol/L), inclusion level (10.38-94.36Mmol/L) and interaction between rice offal type and inclusion level (10.33-107.45Mmol/L). The non-significant difference ($P>0.05$) on the level of Total volatile fatty acid (TVFA) in the rumen fluid irrespective of the levels of inclusion of PKC in the fattening diets is in line with the report of who stated that TVFA is the main source of energy to ruminants feeding solely on roughages. Thus, their concentration gave an indication of the energy value. According to , highly fermentable diets are rapidly converted to volatile fatty acid (VFA) in the rumen. All the values obtained in the growth study for animals on different levels of PKC inclusion and sampling time were within the range reported by based on rice offal type (11.19-92.87Mmol/L), inclusion level (10.38-94.36Mmol/L) and interaction between rice offal type and inclusion level (10.33-107.45Mmol/L) but lower than 60.05 – 87.80 Mmol/L (. and 96.1 - 111.9Mmol/L reported by .

Effect of palm kernel cake on Packed Cell Volume and some biochemical parameter of yearling Bunaji bulls

The result of the effect of levels of inclusion on haematological and biochemical parameters of yearling Bunaji bulls fed diets containing palm kernel cake is presented in figure 4. There was significant difference ($P< 0.05$) among treatments for all the haematological and biochemical parameters measured. Packed Cell Volume ranged from 28.08-30.42%, Glucose ranged from 3.76-4.97mmol/L Urea ranged 3.60-4.43mmol/L, highest urea value was obtained at 0% PKC inclusion, animals on

diets containing 20,30 and 40%PKC where statistically similar ($P>0.05$), Total protein ranged from 70.83 - 78.92 g/l highest value was obtained at 30% PKC inclusion, animals on diets containing 10% and 20%PKC were statistically similar ($P>0.05$) but differ from 40%.

The Packed Cell Volume of experimental animals reported at the Beginning, middle and end of the yearling study all fell within normal range (24-46 %) reported for healthy Zebu cattle by and . The normal PCV obtained for animals across treatment show that CP intake was adequate across treatment, This result is in agreement with the finding of and that reduction in crude protein intake resulted in depressed PCV in Zebu cattle. reported PCV values of 29.5 – 32.8% for white Fulani in Nigeria. Whereas and reported values of 32.88 – 38.00% for Zebu breed in East Africa. This shows that all of the diets can be fed to the animal without any known adverse effect. This result is in agreement with the finding of . The PCV value for yearling bulls at the beginning, middle and end of the experiment were significantly different ($P<0.05$) at varying levels of PKC inclusion. The PCV value was similar to the values observed in Friesian x Bunaji heifers fed diets with varying levels of cottonseed cake . It also falls within the normal range of (24-46 %) reported for healthy cattle by , and . also reported PCV values of 29.5 – 32.8% for white Fulani in Nigeria. There was no any known adverse effect exhibited by the animals hence all of the diet can be fed to the animals. also reported that the inclusion of PKC-based diets fed to goat had no effect on BUN, blood glucose and PCV concentrations. A normal PCV value reported in this study implies the diets was

adequate nutritionally as no malnutrition and suppression of the bone marrow or enlarged spleen associated with low PCV nor dehydration and abnormal increase in red blood production associated with high PCV. The blood glucose values for all the yearling bulls at various levels of inclusion of PKC in this experiment fall within the normal range of 3.0-8.3Mmol/L but higher than 3.45- 3.59 reported by when goats where fed diets containing PKC and the value of 2.11- 2.90 reported by in growing animals, glucose requirement is determined by growth rate, which is set by metabolizable energy intake whereas in mature animals only maintenance energy is required. The physiological status of an animal also affects the glucose concentration (Otto *et al.*, 2000). The blood glucose values at the middle and end of the growth trial fell within the normal range of 3.0-8.3Mmol/L. However, values obtained at the beginning of the trial were below this range but within the value of 2.11- 2.90 reported by . Similar trend was observed by . Glucose, as a source of energy, is necessary for production and reproduction performance. Blood glucose and BUN level may serve as indicators for a ruminant energy status. In the present experiments, these data indicate that bulls consuming the diets with palm kernel cake were in a normal energy status. Similar trend was observed by when rice offal was fed to bulls and when diets containing PKC was fed to goats. However, the variation in blood glucose could be affected by physiological status (Firat and Ozpinar, 1996) or disease conditions. There was significant difference ($P<0.05$) in glucose value for experimental animals at the beginning, middle and end of the experiment at varying levels of PKC inclusion. The glucose value obtained in the

