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EFFECT OF FEEDING GRADED LEVELS OF PALM KERNEL CAKEON SOME BLOOD PARAMETERS OF WEANER CALVES

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ABSTRACT

A study was conducted to evaluate the effect of feeding diets containing graded levels of Palm Kernel Cake (PKC) on haematological and biochemical characteristics of weaner calves. Thirty (30) weaner calves (15 males and 15 females) with a live weight range of 85-94kg, and aged between 7.5-9.0 months were balanced for weight and allotted to five (5) dietary treatments in a 2x5factorial arrangement laid 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% for concentrate and 2% for 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 parameters. The crude protein (CP) content of the experimental diets varied between 13.88 and 18.00%, while the metabolizable energy (ME) ranged from 11.79 to 11.81MJ/kg DM. The crude fibre (CF) content varies from 28.00 to 33.50%. Generally, the effect of sex, graded levels of PKC and the combine effect of sex and PKC significantly ($P<0.05$) influenced some of the blood parameters measured; however, they fell within the normal range for healthy calves. Male calves had higher packed cell volume (PCV) and total protein (TP) values of 30.02% and 75.36g/l, respectively as compared to male calves which had 29.96% and 68.65g/l PCV and TP, respectively.But some of the blood urea values observed in female calves werehigher (4.87 mmol/l) than those in the male animals (4.63 mmol/l). There was no significant ($P>0.05$) difference in Glucose values for both male and female calves (3.94 and 3.74mmol/l), respectively. Sampling time significantly ($P<0.05$) influenced PCV values with the least (28.97%) and highest (30.77%) values obtained at the beginning and end of the feeding trial, respectively. The glucose value obtained at the beginning of the experiment (2.69mmol/l) differed significantly ($P<0.05$) from the values obtained at the middle (4.16mmol/l) and end (4.63mmol/l) of the experiment. The graded levels of PKCinfluenced PCV and TP values of calves. The highest values of PCV and TP (32.17% and 76.67 g/l) were recorded in calves fed 10% level of PKC followed by(30.17% and 71.96 g/l) at 30%, (29.94% and 72.28 g/l) at 40% and (29.28% and 70.28g/l) at 0% levels of PKC. Calves fed diet containing 20% level of PKC had the least value ofPCV and TP (29.39% and 68.83 g/l, respectively). There was no significant ($P>0.05$) difference in Glucose value obtained for the weaner calves irrespective of PKC inclusion in the diet. When sex and level of inclusion of PKC were considered, there was no significant ($P>0.05$) difference in PCV and glucose values obtained. Urea values were similar at the beginning and end of the feeding trial for both male and female calves but different at the middle of the experiment with females having higher (3.46 mmol/l) values as compared with the males (2.85mmol/l). The study concluded that up to 40% inclusion level of PKC could be added to the diets of weaner calves with noadverse effect on some their blood paramaters.

INTRODUCTION

The health status of animals maintained under different feeding conditions is one of the criteria for welfare assessment (Scammell, 2006). 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 (Ahmad *et al.*, 2003). 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 affect heamatological and biochemical parameters cannot be over-emphasized (Scammel, 2006). Testing the physiological parameters of animals is essential to monitoring their health status (Radkowsk and Herbut, 2014).

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 (Radostits *et al*., 2000).

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 (Anderson *et al.*, 1999; Sattar and Mirza, 2009). 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).Palm kernel cake (PKC) is a product of oil palm processing. It is obtained after oil extraction from Palm kernel. Protein content is between 18 - 25% (Onwuka *et al* 2014). PKC is deficient in lysine, methionine, histidine and threonine. PKC is gritty and high in fibre content (at least 9%). The objectives of the study was to evaluate the effect of feeding diets containing graded levels of palm kernel cake (PKC) on some blood parameters of weaner calves.

MATERIALS AND METHODS

Experimental Site

The Experiments was conducted at the Experimental Unit of the Beef Research Programme of the National Animal Production Research Institute, Shika, Zaria, Nigeria. The study area falls within latitudes 11^{o} 8′ 19.56″ N and longitudes 7^{o} 45′ 51.22″ E, with an altitude of 640m above sea level (Google Earth, 2016). Shika is located within the Northern Guinea Savannah ecological zone of Nigeria with an average annual rainfall of 1,100 mm which starts from late April/early May and ends mid-October, the temperature range from 27-35°C depending on the season, while the mean relative humidity during the harmattan and wet seasons are 21%-72%, respectively (Ovimap, 2016)

Experimetal Animals, Design and Management

A total of thirty (30) weaner calves (15 bull and 15 heifer) aged between 7.5-9.0 months with a body wieght of 85-94kg were balanced for weight and allotted to five (5) dietary treatments in a 2x5factorial arrangement laid in Completely Randomized Design (CRD). Cotton seed cake is the main protein source of the control diet (0%PKCinclusion) while the Four test diets contain 10%, 20%, 30% and 40% PKC inclusion. The diets were formulated to be isonitrogenous and isocaloric as shown in Table 1.They were individually penned and fed diets containing graded levels of Palm Kernel Cake (PKC) and *Digitaria smutsii* (Wholly finger grass)hay at 4% body weight (that is, 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. Clean drinking water was provided and water intake was measured and evaporative loss was also determined. The feeding trial lasted for a period of 90 days.

Source of Palm Kernel Cake

The palm Kernel cake used for this experiment was purchased from Rebson Feedmil, Samaru, Zaria in Kaduna state.

