

Evaluation of rice offal as energy source for fattening Bunaji bullsSani^{1*}, R.T., Lamidi¹, O.S. and Jokhtan², G.E.¹ National Animal Production Research Institute, Ahmadu Bello University, Shika - Zaria.²National Open University of Nigeria, Kaduna State.* geowife4life@gmail.com Tel :+2348038008759**Abstract**

A study was conducted using 20 Bunaji bulls with a live weight range of 210-249kg and age range of 2-3 years to evaluate the feeding value of raw or parboiled rice offal as energy source for bull fattening. Four bulls per treatment were allotted to five dietary treatments in a 2x2 factorial arrangement with a common control. Feeding trials was conducted for 90 days. A concentrate and basal diets of *Digitaria smutsii* were offered at 2% body weight. The proximate and mineral composition of the feed ingredients showed that raw rice offal (RRO) had 7.69% CP, 6.64% hemicellulose and 24.86% silica while parboiled rice offal had (PRO) 4.38% CP, 6.10% hemicellulose and 36.91% silica. 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. The crude fibre varies from 14.59 to 17.84%. The result of the fattening trial showed that there was no significant ($P>0.05$) difference in concentrate, hay, total dry matter intakes and daily weight gain of bulls fed the control diet (NRO) and diets containing RRO and PRO. Inclusion level of rice offal had no significant effect ($P>0.05$) on intake of concentrate, hay and total feed intake. However, live weight gain of the bulls on the control diet was significantly ($P<0.05$) higher than bulls on 20 and 30% rice offal inclusion. The intake of concentrate, hay, total feed and daily live weight gain of the bulls were similar ($P>0.05$) irrespective of type and inclusion levels of the rice offal. All the bulls experimented attained an average weight gain of between 1.11Kg to 1.29Kg which was above 1Kg. Economic parameters such as cost per Kg gain, net benefit (NB) and return to naira invested on feed (RIF) were similar ($P>0.05$) for bulls on both RRO and PRO. There was no significant ($P>0.05$) differences in the Value of weight gain (VWG), NB, RIF, Cost of feed and Cost per Kg gain for bulls on varying levels of inclusion of RRO or PRO. The inclusion of raw rice offal or parboiled rice offal lead to reduction in feed cost from N25,001.10 to a range of N22,115.50-N23,639.6 (about 5.45%-11.54% reduction in feed cost). It was concluded from this trial that rice offal of all kind (raw or parboiled) may be used to replace up to 30% of maize offal as source of energy in the fattening diet of Bunaji bulls without any detrimental effect on live weight. Hence it can be adopted by farmers.

Keyword: Bunaji bulls, energy, intake, rice offal, weight gain

Introduction

Nigeria's cattle population is put at 20 million (FAO, 2013). The breed mostly fattened by small holder cattle fattening operation is the white Fulani which constitute about 60% (Alawa *et al.*,

2007). This breed is reported to have a higher dressing percentage when compared with other indigenous breeds of cattle (Adamu and Alawa, 2005). Bunaji is the most numerous and widely distributed breed of cattle in Nigeria (Ahamefule *et al.*, 2007) representing

about 51% of the national cattle population (Ikhatua, 2010) owned mainly by the nomadic fulani people.

Cattle fattening is not a new practice in Nigeria and has gained prominence as an important business in the livestock industry. It gives the farmer year round employment which provides him extra income and also provides a fast source of meat to meet the high demand for high quality protein needed in human diet.

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 (Lamidi *et al.*, 2008). Research efforts have been directed towards harnessing and enhancing the utilization of these abundant agricultural by-products and crop residues in the northern region for livestock feeding. 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 (Iyeghe Erakpotobor *et al.*, 2002).

There is need therefore, to evaluate alternate source of cereal by product that is cheaper in price and abundant compared to maize offal for use as energy source for beef cattle fattening. One of such alternative energy source and by product is rice offal. There is tendency that these by-product will be more available in future through the recent Presidential initiative on rice production in Nigeria which is aimed at encouraging local rice production in order to reduce over-dependence of the country

on imported rice (James, 2011)

Rice offal is an agro-industrial by-product that could contribute to livestock feeding. It is available in large quantities all year round in many towns and villages in the rice growing areas of Nigeria. It is a by-product of one step milling process of paddy rice which produces only two products; the rice seeds ready for human consumption and the waste product which is made up of rice husk, rice bran, rice polishing and small quantities of broken grains; it also has high content of silica and fibre (Dafwang, 2006). In Nigeria, the bulk of rice produced is being processed by small milling machines which produce large quantities of rice offal which until early 1990's were often burnt off to reduce waste pollution (Dafwang and Damang, 1996). Nigeria production of paddy rice is estimated 4,700,000 tonnes (FAO, 2013). The study was carried out to evaluate the performance of Bunaji bulls fattened on diet containing raw or parboiled rice offal.

