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Rumen Metabolite and Haematological Characteristics of Bunaji Bulls fed Diet Containing Raw or Parboiled Rice Offal as Energy Source.

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Abstract: *A study was conducted to evaluate the effect of feeding raw or parboiled rice offal diet on rumen metabolite and haematological characteristics of bulls.20 Bunaji bulls aged 2-3 years with live weight 210-249kg were allotted to five dietary treatments having Four bulls per treatment in a 2x2 factorial arrangement with a common control. Feeding trials lasted 90 days. Rumen fluid was collected at 0, 2, 4 and 6 hrs intervals to determine the rumen pH, rumen ammonia nitrogen (RAN) and rumen total volatile fatty acid (TVFA) for all the bulls. Blood sample were obtained at the beginning, middle and end of the feeding trial to determine haematological parameters. A concentrate and basal diets of Digitaria smutsii were offered at 2% body weight. The CP contents of the experimental diets vary between 19.69 and 20.44% while the ME ranged from 10.86 to 11.16MJ/kg DM. Rumen parameters were not significantly (P>0.05) affected by rice type but significantly (P<0.05) affected by inclusion level. Rumen pH at 6hrs after feeding at 0% (6.63) and 30% (6.76) were similar (P>0.05), but differed (P<0.05) significantly from 20% (6.93) inclusion level. Bulls on diet containing 20% (44.70 µmol) and 30% (23.49 µmol) inclusion levels had the highest and least TVFA values respectively. Varying inclusion levels of RRO and PRO was not significant (P>0.05) on rumen pH and TVFA at different sampling time. However, significant (P<0.05) difference was observed for RAN at 2hrs post feeding. Bulls on 30% PRO had the highest value (22.41g/100g) while 20% PRO (14.80g/100g) had the least value. Haematological parameters were not significant (P>0.05) with rice offal type. Blood glucose was however significant (P<0.05) at the middle of the experiment with varying level of inclusion. There was no significant (P>0.05) difference for all the haematological parameters measured for Animals on varying levels of inclusion of raw or parboiled rice offal. It was concluded from this study that raw or parboiled rice offal may be used to replace up to 30% of maize offal as source of energy in the diet of Bunaji bulls without any detrimental effect on rumen metabolite and haematological composition of the bulls. Hence it can be adopted by farmers.*

Keyword: *Bunaji bull, haematological composition, rice offal, Rumen metabolite.*

I. Introduction

Cheap and abundant agricultural by- products available to the farmer for fattening include maize stover, maize offal, rice straw, rice bran, wheat offal, sorghum panicle, groundnut haulms amongst others [1]. The utilization of these crop residues and agro-industrial by-products at reasonable cost could enhance production and reduce cost of compounded feeds, without adversely affecting the performance of the animals. This becomes more important considering the high cost and demand for conventional feedstuffs and the competition between man and livestock for the same feed resources [2].

The various blood functions are made obtainable by the individual or collective actions of its constituents such as haematological and biochemical indices. These blood constituents are affected by the quality, quantity and toxicity of the feed taken by the animal [3]. Blood constituents are vital for monitoring flock health, clinical and diagnostic evaluation of various types of diseases in animals [4]. More accurate assessment of nutritional states of cattle can be made using blood metabolite concentrations than from assessment of body weights or condition scores alone. Serum concentrations of metabolites such as glucose, cholesterol, Non-esterified fatty acids, blood urea nitrogen, creatinine, total proteins, albumin, globulin and minerals are commonly used to assess the nutritional status of cattle [5]. Also, Cattle are ungulates with a complex stomach system [6] modified for rumination; they are raised as livestock for meat production, dairy animals for milk production and as draft animals. The rumen is the first and the largest compartment where continuous anaerobic fermentation takes place by a complex consortium of microorganisms [6]. Moreover, rice offal has high content of silica and fiber [7]. It is against this background that this study was undertaken to investigate the effect of utilization of rice milling waste as energy source on the Rumen metabolites and Haematological indices of bunaji bulls.

II. Materials And Methods

Experimental Site

The experiment was conducted in the Experimental pens of the Beef Research Programme of National Animal Production Research Institute, Shika, Zaria, Nigeria. The study area falls within latitudes 11^o to 12^{o}N and longitudes 7^o to 8^{ol}E, with an altitude of 640m above sea level. Shika is located within the Northern Guinea Savannah ecological zone 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.

Feeding Trial

A feeding trial was conducted using 20 Bunaji bulls with a live weight range of 210-249kg and average weight of 220kg with an age range of 2-3 years. The bulls were allotted to five dietary treatments in a 2x2 factorial arrangement with a common control to compare the effect of 2 levels of inclusion (20 and30%) of raw and parboiled rice offal on the fattening performance of Bunaji bulls. In the control diet (NRO), maize offal served as the main energy source and therefore had no rice offal. It contains 60% maize offal, 19.5% cotton seed cake, 19.5% poultry litter, 1% salt. The four test diets designated RRO contain 20 and 30 percent raw rice offal and PRO contain 20 and 30 percent parboiled rice offal. The TDN (%), ME (Kcal/Kg DM) and feed cost per Kg were calculated. There were four animals per treatment; the experimental diets were formulated to be isonitrogenous and isocaloric (Table 1). The trial lasted for 90 days.

Animal Management

The bulls were housed in individual pens and weighed every forth night. They were fed concentrate and hay (Digitaria smutsii) at 2% of their body weight each. The ration was adjusted at regular intervals of 2 weeks along with changes in live weight.

Rumen Fluid Sampling

Rumen fluid samples were collected from the bulls at the end of the feeding trial at 0hr, 2hrs, 4hrs and 6hrs after feeding. About 50mls of the rumen fluid was drawn from two bulls in each treatment using 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 was collected into a plastic bottles containing equal quantity of 0.1N H_2SO_4 to trap ammonia. The samples were frozen until analysed. Rumen ammonia concentration was determined by steam distillation into boric acid and back titrated with 0.01N hydrochloric acid, according to the procedure described by [8]. Rumen pH was determined using Philips digital pH meter (model 9409)

Blood Analysis

About 10mls of blood samples was collected from twenty bunaji bulls at the commencement of the trial, middle and end of the experiment through jugular vein puncture using disposable syringe and sterile 19G needle.5ml of blood was put in vacutainer tubes containing ethylene diaminetetraacetic acid (EDTA) as anti-coagulant to measure packed cell volume. The remaining 5mls of blood samples was collected in plain bottles and analyzed for total protein, blood urea and blood glucose.