Tables 1: Ingredient Composition of Concentrate Diets fed to Calves

Ingredients (%)	Inclusion Levels of Palm Kernel Cake				
	0	**10**	**20**	**30**	**40**
Palm Kernel Cake	0.00	10.00	20.00	30.00	40.00
Cotton Seed Cake	30.00	27.00	24.00	20.50	17.50
Poultry Litter	20.00	18.00	16.00	14.00	12.00
Rice Offal	12.00	12.00	12.00	12.00	12.00
Maize Offal	37.00	32.00	27.00	22.50	17.50
Common Salt	1.00	1.00	1.00	1.00	1.00
Calculated	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Analysis					
Crude Protein	16.00	16.02	16.05	16.00	16.02
ME(MJ/KgDM)	11.80	11.81	11.79	11.81	11.81
TDN(%)	65.88	63.35	60.84	58.32	55.79
Cost /Kg (₦/kg)	40.21	35.82	31.43	26.96	22.58

Haematological and Biochemical Analysis

10mls of blood samples were collected from each of the experimental animal at the end of the feeding trial, growth and fattening experiment at 0hr, 3hrs, 6hrs and 9hrs post feeding through jugular vein puncture using a disposable sterile syringe with 18G needle. Five (5mls) of the blood collected was emptied into vacutainer tubes containing Ethylene diaminetetra-acetic acid (EDTA) as anti-coagulant to determine the packed cell volume. The remaining 5mls was emptied into plain bottles for the determination of total protein, blood urea nitrogen and glucose.

Chemical Analysis

The experimental diets and PKC were analyzed for proximate composition according to the procedures of AOAC (2000). While Acid Detergent Fibre (ADF) and Neutral Detergent Fibre (NDF) were both determined according to methods of Van Soest (1991) at the Central laboratory of the National Animal Production Research Institute (NAPRI), Shika, Zaria, Nigeria. The blood samples collected were analyzed for some haematological and biochemical parameters at the Ahmadu Bello University Teaching Hospital, Shika-Zaria. Metabolizable energy (ME) was determined by the equation of Alderman and Cottrill (1985). That is, ME (MJ/Kg DM) = 11.78 + 0.0064 CP + $(0.000665EE)^2$ - CF (0.00414EE) - 0.0118Ash. Where ME = Metabolizable Energy, DM = Dry Matter, CP = Crude Protein, EE = Ether Extract, CF = Crude Fibre.

Statistical Analysis

The data collected from this study was subjected to analysis of variance (ANOVA) using the General Linear Model (GLM) procedure of SAS (2002) to see the response of the animals to measured parameters. Significant levels of difference among treatment means were separated using Duncan Multiple Range test (Duncan 1955). Data on blood samples were analyzed using repeated measure analysis. The statistical model is given below:

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

where:

Y_{ijk} = j^{th} observation of the i^{th}graded levels of PKC;

μ = the overall mean

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

t_k = the effect of k^{th} sampling period/sex;

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

period/sex;
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 σ2, the variance between measurements within animals

RESULTS

Proximate and cell wall compositions of concentrate diets containing gradedlevels of palm kernel cake fed to Weaner calves

The dry matter and crude protein contents of the experimental diets ranged between 97.3 - 97.96% and 13.88 – 16.75%, respectively (Table 2). The crude fibre content ranged between 28 and 33.5% with diets containing 0%PKC inclusion having the lowest CF and diets containing 20%PKC inclusion with the highest. The NDF and ADF ranged between 49.29 - 58.02% and 27.27 - 37.3%, respectively. The ash content ranged between 5.74 and 7.48% (diets containing 40%PKC inclusion and 0% PKC inclusion) , while the ether extract content ranged between 10.64 and 15.6% (diets containing 40%PKC inclusion and 0% PKC inclusion). Gross energy ranged between 3029.57-3609.74 cal/g(diets containing 40%PKC inclusion and 10% PKC inclusion) and ME ranged between 11.79-11.81MJ/KgDM.

Table 1: Chemical Composition of the Experimental Diets fed to Weaner Calves.

Parameter (%)	Inclusion Levels of Palm Kernel Cake (%)				
	0	**10**	**20**	**30**	**40**
DM	97.40	97.36	97.30	97.96	97.81
CP	16.75	18.00	13.88	16.31	16.06
CF	28.00	29.00	33.50	31.00	32.50
EE	15.60	12.98	12.76	10.86	10.64
Ash	7.48	7.39	6.24	6.33	5.74
NDF	49.29	53.14	58.02	52.65	54.20
ADF	35.11	37.3	33.97	35.21	27.27
HC	14.18	15.84	24.05	17.44	19.18
GE[1]	3165.47	3609.74	3235.46	3268.42	3029.57
ME[2]	11.80	11.81	11.79	11.81	11.81

[1] = (Calorie/g), [2] = (MJ/KgDM), DM = Dry Matter, CP = Crude Protein, EE = Ether Extract, CF = Crude Fibre, NDF= Neutral Detergent Fibre, ADF=Acid Detergent Fibre,HC= Hemicellulose,ME = Metabolizable Energy, GE= Gross 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) - 0.0118Ash.

Effect of sex on some haematological and biochemical parameters of weaner calves

Figure 1 shows the effect of sex on haematological and biochemical parameter of weaner calves. The PCV(30.02% and 29.96%) and TP (75.36g/L and 68.65g/L) were highest for male than female while urea value(4.63mmol/L and 4.87mmol/L) was higher for female than male. There was no significant difference (P>0.05) in glucose value for both male and female weaner calves.

Effect of sampling intervals on some haematological and biochemical parameter ofWeaner calves fed graded level of palm kernel cake

The PCV was highest (30.77%) at the end of the experiment and lowest at the beginning (28.97%). Glucose value was lowest (2.69mmol/l)at the beginning of the feeding trial but statistically similar value(P>0.05) at the middle(4.16mmol/l) and end of the experiment (4.63mmol/l). Urea value was lowest (3.16mmol/l) at the middle of the trial

and highest (6.72) at the end. The highest TP value was obtained at the middle (78.47g/l) of the experiment, followed by (73g/l) and (68.14g/L) at the end and beginning of the feeding trial, respectively (figure 2).

Effect of graded levels of palm kernel cake on some haematological andbiochemical parameters of weaner calves

Figure 3 shows the effect of graded levels of PKC on some haematological and biochemical parameters of weaner calves. The Packed cell volume, blood urea nitrogen and total protein were significantly ($P<0.05$) affected by the graded levels of PKC in the diets, but there was no significant ($P>0.05$) difference in blood glucose values across the treatments. The values for PCV, glucose, BUN and TP ranged from 28.39-32.17%, 3.57-4.11mmol/l and 4.21-5.34mmol/l and 68.83-76.67g/l, respectively.