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 11°13'10.1" to 11°13'17.0"N and longitudes 7°33'28.2" to 7°33'29.5"E, with an altitude of 645m above sea level (Google Earth, 2015). 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 ranges from 27-35°C depending on the season, while the mean relative humidity during the harmattan and wet seasons are 21%-72%, respectively (Ovimap, 2015).

Fattening Trial

A fattening 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 and 30%) 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 contain 20 and 30 % raw rice offal (RRO) and 20 and 30 % parboiled rice offal (PRO). 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 fourth night. They were fed concentrate and hay (*Digitaria smutsii*) at 2% of their body weight respectively. The ration was adjusted at regular intervals of 2 weeks along with changes in live weight.

Source of Test Ingredient

Parboiled and raw rice offal used for this experiment was sourced from a commercial rice mills at Kura in Kano State. The rice offal were sampled and analysed for proximate, fibre and mineral analysis (Tables 2 and 3).

Data Collection

Parameters measured include: Initial body weight, Final body weight, Weight gain (final body weight – initial body weight), Feed intake (feed offered – left over feed),

Water intake [water offered –(left over water +water loss due to evaporation)], Feed to gain ratio, Feed cost per Kg gain.

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 AOAC (2000) procedure. Also, Acid Detergent Fiber (ADF) and Neutral Detergent Fiber (NDF) were determined in all the feed ingredients according to van Soest et al. (1991) at the Central laboratory of National Animal Production Research Institute (NAPRI), Shika, Zaria. Metabolizable energy (ME) was determined by equation of Alderman and Cottrill (1985) as: $ME (MJ/Kg DM) = 11.78 + 0.0064 CP + (0.000665EE)^2 - CF (0.00414EE) - 0.0118A$. Where ME = Metabolizable energy, DM = Dry matter, CP = Crude protein, EE = Ether Extract, CF = Crude fiber and A = Ash. Silica (SiO₂), sodium oxide (Na₂O), calcium oxide (CaO), Magnesium oxide (MgO), Aluminium oxide (Al₂O₃), phosphorus oxide (P₂O₃) analysis were carried out for raw and parboiled rice offal using X-Ray Fluorescence (XRF) techniques. The primary incident x-ray of sufficient energy excites elements in the pelletized rice offal samples. The resultant spectrum generated from detector counts of secondary fluorescence x-ray aided qualitative estimation of elements. A quantitative estimate of chemical elements was established using a duly calibrated method with standard conditions at Multi-User Science Research Laboratory (MUSRL), Ahmadu Bello University, Zaria.

Marginal cost analysis

The market price of the various feed ingredients as at the time of this study was used to compute the total cost of feed consumed within the fattening period and

Table 1: Ingredient composition (%) of experimental concentrate diets.

Ingredient	Inclusion levels of rice offals				
	0	20RRO	30RRO	20PRO	30PRO
Maize offal	60.00	45.00	39.00	45.00	39.00
Rice offal	0.00	12.00	18.00	12.00	18.00
Cotton seed cake	19.50	24.90	29.70	24.00	29.00
Poultry litter	19.50	17.60	12.80	18.50	13.40
Salt	1.00	1.00	1.00	1.00	1.00
Total	100.00	100.00	100.00	100.00	100.00
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

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

Table 2 Chemical composition (%) of feed ingredients and hay.

Parameters	Feed Ingredients					
	<i>D. smutsii</i>	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	14.40	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

Parameters	Raw rice offal (%)	Parboiled rice offal (%)
SiO ₂	24.860	36.910
Na ₂ O	0.023	0.057
CaO	0.141	0.043
MgO	0.118	0.040
Al ₂ O ₃	0.004	0.008
P ₂ O ₅	0.337	0.393

feed cost per Kilogram weight gain. This was used to determine how profitable or otherwise it was to fatten bulls with or without raw or parboiled rice offal as an energy source at various levels.

Data analysis

The data from the fattening trial was analysed using General Linear Model procedure of SAS (2002) to see the response of the animals to measured parameters. Significant levels of difference among treatment means was separated using Duncan multiple range test of 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.