Chemical analysis

Analysis of individual feed ingredients (raw and parboiled rice offal, cotton seed cake, poultry litters and hay) and faecal samples were carried out by [9] procedure. Also, Acid Detergent Fiber (ADF) and Neutral Detergent Fiber (NDF) were determined in all the feed ingredients according to [10] at the central laboratory of National Animal Production Research Institute (NAPRI), Shika, Zaria. Metabolizable energy (ME) was determined by equation of [11]. ME (MJ/Kg DM) = 11.78 + 0.0064 CP + $(0.000665EE)^2$ - CF (0.00414EE) - 0.0118A. Where ME = DM = Dry matter, CP = Crude protein, EE = Ether Extract, CF = Crude fiber and A = Ash. Moreover, Silica and other major oxides analysis were carried out for raw and parboiled rice offal (using X-Ray Flourescence (XRF) techniques). Inner electronic structure of atoms was probed. The resultant spectrum generated aided qualitative estimation of elements. Also, a quantitative estimate of chemical elements was established using a duly calibrated method with standard conditions at Multi-User Science Reasearch Laboratory (MUSRL), Ahmadu Bello University, Zaria. The blood sample analysis was done at Ahmadu Bello University teaching hospital. Shika zaria

Data analysis

The data from the fattening trial, rumen metabolite and haematological assessment were analysed using General Linear Model procedure of [12] to see the response of the animals to measured parameters. Significant levels of difference among treatment means was separated using DMRT in the SAS package. The Model used is as follow:

$Y_{ijk} = \mu + P_i + G_j + (PG)_{ij} + E_{ijk}$

Where

Y_{ijk}= k^{th} observation of j^{th} graded level of rice offal inclusion and i^{th} type of rice offal.

μ=overall mean

P_i = effect of i^{th} type of rice offal on performance

G_j = effect of j^{th} graded level of rice offal on performance

$(PG)_{ij}$ = effect of interaction between i^{th} type of rice offal and j^{th} graded level of rice offal inclusion

E_{ijk} = random error .

III. Results And Discussion

Chemical Analysis

Percent and Chemical composition of experimental diets are shown in table 1 and 2 while Mineral content of raw and parboiled rice offal is shown in table 3.

Silica content is very high in both raw (24.86 %) and parboiled rice offal (36.91 %) compared to other oxides (Table 3). Also, peak of silicon is high when compared with other chemical elements (Fig I and 2). Qualitatively, silicon (Si) had the highest peak in with high intensity in parboiled (over 6500 count per seconds-cps) and raw (about 3500 cps) within K_α line energy (1.5-2.0 KeV) for parboiled and K_α to K_β line energy (1.8-3.0 KeV) for raw rice offal (see fig I and 2).

Quantitatively silica is very high for raw (24.86%) and parboiled (36.91%) relative to other mineral elements. [13] noted high silica (17.9%) content from rice hulls.[14] worked on chemical composition of rice polishing from several sources and reported a range (2.5-11% SiO_2). Since rice offal contains approximately 60% hull, 35% bran and 5% polishing (15). Higher content of SiO_2 in present study probably result from SiO_2 contents rice bran.

The calcium (Ca) content of the raw (0.03%) is less than parboiled (0.10%) rice offal. This observation differs from the value for raw (0.09%) and parboiled (0.02%) by [15] where higher Ca content was documented in the raw rice offal. The Phosphorus (P) content of parboiled (0.304%) is greater than raw (0.26%) rice offal. These values are close to contents of raw (0.29%) and parboiled (0.32%) of [15]. These values are lower than those reported by [16] and [17]. Both reported 0.49% P in their samples. Parboiled rice offal gave higher values of Sodium (0.04%), Aluminium (0.004%) than raw with Sodium (0.02%), Aluminium (0.002%) except Magnesium (0.07%-RRO, 0.02%-PRO).

EE normally have an inverse significant correlation with crude fiber, calcium and phosphorus [14]. This trend was confirmed in raw and parboiled rice offal of present study. The EE (15.74%) in raw is higher than parboiled (10.75%) hence an anticipated inverse proportional relationship with CF in raw (33.99%) to parboiled (34.73%), P in raw (0.26%) to parboiled (0.30%) and Ca in raw (0.03%) to parboiled (0.10%) was noted in present study.

Chemical composition of experimental diets

Chemical Composition of concentrate Diets is presented in table 4. The ME of the diets ranged between 10.85 - 11.16MJ/Kg DM. It falls within the range 10 - 11.6MJ/Kg DM recommended for Bulls [18]. The Crude Protein (CP) of the diets range from 22.44% to 19.69%. These fall within the range of (19.00 to 22.91%) reported by [19] but higher than 13% and 13 - 15% reported by [18] and [17] respectively. The CF range between 14.59% to 17.84%. The CF the control diet (NRO) and 30% RRO inclusion were lower than the minimum level of 17% required for beef cattle [20].

The EE of all the diets also exceeded the maximum recommended level of 6% for matured cattle [21]. This increase might have resulted due to the presence of cotton seed cake in all the diets. The high fat level did not have negative effect on the performance of the animals vis a vis feed intake or diarrhoea, this could be due to the type of fats in the diets and the form it was supplied to the animal as similar trend was observed by [22].

Effect of Diet containing Raw and Parboiled Rice Offal on the Rumen Metabolites of Bunaji Bulls.

Figure 3, 4 and 5 shows the effect of Experimental Diets on Rumen Metabolites of Bunaji Bulls. The rumen fluid pH obtained in this study were not significant (P>0.05) based on rice offal type (6.46-7.16), inclusion level (6.46-7.16) and interaction between rice offal type and inclusion level (6.46-7.24) irrespective of sampling time except at 6hrs post feeding which was significant (P<0.05) with inclusion level.

At 0hr the pH of the rumen fluid was slightly above the normal range of 6.0-7.0 [23]. This could be due to conditioned reflex displayed by much salivation into the buccal cavity in expectation of the morning feeding regime. At 2hrs, 4hrs and 6hrs after feeding, the pH values was 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 [23]. This finding is also in agreement with the report of [24] with rumen pH that ranged between 6.49 to 6.67.

The Rumen Ammonia Nitrogen (RAN) obtained in this study were not significant (P>0.05) based on rice offal type (12.31-33.95mg/100ml), inclusion level (10.98-33.95mg/100ml) and interaction between rice offal type and inclusion level (10.93-33.95mg/100ml) irrespective of sampling time except at 6hrs post feeding which was significant (P<0.05) based on interaction between rice offal type and inclusion level. These values are higher than 6.36-21.95 mg/100ml reported by [24] but it is mainly within the normal range of 5-20mg/100ml [25] for optimum RAN level required for maximum rumen function except for the values obtained at 6hrs post feeding which was above this value. The values obtained at 4hrs post feeding fall within the range of 11.42 - 14.43mg/100ml reported by [26] except for 20% parboiled rice offal inclusion which was slightly above this value.

The high values obtained in this study could be due to low fermentable energy content of the diets. It could also be due to the fact that the poultry litter present in the diets is quite soluble in the rumen and rapidly converted to ammonia [27]. However there was no adverse effect on the performance of the animals.

The Total volatile fatty acid (TVFA) obtained in this study were not significant (P>0.05) 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) irrespective of sampling time except at 0hr which was significant (P<0.05) with inclusion level. These concentrations gave an indication of the energy value. 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 [28]. The range of TVFA in this study at 0hr before feeding is within the value of 19.57-36.57Mmol/L reported by [29] when pigeon pea forage was supplemented in sheep diets except for 20% level of inclusion of raw and parboiled rice offal which were higher than these values. All the values obtained in this study is lower than 96.1 - 111.9Mmol/L reported by [26] except for the value of 107.90Mmol/L obtained for animals fed 20% raw rice offal at 4hrs post feeding which fall within this range

It was lowest at 0hr before feeding, then increases at 2hrs post feeding, it reaches its peak at 4hrs after feeding for rice offal type, inclusion level and interaction between rice offal type and inclusion level probably due to increase in digestibility of the feed, then it drastically reduced at 6hrs post feeding. This is in line with observation of [28].