yearling trial falls within the range of 3.0-8.3mmol/L reported by . The Blood Urea level for healthy animals has been reported by Mehrez *et al.* (1976) to range between 2.5-6.5 mmol/L. The value of 3.60 - 4.43 and 4.31 - 5.04 reported in the yearling and fattening trials respectively fell within the normal range. Measurement of blood urea nitrogen (BUN) may be useful as a tool for making real-time adjustments in protein supplementation for grazing or wintering beef cattle (Hammond, 2006). The urea value reported in yearling trials fell within the normal range of Blood Urea for healthy animals reported by which range between 2.5-6.5 mmol/L. reported urea value of 15.58-17.58 mg/dL (5.56-6.28 mmol/L) when goats were fed diets containing PKC. It also falls within the range reported by Sani *et al.* (2014) when rice offal based diets was fed to Bunaji bulls.

The urea value obtained for yearling bunaji bulls fed diets containing varying levels of PKC inclusion at different sampling intervals were within the normal range of 2.5-6.5 Mmol/L (Moloney *et al.*, 1994). Similar report was obtained by Finangwai *et al.* (2013) who fed Friesian x Bunaji heifers with concentrate diets containing varying levels of groundnut haulms. When rumen ammonia is absorbed into the systemic blood, it is converted to urea by the liver, thus, the moderate levels of serum urea with inclusion of PKC in the diet could be a pointer to better urea nitrogen utilization. When rumen ammonia is absorbed into the systemic blood, it is converted to urea by the liver; thus, the moderate levels of serum urea with inclusion of PKC in the diet could be a pointer to better urea nitrogen utilization. Monitoring of blood urea levels can be used for measuring protein status in cattle from different feeding regimes and

seasons (Hammond, 2006). The total protein of the experimental animals reported across treatment for the yearling 70.83-78.92g/L falls within normal range of 60-82 g/L reported by . This is in line with the reports of Hagawane *et al.* (2009) who indicated that TP concentrations are usually used as an appraisal of nutritive status of animals reflecting improved feed intake and metabolism. Total protein levels are lower in young animals and higher in mature animals whilst albumin levels are lower at birth and then increases . The Total Protein of the experimental animals reported at the start, middle and end of the yearling all fell within normal range of 60-82 g/L reported by . This could however mean that the animals received adequate levels of protein from the diets and this translated into adequate production of microbial proteins by the microbes to the animal. This result is in agreement with the finding of . The Total Protein value reported for yearling bulls fed diets containing varying levels of PKC inclusion at different sampling intervals in this study falls within normal range of 60-82 g/L reported by ; and . This could however mean that the animals received adequate levels of protein from the diets and this translated into adequate production of microbial proteins by the microbes to the animal except at the end of the yearling experiment at 0% (90.75g/L) and 30% (93.50) PKC level of inclusion which was slightly above the normal range. The Total Protein value reported for animals fed diets containing varying levels of PKC inclusion at different sampling intervals in this study falls within normal range of 60-82 g/L reported by , and . Total serum protein concentration reflects all of the different proteins in plasma with the exception of those that are consumed in clot formation,

Feed intake, rumen metabolite and some blood parameters of yearling Bunaji bulls

such as fibrinogen and the clotting factors. The normal range of TP obtained implies that the animals received adequate levels of protein from the formulated diets which was well utilized for adequate production of

microbial proteins by the microbes to the animal except at the end of the fattening trial at 0% (83.00g/L) and 30% (84.50g/L) PKC level of inclusion which was slightly above the normal range.

Fig : Effect of levels of inclusion on Packed Cell Volume and Some biochemical parameter of yearling Bunaji bulls fed diets Containing Palm Kernel cake.

Fig : Effect of sampling interval on Packed Cell Volume and some biochemical parameter of yearling Bunaji bulls fed graded level of palm kernel cake

Fig : Effect of level of inclusion and sampling intervals on packed cell volume and some biochemical parameter of yearling Bunaji bulls fed diets containing PKC

Conclusion

The study showed that the use of palm kernel cake up to 40% in the diets of yearling Bunaji bulls had no adverse effect on the rumen metabolite and some of their blood profiles. Therefore, it can be utilized by farmers to increase the productivity of their yearling bulls.

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