Results and Discussion

Chemical compositions of the feed ingredients are presented in Table 2. The crude fibre (CF) content of RRO (33.99%) and PRO (34.73%) obtained in this study is close to 35.24% CF for RRO but lower than 42.48% CF for PRO (Duru, 2010). The dry matter (DM) content 91.34% for raw rice offal is lower than value (94.94%) reported by Duru (2010) for RRO. However, the DM of 93.36% for PRO is similar to 93.48% reported by Duru (2010) for PRO. The metabolizable energy (ME) of present study are generally higher for raw (9.76 MJ/Kg) and parboiled (10.59 MJ/Kg) rice offal than those reported by Duru (2010) for raw (8.92 MJ/Kg) and parboiled (7.56 MJ/Kg) rice offal.

The differences observed in the proximate

value obtained in this study relative to previous studies could be primarily due lack of clear distinction between rice milling waste varieties. It may also result from differences in seasons, processing methods; proportion of broken grains in samples utilized and soil condition of rice crops.

Table 3 shows the mineral content of raw and parboiled rice offal. Silica is very high for raw (24.86%) and parboiled (36.91%) relative to other mineral elements. Valchev *et al.*, (2009) noted high silica (17.9%) content from rice hulls. Ambreen *et al.*, (2006) 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 (Duru, 2010), higher content of SiO_2 in present study probably result from SiO_2 contents in rice bran. The calcium (Ca) content of the raw (0.10%) is higher than parboiled (0.03%) rice offal. This observation is similar to the value for raw (0.09%) and parboiled (0.02%) by Duru (2010) where higher Ca content was documented in the raw rice offal. The Phosphorus (P) content of parboiled (0.17%) is greater than raw (0.15%) rice offal. These values are lower than (0.29%) raw and parboiled (0.32%) reported by Duru (2010). Also, they are lower than those reported by Obeka (1985) and Aduku (1993). Both reported 0.49% P in their samples.

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 (Rutherglen, 1995). The Crude Protein (CP) of the diets range from 19.69% to 22.44% . These fall within the range of (19.00 to 22.91%) reported by Lamidi *et al.* (2007). It is also similar to 19.63% reported by Madziga *et*

Table 4 Chemical compositions (%) of concentrate diets containing varying levels of raw or parboiled rice offal fed to fattening Bunaji bulls.

Parameters	Level of inclusion of rice offals (%)				
	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/Kg DM)	11.05	10.87	11.16	10.86	10.85

RRO = Raw rice offal, PRO = Parboiled rice offal, ME was determined by equation of Alderman and Cottrell, 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.

al. (2013) but higher than 13% and 13 - 15% reported by Rutherglen (1995) and Aduku (2005) respectively. The CF range between 14.59% to 17.84%. The CF of the control diet (NRO) and 30% RRO inclusion were lower than the minimum level of 17% required for beef cattle (NRC, 2000).

Interactive effects of diets containing raw or parboiled rice offal on fattening performance of Bunaji bulls are presented in Tables 5, 6 and 7. There was no significant ($P>0.05$) difference on the performance of bulls based on rice type, inclusion level and interaction between type and inclusion level except average weight gain (AWG) which was significant ($P<0.05$) with inclusion level.

The average daily weight gain obtained in the present study irrespective of rice type (1.17-1.29Kg/day), inclusion level (1.14-1.29Kg/day) and interaction between type and inclusion (1.11-1.29Kg/day) is higher than those obtained in earlier studies reported by Olayiwole *et al.* (1981) 0.86 Kg/day, Ikhatua and Olayiwole (1982) 1.07

Kg/day, Scarr (1986) 0.5 Kg/day, Lamidi *et al.* (2007) 0.69-0.91 Kg/day, Idowu (2011) 0.4-0.66 Kg/day and Madziga *et al.* (2013) 0.96-1.01 Kg/day. Higher values obtained could probably be due to differences in experimental diets, age and live weight of the experimental bulls.

Feed Efficiency (FE) based on rice type (6.26-6.67), inclusion level (6.26-6.72) and interaction between rice type and inclusion level (6.26-6.93) obtained in this study is superior to 9.03-12.05, 13.71-22.4 and 9.04-9.55 reported by Lamidi (2005), Idowu (2011) and Madziga *et al.* (2013) respectively. This could probably be as a result of differences in experimental diets, age and live weight of the experimental Animal.

Marginal cost evaluation of feeding RRO and PRO to Bunaji bulls are presented in Tables 8, 9 and 10. Feed account for 70-80% of the total cost of fattening bulls (Lamidi, 2005) and since feed cost was the major cost monitored during the study; the economic returns were based on this. The

Table 5: Effect of feeding diets containing raw or parboiled rice offal on performance of fattening Bunaji bulls.