Effect of Experimental Diets on Heamatological Parameters of Bunaji Bulls.

Effect of Experimental Diets on Heamatological Parameters of Bunaji Bulls is represented in fig 6, 7 and 8. There was no significant different (P>0.05) on all the blood parameters measured when raw or parboiled rice offal was fed to the animals (fig 6) and when varying level of rice offal was fed to the animals (Fig 7)except blood glucose which was significant (P<0.05) at the middle of the trial. There was also no significant interaction effect (P>0.05) on most of the blood parameters measured (Fig 8).

The Total Protein (TP) of the experimental animals reported at the start, middle and end of this study all fell within normal range of 60-82 g/L reported by [30]. 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 (Fig 6)except at the end of the experiment at 0% level of inclusion which was slightly above the normal range (Fig 7) when inclusion levels was considered. Also when rice type and inclusion levels was considered TP fall within the normal range except at the end of the experiment at 0% level of inclusion and 20% parboiled rice offal inclusion which was slightly above the normal range (Fig 8)

The Blood Urea for healthy animals has been reported by [31] and [32] to range between 2.5-6.5 mmol/L. The value reported in this study fall within the normal range except for the value of 10.80Mmol/L obtained for animals on raw rice offal diet at the beginning of this trial which exceeded this range. The values obtained at the end of this trial is similar to 4.24-5.56Mmol/L reported by [33] when grass silage supplemented with barley or molasses based supplement were fed (Fig 6).when inclusion level was considered blood urea fall within the normal range except in the middle of the trial at 0 and 30% level of inclusion which fall slightly below this value (Fig 7). However when interaction between rice type and inclusion level was considered the value reported fall within the normal range except for the value of 19.50Mmol/L obtained for animals on 30% raw rice offal diet at the beginning of this trial which exceeded this range. The values obtained in the middle of this trial was lower than the normal range except for animals on 20% raw rice offal diet.

The blood glucose value at the beginning of the trial was below the normal range of 3.0-8.3Mmol/L [32], however the values obtained at the middle of the experiment fall within the normal range. The value at the end of the trial is within the range of 2.11- 2.90 reported by [26]. When inclusion level was considered values obtained at the beginning of the trial were below this range. The value at the end of the trial at 0% and 30%

level of inclusion of rice offal also fall within the range of 2.11- 2.90 reported by [26] (Fig7) When interaction was considered, 20% raw and parboiled rice offal fall within the normal range given by [32] (Fig 8).

The Packed Cell Volume of experimental animals reported at the start, middle and end of this study all fell within normal range (24-46 %) reported for healthy cattle[34, 35].[36] reported PCV values of 29.5 – 32.8% for white Fulani in Nigeria. Whereas [37] and [38] reported values of 32.88 – 38.00% for Xebu breed in East Africa. when rice type, inclusion level and interaction between rice type and inclusion level were considered(Fig 6,7 and 8).It shows that all of the diets can be fed to the animal without adverse effect. This result is in agreement with the finding of [24].

IV. Conclusion

It was concluded from this study that the use of raw or parboiled rice offal in Bunaji bull diets had no adverse effect on their rumen metabolite and haematological composition. Therefore, it can be utilized by farmers for increased productivity.

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References

[1]. Lamidi, O.S., Adeyinka, I.A., Alawa, C.B.I., Balogun, A. R. and Barje, P.P. (2008). Survey of Dry season feed Resources for smallholder fattening schemes in Northern Nigeria. Asian Journal of Animal and Veterinary Advances 3(2): 92-97.
[2]. Iyeghe-Erakpotobor, G.T., Otchere, E.O., Tegbe, T.S.B., Jegede, J.O. and Abeke, F.O. (2002). A Review of some Agroindustrial by-products in the nutrition of pigs. National Animal Production Research Institute Ahmadu Bello University Shika-Zaria, Nigeria.
[3]. Roberts, K.M., Daryl K.G., Peter, A.M., Victor, W.R (2003). Harper's Biochemistry 25th edition Mc. Graw Hill New York 763-765.
[4]. Taiwo, V.O and Anosa, V.O (1995). Fabrinogen, Leucocyte and Heamatoligical Values for cattle with various disease conditions. Tropical Vet. 13 (182): 51-57.
[5]. Ndlovu, T., Chimonyo, M., Okoh, A.I., Muchenje, V., Dzama, K and Raats, J.G (2007). Assessing the nutritional status of beef cattle: current practices and future prospects. African Journal of Biotechnology Vol. 6 (24): 2727-2734.
[6]. Kudo, H., Abdullah, N., Ho, Y. W., Jalaludin, S., Hawa, I. and Fukuta K. (1995). Behaviour and Reproduction of Captive Lesser Mouse Deer (Tragulus javanicus). Malays. Journal of Animal Science, 1: 24-28.
[7]. Dafwang, I.I. (2006). Meat, milk and eggs from farm wastes: Explorations in animal nutrition research and extension. An inaugural lecture. A publication of the University organized lectures committee, Vice chancellor's office, ABU, Zaria, pp:73.
[8]. Whitehead, R., Cooke, G.H.,Chapman.B.T.(1976). Automation in analytical chemistry technicon syrup. Vol.2,Pg 377.basingstoke intants, Technicon instruments company limited.
[9]. AOAC. (2000). Official method of Analysis. Association of Official Analytical Chemists. Official Methods of Analysis, Washington, DC.
[10]. Van Soest, J.P. (1991). The use of detergents in the analysis of fibrous feeds. Determination of plant constituents. Journal Association of Agricultural Chemistry.50:50-55.
[11]. Alderman, G. and Cottrill, B.R. (1985). Energy and protein requirements of ruminants. An advisory manual prepared by the AFRC Technical Committee on Responses to Nutrients. Wallingford, UK, CAB International.
[12]. SAS (2002). INSTITUTE inc. SAS/STAT user's guide. 6.03 Edition, Gray NC, USA
[13]. Valchev, L., Lasheva, T. and Josifov, N. (2009): Silica Products from Rice Hulls, Journal of the University of Chemical Technology and Metallugy, 44(3), 257-261.
[14]. Ambreen, N., Hanif, N.Q and Khatoon, A (2006). Chemical Composition Of Rice Polishing from Different Sources. Pakistan Veterinary Journal, 26: 190-192.
[15]. Duru, S. (2010). Evaluation of three types of rice offal in broiler diets Ph.D Thesis. Department of Animal Science Ahmadu Bello University, Zaria. Nigeria.
[16]. Obeka, E.A. (1985). Nutritive Evaluation of Rice offal in the diets of growing pullet and Layers.M. Sc. Thesis, Department of Animal Science, Ahmadu Bello University, Zaria.
[17]. Aduku, A.O. (1993). Tropical feedstuffs analysis table. Department of Animal Science. Faculty of Agriculture, Ahmadu Bello University, Zaria. Pp. 196.
[18]. Rutherglen, D.C. (1995). Energy and Protien Requirements of Beef cattle. Victoria State Government Agricultural Notes. AG0374 ISSN 1329-8062.
[19]. Lamidi, O.S., Adamu, A.M., Ehoche, O.W. and Alawa J.P. (2007). Replacement value of Sun-dried broiler litter for cotton seed cake in the fattening diets for Bunaji bulls. Journal of Animal Production Research 20(1&2):99-112.
[20]. NRC (National Research Council), (2000). Nutrient Requirements of Beef Cattle. 7th Revised Edition. National Academic, Press,Washington, DC, USA. Retrieved on 25th August, 2009 from http://www.nap.edu/books/0309069343/html
[21]. Parish, J.A. and Rhinehart, J.D. (2008). Energy in Beef Cattle Diets.Mississipi Agricultural and Forestry Experiment Station. Retrieved on 12th September, 2010 from wwwthecattlesite.com/articles/1653/energy in beef cattle diets
[22]. Idowu, O.O. (2011) Comparative Evaluation of some cereal by- product as energy source for fattening beef cattle. M.Sc. Thesis submitted to Animal Science Department, Ahmadu Bello University Zaria, Nigeria.
[23]. Mould, F. L. and Orskov, E. R. (1984). Manipulation of rumen fluid PH and its influence on cellulosis in in sacco DM degradability and the rumen micro flora of sheep offered either hay or concentrate. Animal Feed Science and Technology. 16:1-14.
[24]. Lamidi, O.S. (2005). The use of some conventional non protein sources for fattening cattle. Ph.D. Thesis. Department of Animal Science, Ahmadu Bello University, Zaria, Nigeria.
[25]. Leng, R.A. and Nolan, J.V. (1984). Nitrogen metabolism in the rumen. Journal of Dairy Science. 67:1072-1089.
[26]. Jonas, J and Vilma, B. (2007): Effect of L. Plantarum, Pediococcus Acidilactici, Enterococcus Faecium and L. Lactis microbial supplementation of grass silage on the fermentation characteristics in rumen of Diary Cows. Veterinarija Ir Zootechnika T. 40 (62). 29 pts@lgi.lt

