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Feed Intake and Carcass Characteristics of Bunaji Bulls Fed Raw or Parboiled Rice Offal as Energy Source

Sani, R.T[1*] Lamidi, O.S[1] Jokhtan, G.E[2]
1.National Animal Production Research Institute, Ahmadu Bello University, Shika - Zaria
2.National Open University of Nigeria, Kaduna State
*Email of the corresponding author: geowife4life@gmail.com

Abstract
A feeding trial was conducted for 90 days using 20 Bunaji bulls aged 2-3 years with a live weight 210-249kg. Four bulls per treatment were allotted to five dietary treatments in a 2x2 factorial design with a common control. The concentrate and basal diets of Digitaria smutsii were offered at 2% body weight. At the end of the feeding trial, Carcass evaluation was also carried out with 15 Bulls to determine the carcass yield of the bulls fattened on the different experimental diet. 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.The carcass evaluation showed significant (P<0.05) difference with rice type for legs, spleen, Empty stomach, Empty intestine, inguinal fat, abdominal fat with PRO being higher except for the spleen which is higher for RRO. At varying levels of inclusion of rice offal, there was significant (P<0.05) difference in dressing percentage, Beef percent of carcass, meat to bone ratio, legs, hide, tail, empty stomach, stomach with content, empty intestine, Inguinal fat, kidney fat, abdominal fat, depth of chest fat, testis and blood. Carcass evaluation for bulls on diets with varying levels of inclusion of raw or parboiled rice offal were significant (P< 0.05) for legs, hide, empty stomach, empty intestine, inguinal fat and abdominal fat. It was concluded from this trial that the meat from bulls fed either 30% raw or parboiled were of better quality due to low inguinal fat, kidney fat, abdominal fat and depth of chest fat hence it use can be adopted by farmers to improve the carcass characteristics of fattened bulls.
Keywords: Bunaji Bulls, Carcass evaluation, Feed intake, parboiled rice offal, raw rice offal.

1. Introduction

Cattle fattening is not new in Nigeria and it has gain prominence as an important business in the livestock industry. The breed mostly (60%) fattened by small holder cattle fattening operation in Nigeria is the white Fulani (Alawa, 2007), it is reported to have a higher dressing percentage when compared with other indigenous breeds of cattle (Adamu and Alawa, 2005). Cattle fattening, provides a fast source of meat to meet the high demand for high quality protein needed in the diet. This is against the backdrop of inadequate animal protein intake by most Nigerians (Atsu, 2002; Ajayi *et al.,* 2007)

There is a need 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 by product is rice offal. It is a by-product of one step milling process of paddy rice which produces only two products; the rice seeds ready for human use and the waste product which is made up of rice husk, rice bran, rice polishing and small quantities of broken grains. Rice offal constitutes 40% of paddy rice (Duru and Dafwang, 2010).

The amount of meat from bulls depends upon the dressing percentage and the carcass yields. Hot carcass weight represents about 63 ± 2 percent of live weight (dressing percent) and is affected by the length of time an animal is away from feed and water, amount of muscling, distance transported, and amount of finish (Lemenager, 2002). Dressing percentage reflects the proportion of a live animal's weight, which will result in carcass weight. Some major factors that affect dressing percentage are stage of maturity of animal, degree of muscling, hide weight (thickness and amount of mud), fill (amount of stomach content), amount of fatness, and weighing conditions (Radunz, 2010).

The study was carried out to determine the feed intake and carcass yield of Bunaji bulls fed diet containing raw or parboiled rice offal.

2. Materials and Methods

2.1 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° to 12°N and longitudes 7° to 8°lE, with an altitude of 640m above sea level (Garmin Receiver, 2012). 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 (ovimap,2012).

2.2 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 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.

Table 1: Percent feed composition of concentrate diets.

	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)	34.66	32.09	32.09	31.34	31.22

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

2.3 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 respectively. The ration was adjusted at regular intervals of 2 weeks along with changes in live weight.