Effect of sex and sampling intervals on some haematological and biochemical parameters of weaner calves fed diets containing graded levels of palm kernel cake

Effect of sex and sampling intervals on some haematological and biochemical parameters of weaner calves fed diets containing graded levels of palm kernel cake is shown in Figure 4. The PCV and glucose values at the beginning, middle and end of the experiment for both males and females were not significant ($P>0.05$). The values for BUN at the beginning and end of the experiment for both sexes were also not significant ($P>0.05$) but differed at the middle of the experiment, the female animals had higher values of blood urea nitrogen compared to their male counterparts.

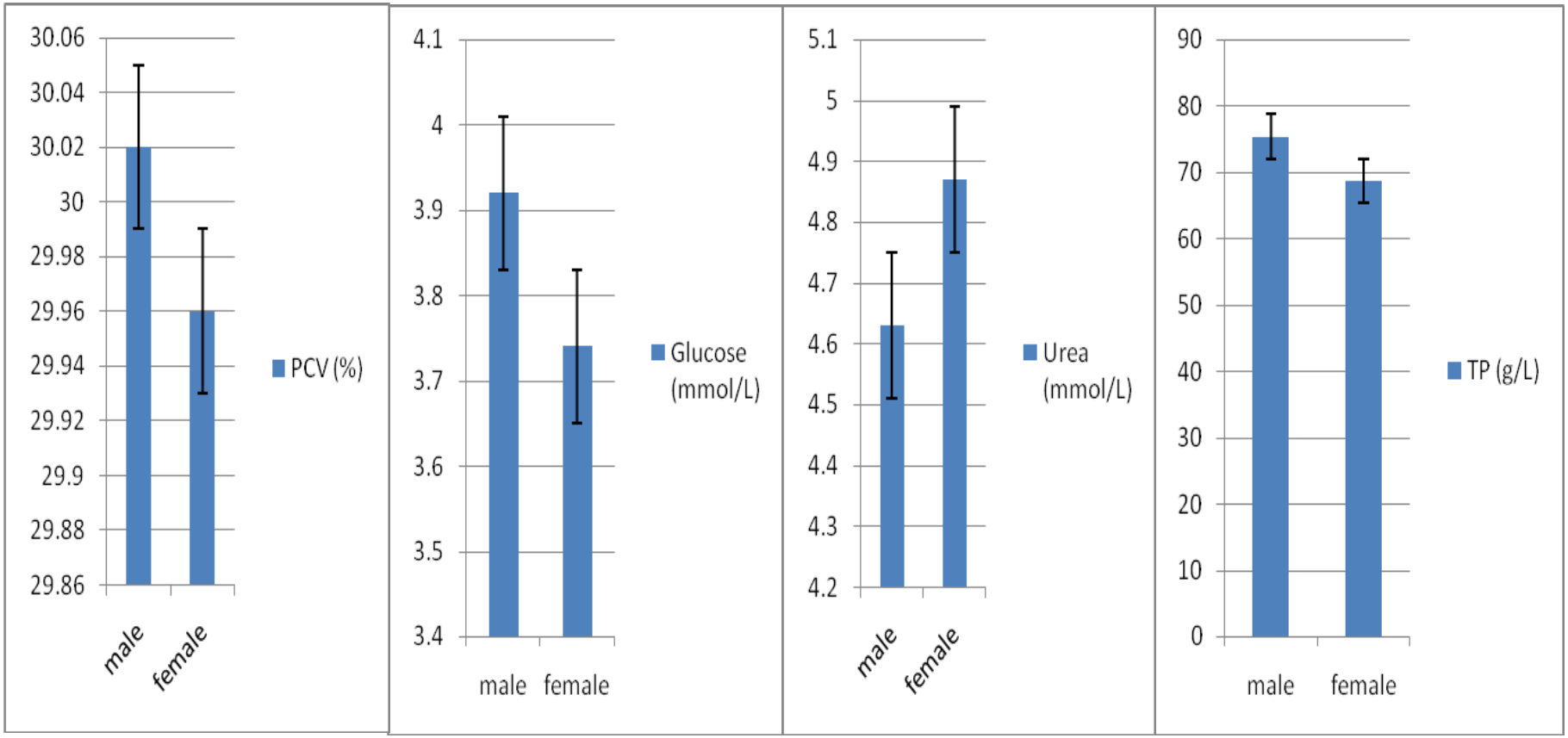


Figure1: Effect of sex on some haematological and biochemical parameters of weaner calves fed diets containing varying levels of palm kernel cake