[27]. Wohlt, J. E., Sniffens, C. J., Hoover, W. H., Johnson, L. L. and Walker, C. K. (1976).Nitrogen metabolism in wethers as affected by dietary protein solubility and amino acid profile Journal of Animal Science. 42:1280-1286
[28]. Stewart, W. E., Daryl G. Stewart and Schultz, L. H (1958). Rates of volatile fatty acid production in the bovine rumen. Journal of Animal Science. Volume 17, Number 3 pages 723-736.
[29]. Jokthan, G. E. (2006). Effect of supplementing rice straw with pigeon pea forage on performance of Yankasa sheep. PhD Dissertation. Department of Animal Science, Ahmadu Bello University, Zaria, Nigeria152 pp,
[30]. Gleghorn, J. F., Elam, N. A., Galyean, M. L., Duff, G. C., Cole, N. A. and Rivera, J. D. (2004). Effect of crude protein concentration and degradability on performance, carcass characteristics and serum urea nitrogen concentrations in finishing steers. Journal of Animal Science, 82: 2705-2707
[31]. Mehrez, A. Z., Orskov, E. R. and McDonald, I. (1976). Rate of rumen fermentation in relation to ammonia concentration. British Journal of Nutrition. 28: 437-443.
[32]. Woodman, H.E. and Evans, R.E. (1974). The nutritive value of fodder cellulose when fed to ruminants and pigs. Agricultural Science. xxxvii 202-223.
[33]. Moloney, A.P., Almiladi, A.A., Drennan, M.J. and Galfrey, P.J. (1994). Rumen and blood variables in steers fed grass silage and rolled barley or sugar cane molasses-based supplementation. Animal Feed Sciences and Technology. 50:37-54.
[34]. Coppock, C.E. and D.L. Wilks. (1991). Feeding whole cottonseed and cottonseed meal to Dairy and beef cattle. Proc. Alternative Feeds for Dairy and Beef Cattle, Natl. Invit. Symp., St. Louis, MO (Jordan, E.R., Ed.). pp. 43-48. Columbia, MO: Coop. Ext., Univ. of Missouri.
[35]. Oyedipe, E.O., Saror, D., Osori, D.I.K. and Akerejola, O. (1985). Haematological parameter of zebu cattle on different protein levels and their relationships to rate of gain. Bulletin of Animal Health and Production in Africa. 32 (2): 129-139.
[36]. Olalokun, E.A. and Oyenuga, V.A. (1975). Observations on the White Fulani (Bunaji) Zebu cattle of Northern Nigeria in Southern Nigeria Environment., Blood values in relation to stage of lactation, milk production and nutrient intake of cows at Ibadan. Ghana Journalof Agricultural Science. 8: 37-43.
[37]. Smith, I.M. (1959). The blood picture of normal Zebu in Uganda. British Veterinary Journal.115: 89 -96.
[38]. Fiennes, R. N. T. W. (1953). The therapeutic and prophylactic of antrycide in trypanosomiasis of cattle. British Veterinary Journal.109:330-344
[39]. Woodman, H.E. and Evans, R.E. (1974). The nutritive value of fodder cellulose when fed to ruminants and pigs. Agricultural Science. xxxvii 202-223.

Tables

Table 1: Percentage feed composition of experimental diet.

	Inclusion level				
Ingredient %	0	20RRO	30RRO	20PRO	30PRO
Maize offal	60	45	39	45.0	39.0
Rice offal	0	12	18	12	18
Cotton seed cake	19.5	24.9	29.7	24.0	29.0
Poultry litter	19.5	17.6	12.8	18.5	13.4
Salt	1	1	1	1	1
Total	100.0	100.0	100.0	100.0	100.0
Calculated analysis					
Crude protein(%)	15.16	15.15	15.11	15.17	15.15
TDN(%)	71.73	66.85	64.56	62.84	58.52
ME(Kcal/Kg DM)	2238	2090	2045	2145	2129
Feed cost (₦/Kg)	42.62	40.34	40.48	40.31	40.71

TDN = Total digestible nutrient, ME = Metabolizable, RRO = Raw rice offal,
PRO = Parboiled rice offal.

Table 2 Chemical composition of individual feed ingredient and hay.

	Ingredient					
Parameters	D. smutsii	MO	CSC	LL	RRO	PRO
Dry matter	93.10	89.46	89.94	93.11	91.34	93.36
Crude protein	8.06	11.88	23.69	19.00	7.69	4.38
Crude fibre	41.28	8.28	38.49	24.91	33.99	34.73
Ether extract	8.39	16.07	17.84	8.63	15.74	10.75
Ash	9.95	5.41	3.87	21.28	14.4	24.21
Acid detergent fibre	50.59	10.33	47.31	42.45	46.85	55.12
Neutral detergent fibre	63.42	21.61	55.37	60.15	53.49	61.22
Hemicellulose	12.83	11.28	8.06	17.7	6.64	6.10
Metabolizable energy(MJ/KgDM)	10.52	11.37	9.14	11.27	9.76	10.57

CSC = Cotton seed cake, MO = Maize offal, LL = Layer litter, RRO = Raw rice offal, PRO = Parboiled rice offal, D.smutsii = Digitaria smutsii. ME for the feed ingredients was determined by 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 = DM = Dry matter, CP = Crude protein, EE = Ether Extract, CF = Crude fiber and A = Ash.