Parameters	Type of rice offal			SEM	LOS
	NRO	RRO	PRO		
Initial weight (Kg)	205.25	202.00	202.66	8.371	NS
Final weight (Kg)	321.25	311.17	308.17	10.66	NS
Average Concentrate intake (Kg/day)	5.21	5.13	4.97	0.153	NS
Average Hay intake (Kg/day)	3.59	3.47	3.52	0.128	NS
Total feed intake (Kg/day)	8.80	8.60	8.49	0.275	NS
Average DM intake (Kg/day)	8.05	7.79	7.70	0.250	NS
Average weight gain (Kg/day)	1.29	1.21	1.17	0.037	NS
Feed Efficiency	6.26	6.46	6.67	0.199	NS

NRO = No rice offal, RRO = Raw rice offal, RRO = Raw rice offal, PRO = Parboiled rice offal, SEM = Standard error of mean, LOS = Level of significance * = P<0.05, NS = Not significant (P>0.05)

Table 6: Effect of feeding diets containing varying levels of raw or parboiled rice offal on performance of fattening Bunaji bulls.

Parameters	Levels of inclusion of rice offal			SEM	LOS
	0	20	30		
Initial weight (Kg)	205.25	203.75	198.00	10.253	NS
Final weight (Kg)	321.25	307.50	300.25	13.058	NS
Average concentrate intake (Kg/day)	5.21	4.78	4.94	0.215	NS
Average hay intake (Kg/day)	3.59	3.43	3.46	0.157	NS
Total feed intake (Kg/day)	8.80	8.21	8.40	0.336	NS
Average DM intake (Kg/day)	8.05	7.68	7.62	0.306	NS
Average weight gain (Kg/day)	1.29 ^a	1.15 ^b	1.14 ^b	0.046	*
Feed Efficiency	6.26	6.71	6.72	0.244	NS

RRO = Raw rice offal, PRO = Parboiled rice offal, SEM = Standard error of mean
Means with different superscript along rows are significantly different at (P<0.05). LOS = Level of significance, * (P<0.05); NS = Not significant (P<0.05)

Table 7: Effect of type and levels of inclusion of raw or parboiled rice offal on performance of fattening Bunaji bulls.

Parameters	Levels of inclusion and Type of rice offal					SEM	LOS
	0	20RRO	30RRO	20PRO	30PRO		
Initial weight (Kg)	205.25	203.25	197.50	204.25	198.50	14.500	NS
Final weight (Kg)	321.25	310.75	301.50	304.25	299.00	18.467	NS
Average concentrate intake (Kg/day)	5.22	5.09	4.96	4.99	4.93	0.304	NS
Average hay intake (Kg/day)	3.59	3.44	3.39	3.43	3.53	0.222	NS
Average feed intake (Kg/day)	8.81	8.52	8.35	8.32	8.46	0.475	NS
Average DM intake (Kg/day)	8.04	7.77	7.56	7.59	7.68	0.433	NS
Average weight gain (Kg/day)	1.29	1.20	1.16	1.11	1.12	0.065	NS
Feed Efficiency	6.26	6.60	6.52	6.82	6.93	0.345	NS

RRO = Raw rice offal, PRO = Parboiled rice offal, SEM = Standard error of mean
LOS = Level of significance*=P<0.05; NS = Not significant (P>0.05)

Evaluation of rice offal as energy source for fattening Bunaji bulls

Table 8: Partial budget analysis for Bunaji bulls fed either Raw or Parboiled rice offal as energy source.

Parameter	Type of rice offal			SEM	LOS
	NRO	RRO	PRO		
Total weight gain (Kg)	116.00 ^a	109.17 ^b	105.5 ^b	3.354	*
Daily weight gain (Kg)	1.29 ^a	1.21 ^b	1.17 ^b	0.037	*
Value of gain (₦)	46400.00 ^a	43666.67 ^b	42200.00 ^b	1341.641	*
Concentrate intake (Kg)	469.63	457.75	451.07	15.804	NS
Hay intake(Kg)	323.11	312.57	316.34	11.538	NS
Total feed intake (Kg)	792.73	770.32	767.42	24.702	NS
Cost of concentrate (₦)	16277.30	15091.50	14638.50	522.658	NS
Cost of hay (₦)	8723.80	8439.40	8541.30	311.522	NS
Total cost of feed (₦)	25001.10	23530.90	23179.90	753.324	NS
Cost/ Kg gain (₦)	216.07	216.54	220.48	6.463	NS
Net Benefit (NB)	21398.90	20135.72	19020.12	1060.123	NS
Return to investment on feed (RIF)	0.85	0.86	0.82	0.051	NS

Table 9: Partial budget analysis for Bunaji bulls fed varying levels of inclusion of rice offal as energy source.