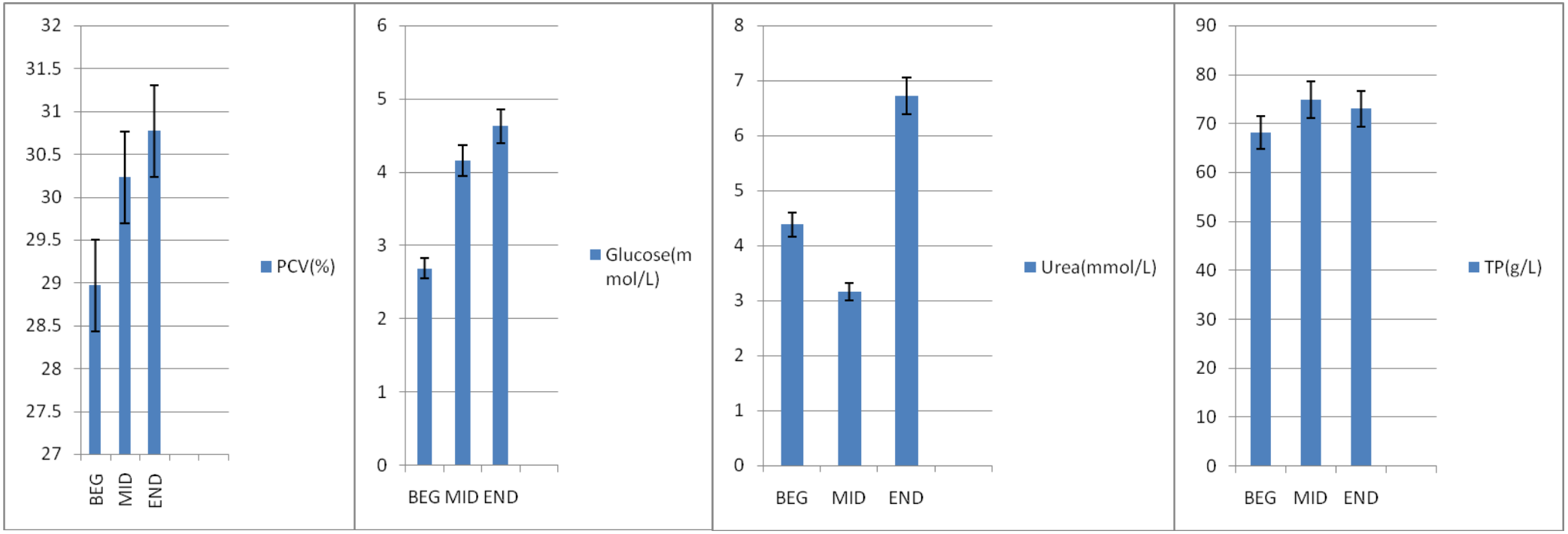


Figure2: Effect of sampling intervals on some haematological and biochemical parameters of weaner calves fed diets containing graded levels of palm kernel cake.

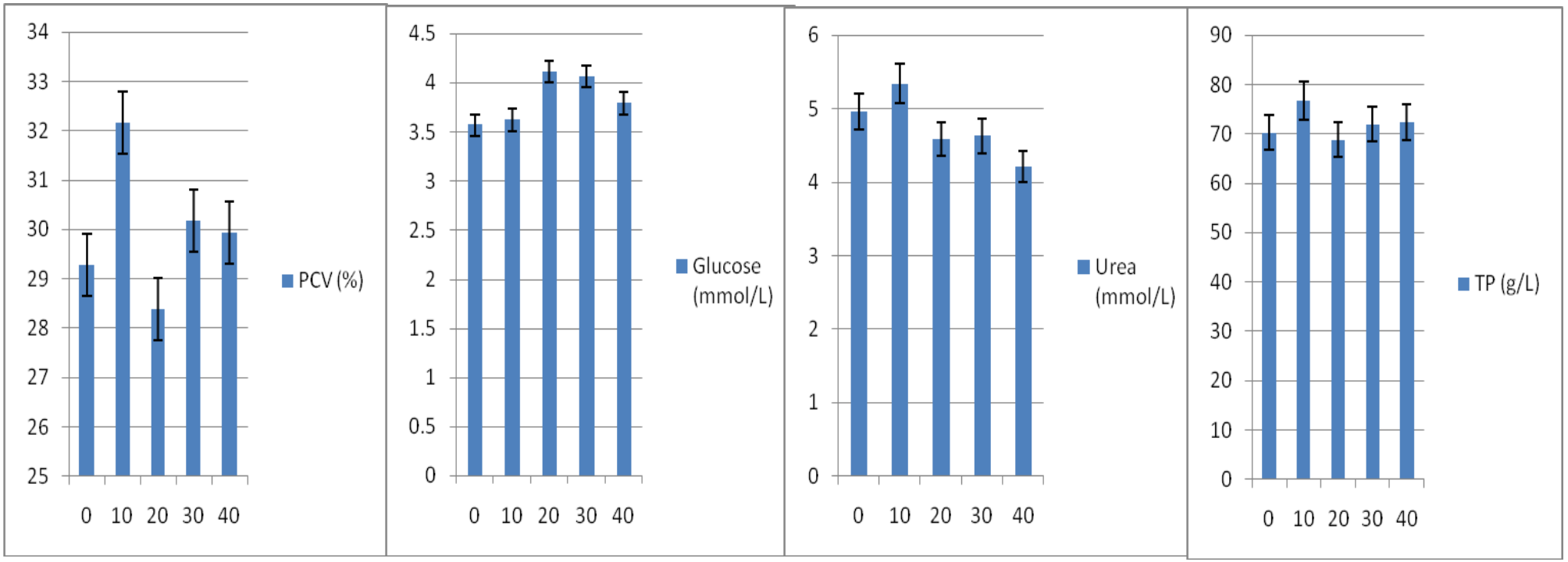


Figure3: Effect of graded levels of palm kernel cake on some haematological and biochemical parameters of weaner calves.