Table 3: Mineral composition of raw and parboiled rice offal

Analyte	Raw rice offal (%)	Parboiled rice offal (%)
SiO_2	24.860	36.910
Na_2O	0.023	0.057
CaO	0.141	0.043
MgO	0.118	0.040
Al_2O_3	0.004	0.008
P_2O_5	0.337	0.393

Table 4 Chemical compositions of concentrate diets containing varying levels of raw and parboiled rice offal fed to fattened Bunaji Bulls.

	Level of inclusion				
Parameters	0	20RRO	30RRO	20PRO	30PRO
Dry matter	90.05	89.77	88.77	89.85	89.17
Crude protein	19.94	19.69	22.44	21.38	20.56
Crude fibre	14.59	17.84	14.91	16.77	17.40
Ether extract	16.28	16.21	14.22	17.05	16.22
Ash	10.19	13.02	9.81	10.74	9.12
Acid detergent fibre (ADF)	20.56	21.89	21.32	24.13	21.09
Neutral detergent fibre (NDF)	36.44	40.81	39.87	43.96	42.41
Hemicellulose	15.88	18.92	18.50	19.83	19.32
Metabolizable energy(MJ/KgDM)	11.05	10.87	11.16	10.86	10.85

RRO = Raw rice offal, PRO = Parboiled rice offal, ME for the feed ingredients was determined by 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 = DM = Dry matter, CP = Crude protein, EE = Ether Extract, CF = Crude fiber and A = Ash.

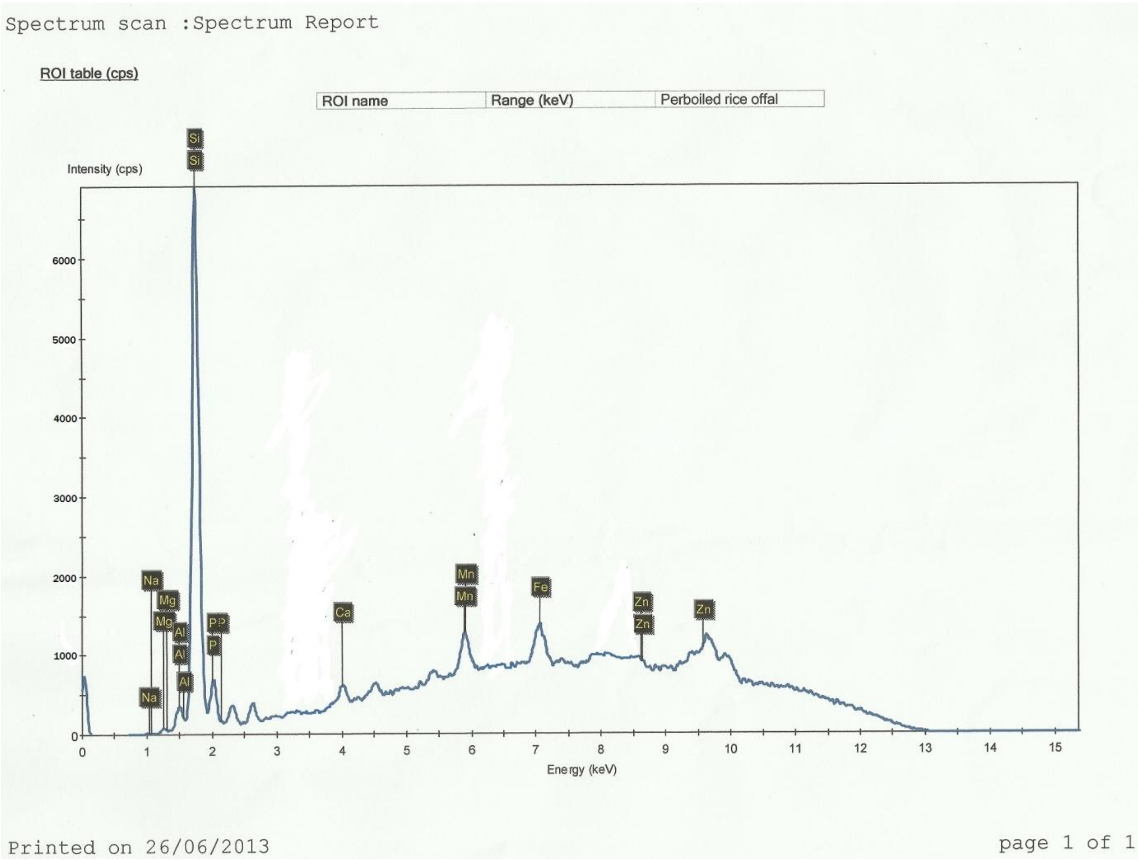

Fig 1: Spectrum of mineral elements in Parboiled rice offal. Silicon had the highest peak and intensity (cps) with K_α line energy.