Parameters	Level of inclusion			SEM	LOS
	0%	20%	30%		
Total weight gain (Kg)	116.00 ^a	103.75 ^b	102.25 ^b	4.108	*
Daily weight gain (Kg)	1.29 ^a	1.15 ^b	1.14 ^b	0.046	*
Value of gain (₦)	46400.00 ^a	41500.00 ^b	40900.00 ^b	1643.168	*
Concentrate intake (Kg)	469.63	448.89	444.72	19.356	NS
Hay intake(Kg)	323.11	308.81	311.46	14.131	NS
Total feed intake (Kg)	792.73	757.70	756.18	30.254	NS
Cost of concentrate (₦)	16277.3 ^a	14239.70 ^b	14078.20 ^b	640.123	*
Cost of hay (₦)	8723.80	8337.90	8409.30	381.534	NS
Total cost of feed (₦)	25001.10	22577.60	22487.50	922.689	NS
Cost/ Kg gain (₦)	216.07	219.12	220.33	7.915	NS
Net Benefit (NB)	21398.90	18922.40	18412.50	1298.40	NS
Return to investment on feed (RIF)	0.85	0.85	0.83	0.063	NS

Table 10: Partial budget analysis for Bunaji bulls fed varying levels of Raw or Parboiled rice offal as energy source.

Parameter	Level of inclusion and Type of rice offal					SEM	LOS
	0	20RRO	30RRO	20PRO	30PRO		
Total weight gain (Kg)	116.00	107.50	104.00	100.00	100.50	5.809	NS
Daily weight gain (Kg)	1.29	1.19	1.16	1.11	1.12	0.065	NS
Value of gain (₦)	46400.0	43000.0	41600.0	40000.0	40200.0	2323.790	NS
Concentrate intake (Kg)	469.63	457.68	445.94	440.09	443.51	27.373	NS
Hay intake (Kg)	323.11	309.36	305.26	308.27	317.66	19.984	NS
Total feed intake (Kg)	792.73	767.04	751.20	748.35	761.16	42.785	NS
Cost of concentrate (₦)	16277.30	14687.0	14310.2	13792.4	13846.2	905.271	NS
Cost of hay (₦)	8723.80	8352.6	8241.9	8323.2	8576.8	539.571	NS
Total cost of feed (₦)	25001.10	23639.6	22552.1	22115.5	22422.9	1304.795	NS
Cost/ Kg gain (₦)	216.07	217.39	216.16	220.85	224.50	11.193	NS
Net Benefit (NB)	21398.90	19960.4	19047.9	17884.5	17777.0	1836.187	NS
Return to investment on feed (RIF)	0.85	0.88	0.86	0.82	0.79	0.089	NS

calculations of other cost such as capital required for pens, depreciation and purchase of stock and labour were not considered. There was no significant ($P>0.05$) difference in economic evaluation of bulls based on rice type, inclusion level and interaction between type and inclusion level except for Total weight gain, Daily weight gain and Value of gain that was significant ($P<0.05$) for rice offal type and inclusion level. Also, cost of concentrate was significant for inclusion level. The Value of gain which is the most important economic factor for the farmers is also highest on the diet containing RRO than PRO base on rice offal type and interaction between type and inclusion level even though they are both statistically similar ($P>0.05$).

When level of inclusion is considered, the bulls on 0%, 20% and 30% levels of inclusion had their initial weights improved by 116 Kg, 103.75 Kg and 102.25 Kg respectively at the end of the 90 days fattening trial. Interestingly, the return to naira invested on feed for 0% and 20% levels of inclusion has the same value of 0.85. The bulls on diets containing varying level of inclusion of raw and parboiled rice offal had their initial weights improved by 116 Kg, 107.50 Kg, 104 Kg, 100.5 Kg and 100 Kg for 0%, 20 RRO%, 30% RRO, 30% PRO and 20% PRO respectively at the end of the 90 days fattening trial. But all these values were statistically similar ($P>0.05$). Feed cost per gain was also least at 0% followed by 30% RRO, 20% RRO, 20% PRO and 30% PRO although no statistical ($P>0.05$) differences were obtained. Positive net benefit and rate of return to feed investment was observed for rice offal types, inclusion level and interaction between type and inclusion levels.

Conclusion

It was concluded from these studies that, the

incorporation of rice offal (raw and parboiled) can replace up to 30% of the maize offal in the diet for fattening Bunaji bulls. Therefore, farmers can fatten their bulls with any of the rice offal types and still attain an average weight gain above 1Kg per day, increased positive Net Benefit, return to investment on feed, superiority of feed conversion efficiency and average weight gain.

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Received: 15th October, 2014

Accepted: 5th February, 2015