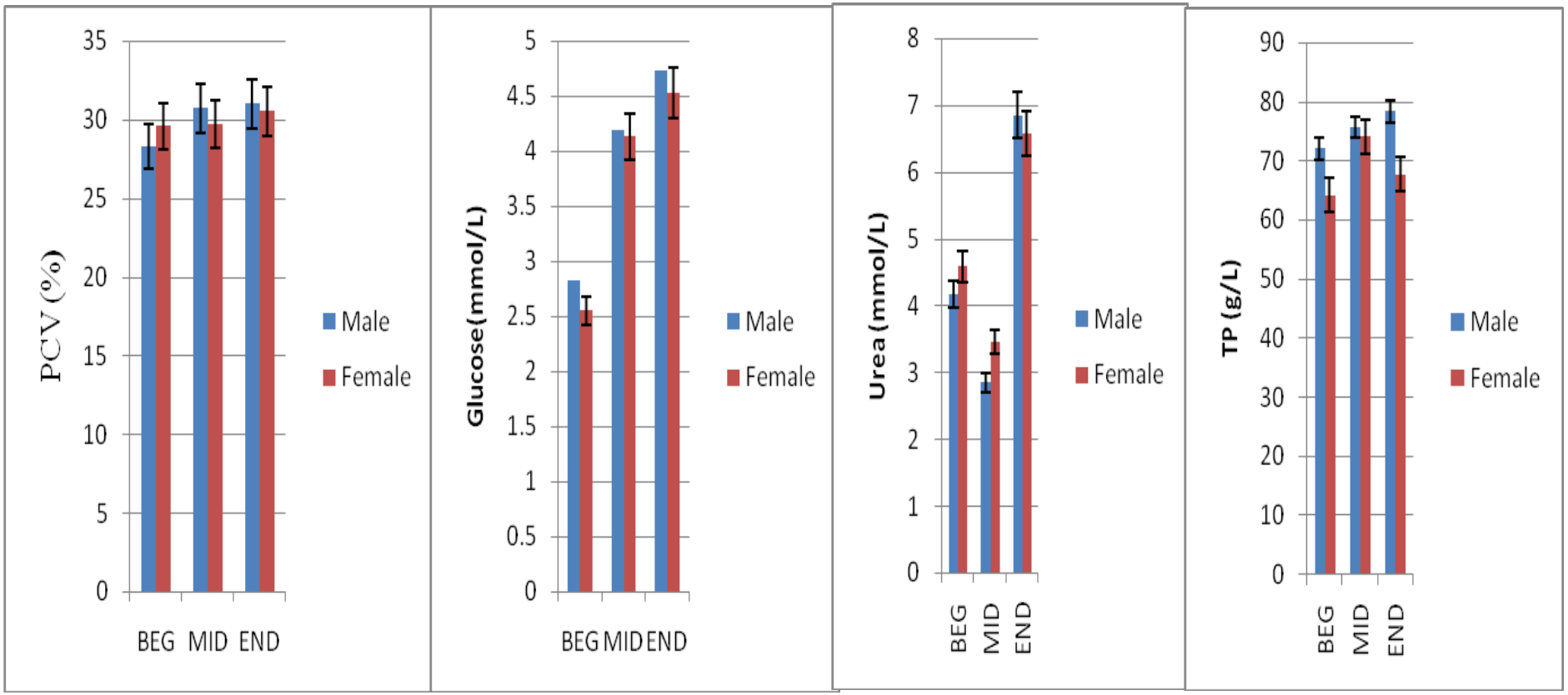


Figure4: Effect of sex and sampling intervals on some haematological and biochemical parameters of weaner calves fed diet containing graded levels of palm kernel cake.

Effect of graded levels of palm kernel cake and sampling intervals on some haematological and biochemical parameters of weaner calves

Figure 5 shows the effect of graded levels of palm kernel cake and sampling intervals on some haematological and biochemical parameters of weaner calves. The PCV values ranged from 27-33.33, 28.17-31.33, 29-32.83%,Glucose ranged from 2.32-3.5,3.73-5.05,4.18-4.95mmol/l, blood urea nitrogen ranged from 3.52 -4.80,2.58-3.52,5.62-7.17mmol/l and total protein ranged from 61.70-76.50,71.50-79.83,68-79.83g/l at the beginning, middle and end of the experiment, respectively across the treatments (Figure 5).

Effect of sex and graded levels of palm kernel cake on some haematological and biochemical parameters of weaner calves

The effect of sex and graded levels of palm kernel cake on some haematological and biochemical parameters of weaner calves is shown in figure 6. There was significant difference ($P<0.05$) between the male and female calves in all the parameters measured across the treatments. Glucose value was similar for the males at 10, 20 and 30% inclusion of PKC but differed at 0 and 40% inclusion of PKC. Female animals had similar glucose value at 20, 30 and 40% inclusion levels of PKC, but differed at 0 and 10% levels of PKC. The TP ranged from 68.44-80.89g/l and 64.57-72.44g/L for male and female, respectively.

Effect of sex, graded levels of PKC and sampling time on some haematological and biochemical parameters of weaner calves

Figure 7 shows the effect of sex, graded levels of palm kernel cake and sampling time on some haematological and biochemical parameters of weaner calves. Males animals fed diest containing 40% inclusion level of PKC had lowest value of PCV (26%). But female calves on 10% inclusion level of PKC had the highest PCV value (33.67%) at the beginning of the experiment. Highest PCV values (35.33%) were recorded at the middle of the experiment in male calves fed diets containing 40% inclusion levels of PKC, while the lowest PCV values (27.33%) were obtained in female calves fed diets containing 40% inclusion levels of PKC. The PCV value at the end of the experiment ranged from 28.67-34.33% for male weaners and 28.60-33.67%. Urea value ranged from 3.33-5.17mmol/l(40%PKC inclusion for male weaner calves and 20%PKC inclusion for female weaner calves at the beginning of the experiment), 2.57-4.27mmol/l(20%PKC and 10%PKC for female weaner calves at the middle of the trials) and 4.57-7.77mmol/l. (40%PKC inclusion for female weaner calves and 10%PKC inclusion for male weaner calves at the end of the experiment).