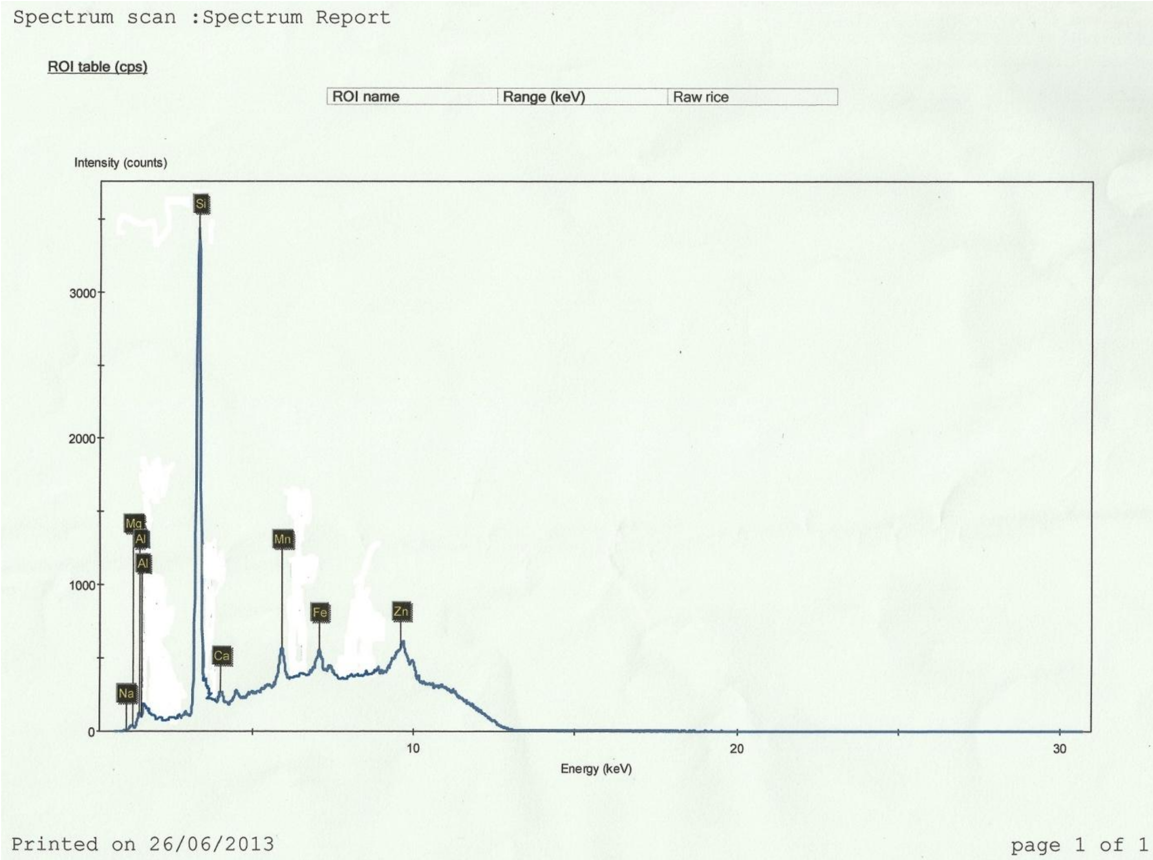

Fig 2: Spectrum of mineral elements in Parboiled rice offal. Silicon had the highest peak and intensity (cps) with $K_{\alpha} - K_{\beta}$ line energy.

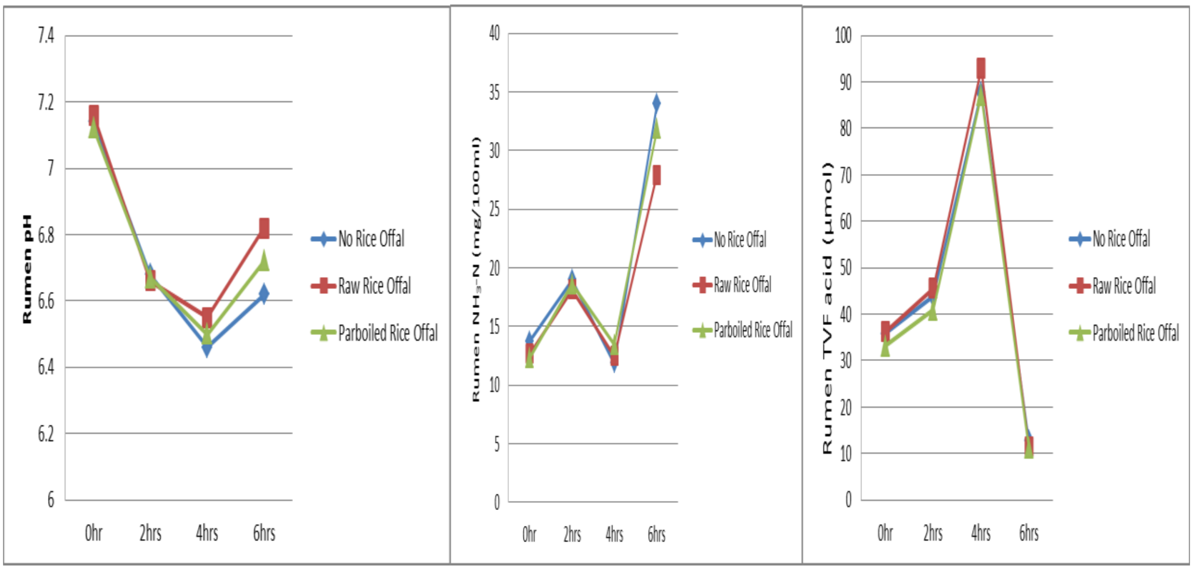

Fig. 3: Effect of feeding diet containing raw or parboiled rice offal on rumen pH, rumen ammonia nitrogen and rumen total volatile fatty acid of fattened Bunaji bulls

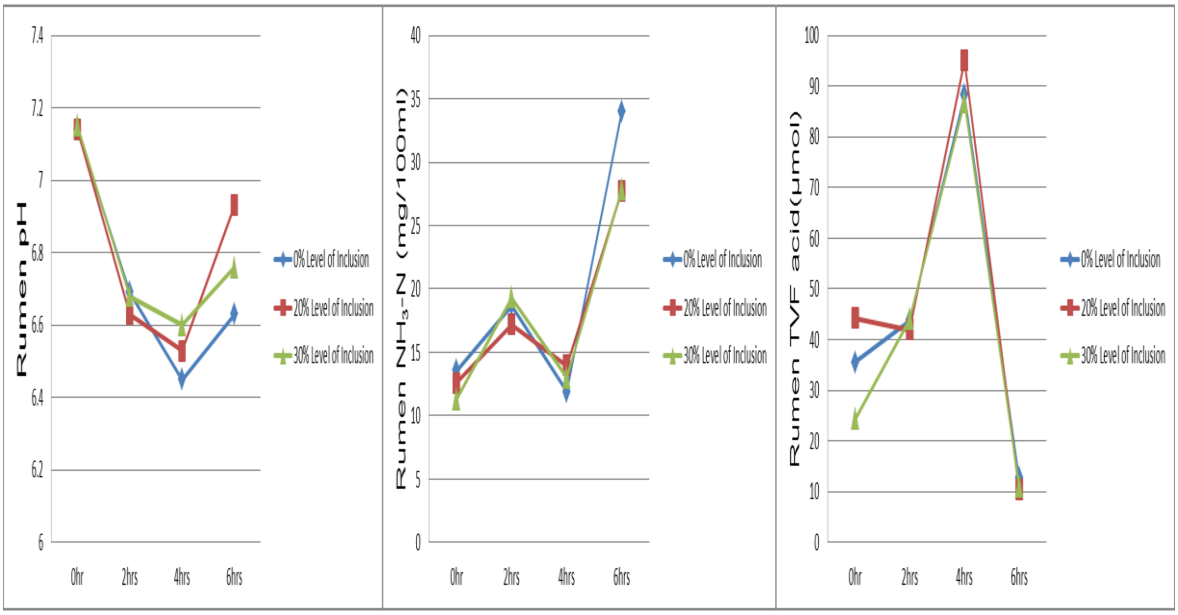

Fig.4: Effect of feeding diet containing varying levels of rice offal on Rumen pH, Rumen ammonia nitrogen and Rumen total volatile fatty acid of fattened Bunaji bulls.