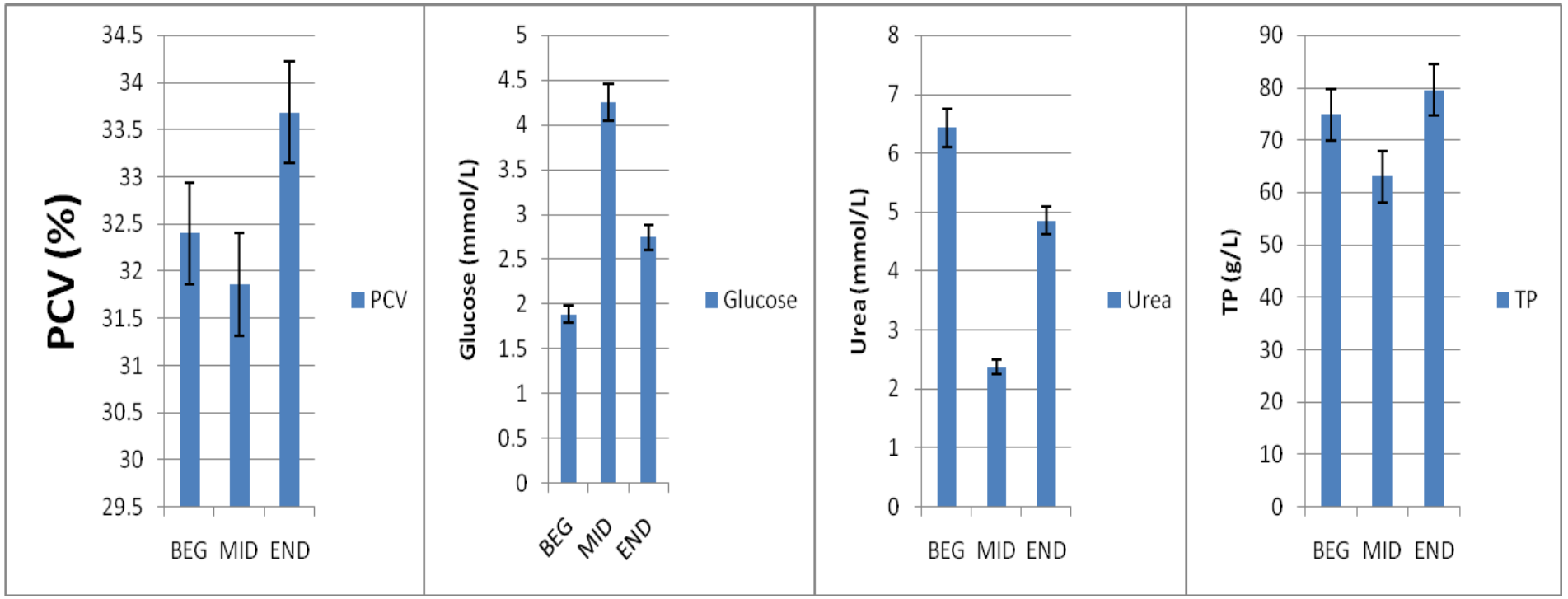


Figure 1: Effect of graded levels of PKC and sampling intervals on some haematological and biochemical parameters of fattened bulls.

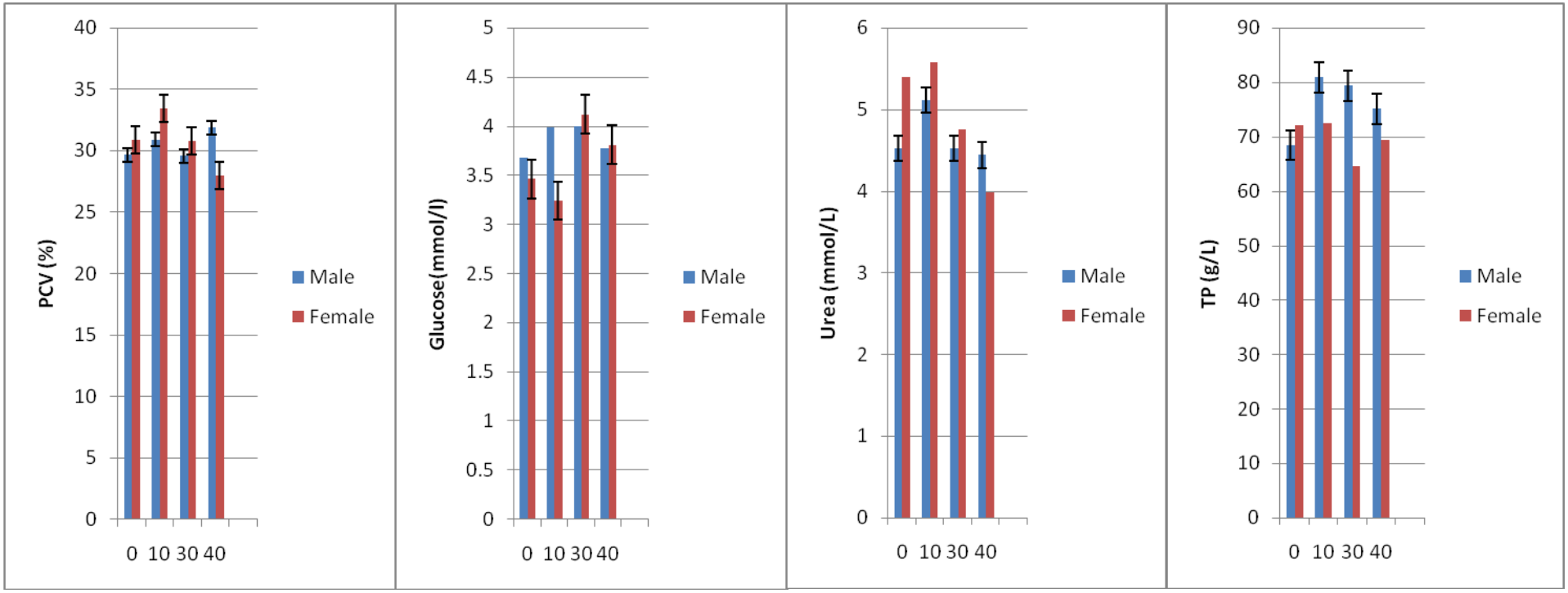


Figure 5: Effect of sex and graded levels of PKC on some haematological and biochemical parameters of weaner calves.

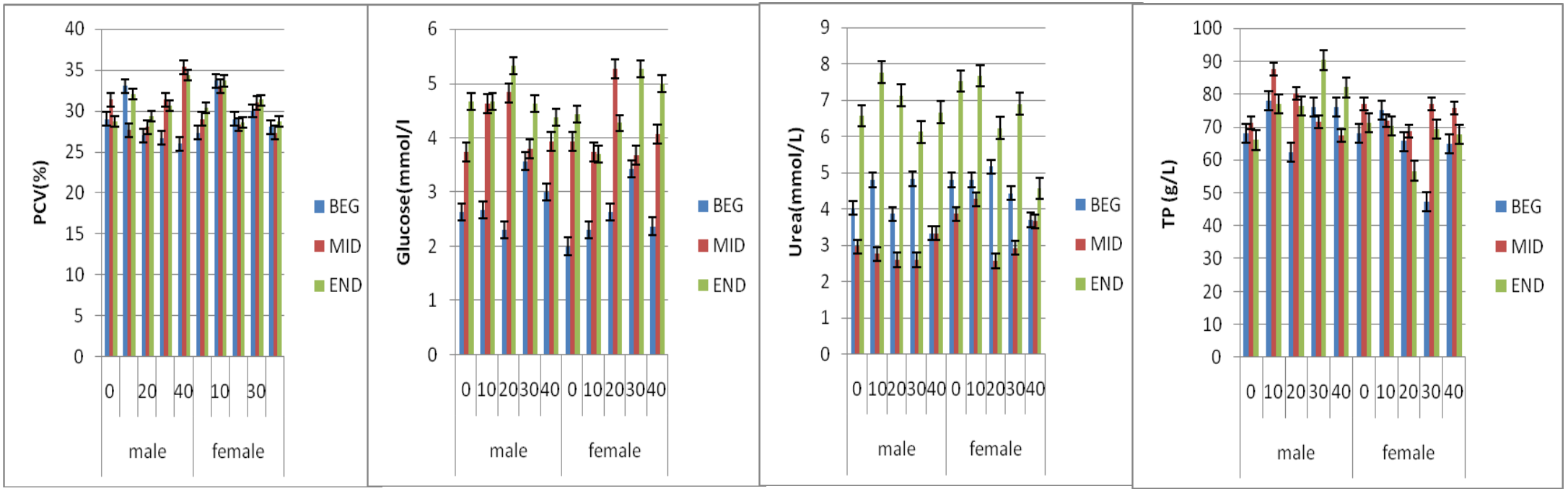


Figure 6: Effect of sex, graded levels of palm kernel cake and sampling time on some haematological and biochemical parameter of weaner calves.

DISCUSSION

The proximate and cell wall compositions of concentrate diets containing graded levels of PKC fed to weaner calves

The CP contents of the diets containing graded levels of PKC (0, 20 , 30 and 40%) fell within the range of 15.38-16.18% reported by Yusuf (2016), 13-16% Aduku (2005) and 16% CP recommended by NRC (1989) for growing bulls. However it was higher than 13% reported by Rutherglen (1995) but lower than the value of 19.64- 22.44% reported by Sani (2014), (19.63%) by Madziga *et al.* (2013) and 19.00 to 22.91% reported by Lamidi *et al.* (2007) for matured bulls. This could be as a result of the fact that the feed was formulated to meet the requirement of different classes of animal. The CF content of the experimental diets ranged from 28 to 33.5% which are higher than the minimum level of 17% CF required for beef cattle (NRC, 2000).This could probably have been because of the high CF content of the PKC in the experimental diets The ether extract of all the diets were higher than the maximum recommended level of 6% for matured cattle (Parish and Rhinehart, 2008). This increase might have resulted due to the presence of cotton seed cake and PKC in all the diets. The ME of the diets was within the range of 11.79-11.81MJ/Kg DM. This is within the range of 10.85-11.16MJ/Kg DM reported by Sani (2014) and 10-11.6MJ/Kg DM recommended for Bulls (Rutherglen, 1995). The differences observed in the proximate composition of the experimental diets used in this study as compared with the results obtained by other authors could be as a result of the differences in feed ingredients, source of grains,method of extraction of certain feed ingredient(PKC and CSC).

Effect of sex on some haematological and biochemical parameters of weaner fed graded levels of palm kernel cake

The packed cell volume of the male and female calves falls within the normal range of 26-30% reported by Radkowsk and Herbut (2014), 24-46% reported for healthy animals (Coppock *et al*., 1985, Oyedipe *et al*., 1985) 24- 48% reported by (Research Animal Resources,2009) and 30- 45 reported by Merck Manual (2012). The glucose value is higher than the 2.11- 2.90 reported by Jonas and Vilma (2007) but within the normal range of 3.0-8.3mmol/l (Woodsman and Evans, 1974). The range of 2.5-6.5 mmol/l of blood urea nitrogen wasreported by Mehrez *et al (*1976) and Woodsman and Evans (1974). The BUN values obtained in this study were within the normal range for healthy calves.

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. The total protein values of 75.36 and 68.65 reported for male and female weaner calves in this study fell within the normal range of 60-82 g/l reported by Gleghorn *et al*. (2004).

Effect of sampling intervals on some haematological and biochemical parameters of weaner calves fed graded levels of palm kernel cake

The PCV values recorded in this study for weaner calves at different sampling intervals (28.97-30.77%),were higher than 27.40 to 28.00% reported by Finangwai *et al*. (2013) for crossbred bulls and but fell within the normal range of (24-46 %) reported for healthy cattle (Coppock *et al*.,1985) but lower than the range of 39.79 to 41.42% reported by Moloney *et al.* (1994) this could be as a result of differences in class of animal used and differences in experimental diets fed..

The values for blood glucose reported in this study at the beginning of the experiment fell within the values of 2.11- 2.90mmol/L reported by Jonas and Vilma (2007) for dairy cow, while the blood glucose values reorded in weaner calves at the middle and end of the experiment fell within the normal range of 3.0-8.3mmol/l reported by Woodsman and Evans (1974) and 4.4 and 4.5mmol/L reported by Doornenbal *et*

al ,(1988) for 7.5 month old bull and steer respectivly.

The blood urea level reported for weaner calves in this study at different sampling time was within the range of 2.5-6.5 mmol/l reported by Mehrez *et al*. (1976) and Woodsman and Evans (1974).The total protein of the experimental animals reported at the beginning, middle and end of this study fell within the normal range of 60-82 g/l reported by Gleghorn *et al*. (2004).This could however mean that the animals received adequate levels of protein from the diets which translated into adequate production of microbial proteins by the rumen microbes.