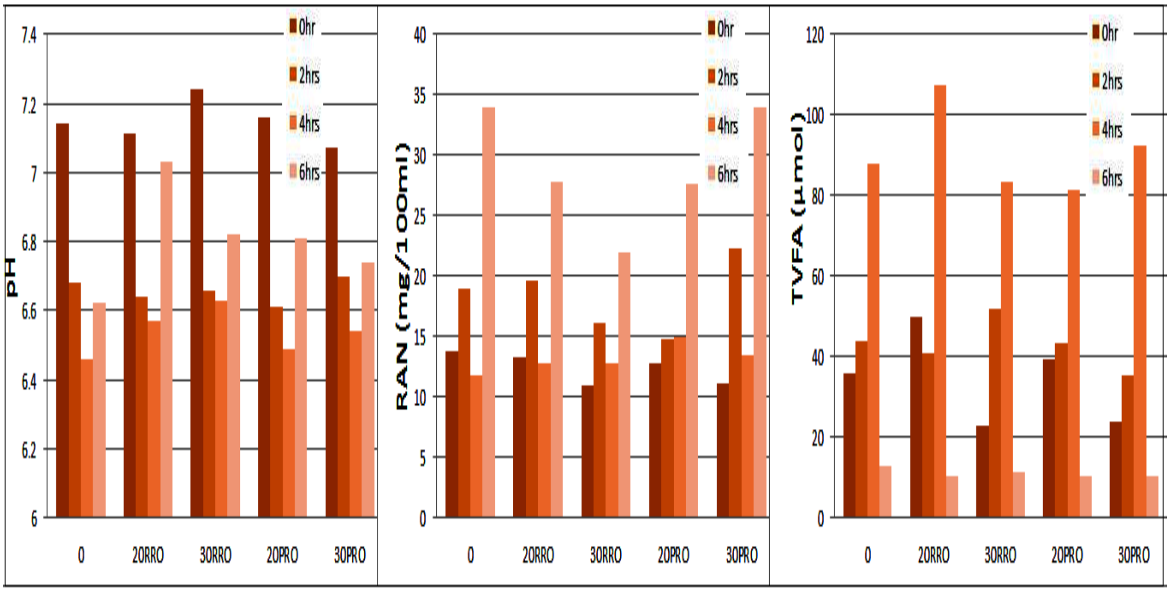

Fig. 5: Effect of type and level of inclusion of raw or parboiled rice offal on Rumen pH, Rumen ammonia nitrogen and Rumen total volatile fatty acid of fattened Bunaji bulls.

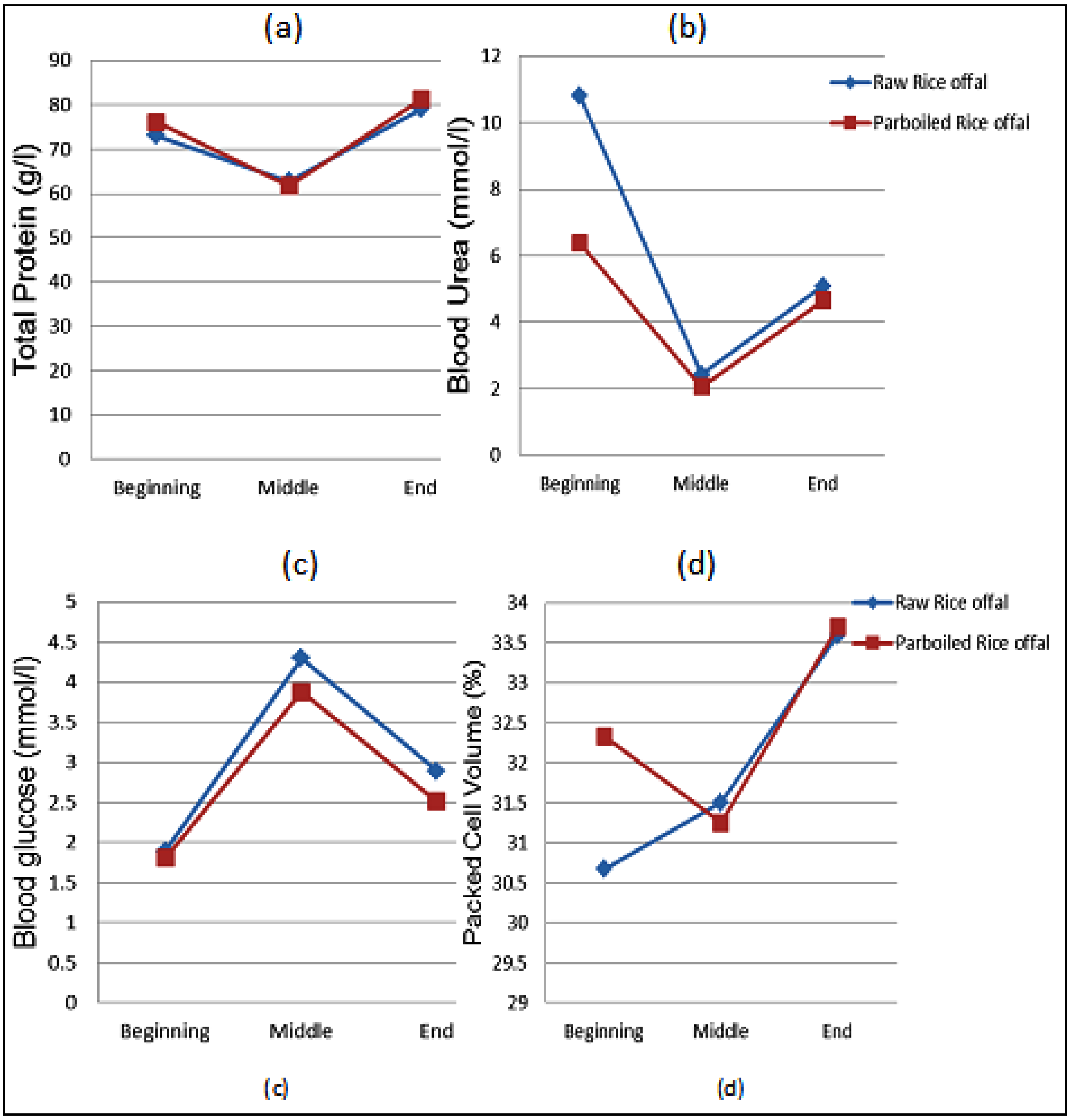

Fig. 6: Effect of feeding diet containing raw or parboiled rice offal on Haematological parameters [(a) Total protein (b) Blood urea (c) Blood glucose (d) Packed cell volume] of fattened Bunaji Bulls at the beginning, middle and end of experiment.