Effect of graded levels of palm kernel cake on some haematological and biochemical parameters of weaner calves

The PCV values of the experimental animals obtained across the dietary treatments in this study was lower than the range of 39.79 to 41.42% reported by Moloney *et al*. (1994)but higher than 27.40 to 28.00% reported by Finangwai *et al*. (2013). It however fell within the normal range of (24-46%) reported for healthy calves (Oyedipe *et al*., 1985).This shows that all of the diets can be fed to the animals without any adverse effect.

The blood glucose values at various PKC inclusion levels fell within the normal range of 3.0-8.3mmol/l reported by Woodsman and Evans (1974) but higher than the 2.11- 2.90 reported by Jonas and Vilma (2007Mehrez *et al*. (1976) and Woodsman and Evans (1974) reported the range of 2.5-6.5 mmol/l as normal blood urea values for healthy animals which is in line with the range of values obtained across treatments in this study. Calves on 30% PKC is also have similar urea value as 4.6mmol/l reported by cozzi *et al.,* (2011) as reference value for holstein dairy cow..

The values for total protein obtained in this study at graded levels of PKC was within the range of 60-82 g/l reported by Gleghorn *et al.* (2004). This could be attributed to the fact 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 Sani *et al*.(2014) who reported TP value within the range of 60-82g/l for bunaji bulls fed diets containing graded level of raw and parboiled rice offal

Effect of sex and sampling intervals on some haematological and biochemical parameters ofweaner calves fed diets containing graded levels of palm kernel cake

The PCV values observed in the experimental animals at the beginning, middle and end of thestudy for both male and female weaner calves were within the normal range of 24-48% reported by Etim *et al* (2013).

The blood glucose values obtained at the beginning of the feeding trial for both male and female calves were within the values of 2.11-2.90 reported by Jonas and Vilma (2007), while those obtained for both sexes at the middle and end of the experiment fell within the normal range of 3.0-8.3mmol/L (Woodsman and Evans, 1974) and 5.5- 8.3mmol/l reported for healthy cattle by Slanina (1999). Similar trend was observed by Sani *et al.* (2014) graded level of raw and parboiled rice offal to bunaji bulls.

The urea value reported in this study for both male and female and at different sampling intervals fell within the normal range of blood Urea for healthy animals as reported by Mehrez *et al* (1976) and Woodsman and Evans (1974) which range between 2.5-6.5 mmol/l. It also fell within the range reported by Sani *et al*.(2014) when rice offal based diets was fed to bulls. Similar resultswas obtained by Finangwai (2013) who fed concentrate diets containing varying levels of groundnut haulms to Friesian x Bunajiheifers.

The values for total protein obtained in this study for male and female calves at the beginning, middle and end of the study fell within the normal range of 60-82 g/l reported by Gleghorn *et al*. (2004). This shows that the

animals' protein requirements were adequately met.Ndlov *et al*. (2007) reported that total protein reflect the availability of protein and that total protein concentration decline in the phase of protein deficiency.

Effect of sex and graded levels of of palm kernel cake on some haematological and biochemical parameters of weaner calves

Packed cell volume obtained in this study fell within the normal range of 24- 48% reported by Research Animal Resources., (2009) irrespective of sex of the animal and the level of PKC. Similar results were also reported byCoppock *et al*. (1985).This showed that all of the diets can be fed to the animal without any adverse effect on their health.This also confirmed the findings of Lamidi (2005) who fed cotton seed cake to bunaji bulls.

The blood glucose values obtained irrespective of sex and levels of PKC inclusion in the diets fell within the normal range of 3.0-8.3mmol/L (Woodsman and Evans, 1974).

The urea values obtained in this study at different levels of PKC inclusion in the diets and for both male and female calves fell within the normal range for healthy animals as reported by Mehrez *et al.* (1976) and Woodsman and Evans (1974) which range between 2.5-6.5 mmol/L. It also fell within the range reported by Sani et *al*. (2014) when rice offal based diets were fed to bulls. Similar report was obtained by Finangwai (2013) who fed Friesian x Bunaji heifers with concentrate diets containing varying levels of groundnut haulms.

The values of total protein obtained in calves fed the experimental diets were within the normal range of 60-82 g/l reported by Gleghorn *et al.* (2004) irrespective of sex and levels of PKC inclusion in the diets.The values obtained in this study suggest efficient utilization of the protein supplied in the diets by the weaner calves

Effect of sex, graded levels of PKC and sampling time on some haematological and biochemical parameters of weaner calves

The PCV values obtained for both male and female calves at the beginning, middle and end of the study fell within the normal range of 26-30% reported by Radkowsk and Herbut (2014), 24-46% reported for healthy animals (Coppock *et al*., 1985, Oyedipe *et al*., 1985) 24- 48% reported by (Research Animal Resources,2009) and 30- 45 reported by Merck Manual (2012). Olalokun and Oyenuga (1975) reported PCV values of 29.5 – 32.8% for white Fulani in Nigeria. Whereas Smith (1959) and Fiennes (1953) reported values of 32.88 – 38.00% for Zebu breed in East Africa. This showed that all of the diets can be fed to the animal without any adverse effect. This result is in agreement with the findings of Lamidi (2005) and Sani et *al*. (2014).

Blood glucose values obtained in this study irrespective of sex, levels of PKC inclusion and sampling intervals fell within the normal range of 3.0-8.3mmol/l (Woodsman and Evans, 1974) and 5.5- 8.3mmol/l reported for healthy cattle by Slanina (1992). The urea values reported at the beginning and middle of this study for both male and female calves at graded levels of PKC fell within the normal range for healthy animals (Mehrez *et al*., 1976) and Woodsman and Evans (1974) which range between 2.5-6.5 mmol/l, while a slightly higher value was reported at the end of the experiment. It also fell within the range reported by Sani et *al*.(2014) when rice offal based diets were fed to bulls.

CONCLUSION

It was concluded from this study that the use of palm kernel cake up to 40% in the diets of weaner calves had no adverse effect on some of their blood profiles. Therefore, it can be utilized by farmers to increase the productivity of their calves.

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