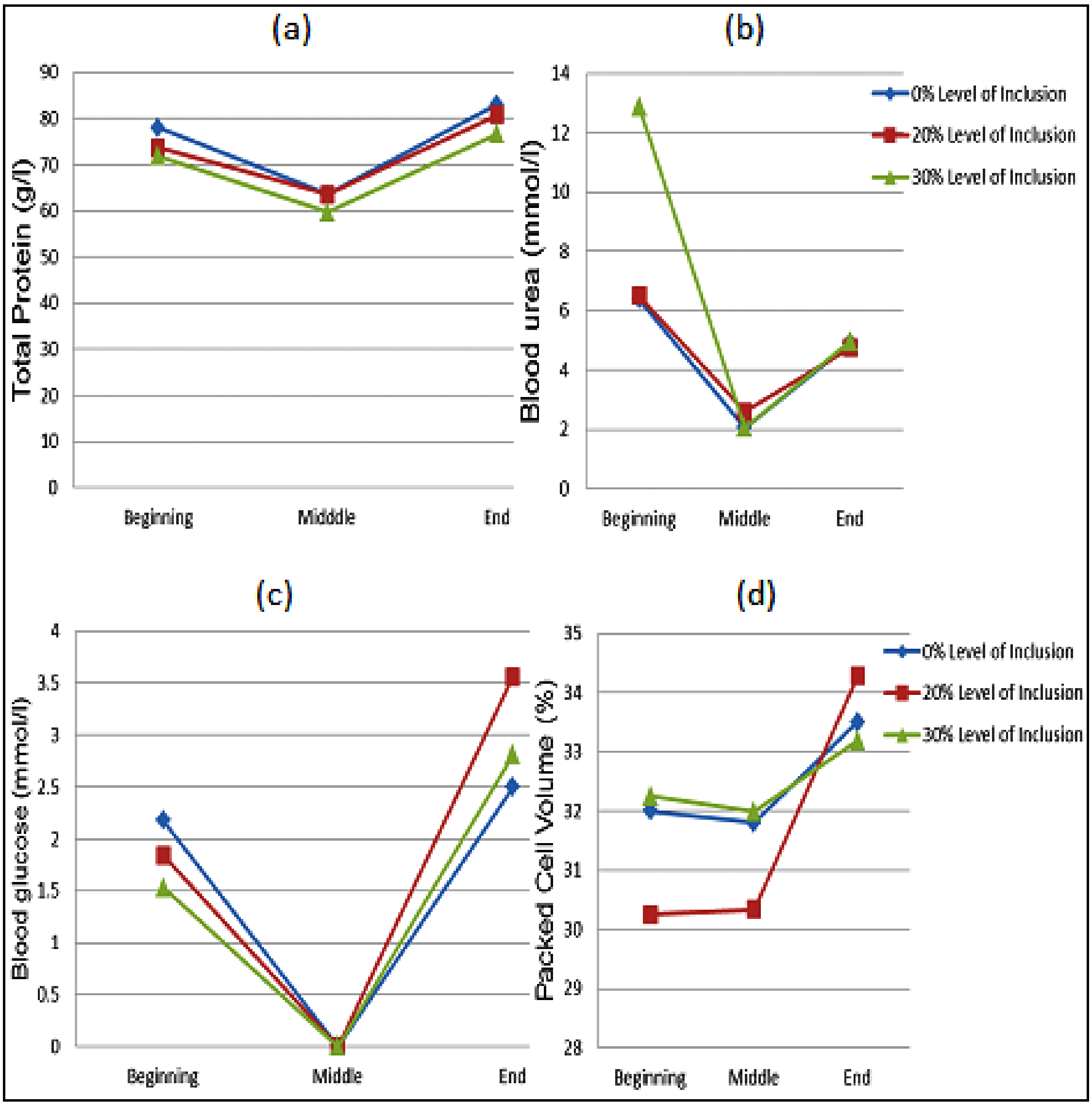

Fig. 7: Effect of feeding diet containing varying levels rice offal on Haematological Parameters [(a) Total protein (b) Blood urea (c) Blood glucose (d) Packed cell volume] of fattened Bunaji Bulls at the beginning, middle and end of experiment.

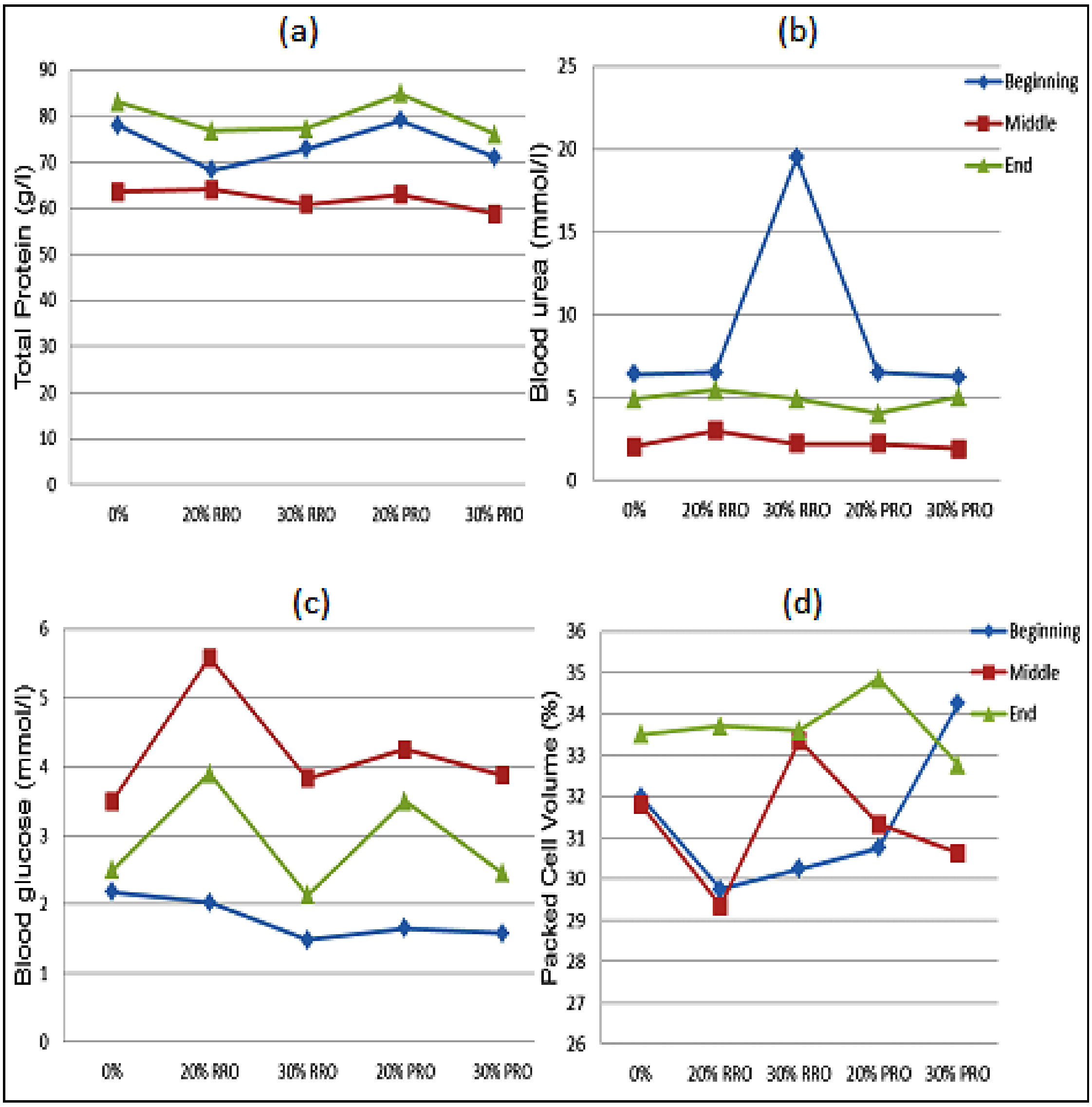

Fig. 8: Effect of type and level of inclusion of raw or parboiled rice offal on Haematological Parameters [(a) Total protein (b) Blood urea (c) Blood glucose (d) Packed cell volume] of fattened Bunaji Bulls at the beginning, middle and end of experiment.