2.4 Carcass Evaluation

Three bulls from each treatment were slaughtered to determine the carcass composition. The bulls were slaughtered after 24 and 12hrs of feed and water withdrawal, respectively to get shrunk body weight. After slaughter, the hot carcass was weighed using a calibrated hanging scale of 500kg (50Kg graduation). The external offal (head, limb, tail and hide) were removed and weighed separately using calibrated scale of 100kg (200g graduation). After evisceration the internal offal (liver, spleen, kidney, heart and lungs) were removed and weighed individually using a calibrated weighing scale of 10Kg (50g graduation). The GIT was weighed with content using calibrated scale of 100kg (200g graduation) and reweighed after washing. Total lean meat (boneless) was separated and weighed. The bones were also weighed. Dressing percentage was calculated by dividing hot carcass by the fasted body weight expressed in percentage.

2.5 Chemical analysis

Analysis of concentrate diet was carried out by AOAC (2000) procedure. Also, Acid Detergent Fiber (ADF) and Neutral Detergent Fiber (NDF) was determined according to Van Soest (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. 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.

2.6 Data analysis

The data from the feeding trial and carcass evaluation were 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 DMRT in the SAS package.

3. Results and Discussion

3.1 Proximate composition of experimental diet

Chemical Composition of concentrate Diets is presented in Table 2. 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 22.44% to 19.69%. 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 al.* (2013) but higher than 13% and 13 - 15% reported by Rutherglen (1995) and Aduku (1993) 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 (NRC, 2000).

Table 2: Chemical compositions of concentrate diets containing varying levels of raw or parboiled rice offal fed to fattening 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.

3.1 Effect of diet containing raw or parboiled rice offal on carcass yield of Bunaji Bulls.

There was no significant differences ($P>0.05$) on carcass yield irrespective of the type of rice offal fed to the animal except for the legs, spleen, empty stomach, empty intestine, inguinal fat and abdominal fat which were significant ($P<0.05$) Table 3.

Table 3: Effect of feeding diet containing raw or parboiled rice offal on carcass yield of fattened Bunaji bulls.

	Type of rice offal				
Parameters	NRO	RRO	PRO	SEM	LOS
Fasted weight	317.00	314.83	329.00	8.952	NS
Slaughter weight	306.00	300.87	309.32	9.134	NS
Hot carcass weight	193.26	183.34	188.32	7.057	NS
Dressing %	60.88	58.07	57.21	0.726	NS
Weight of dissectible beef	123.00	112.67	111.00	4.851	NS
Beef (% of carcass)	63.50	61.27	58.87	0.946	NS
Bone yield	44.35	44.45	46.79	1.095	NS
Meat: bone ratio	2.78	2.53	2.39	0.091	NS
Legs	7.30^{c}	7.54^{b}	8.19^{a}	0.129	*
Hide	19.50 ^{b}	20.20	20.32	0.310	NS
Head	16.75	16.62	16.66	0.382	NS
Tail	3.40^{a}	3.27	3.27	0.045	NS
Liver	4.00	3.78	3.85	0.125	NS
Spleen	0.78^{b}	0.80^{a}	0.73^{b}	0.022	*
Heart	120	1.16	1.14	0.035	NS
Lungs	2.01	2.07	2.14	0.065	NS
Kidney	0.55	0.58	0.55	0.011	NS
Stomach with content	34.40	35.50	37.09	0.863	NS
Empty stomach	7.55 ^{b}	7.78^{b}	8.32^{a}	0.112	*
Intestine with content	12.10 ^{b}	13.97	13.74	0.437	NS
Empty intestine	6.10 ^{b}	6.12^{b}	7.01^{a}	0.165	*
Inguinal fat	2.85^{a}	2.39^{c}	2.77^{b}	0.117	*
Kidney fat	3.76^{a}	3.08^{c}	3.60^{b}	0.225	*
Abdominal fat	4.39^{a}	3.54^{b}	3.75^{b}	0.185	*
Intestinal fat	1.86	1.65	1.80	0.098	NS
Depth of chest fat	9.85	8.73	8.93	0.098	NS
Testis	0.50	0.58	0.57	0.029	NS
Longissimus muscle	1.25	1.34	1.35	0.078	NS
Rib muscle	2.17	2.19	2.14	0.080	NS
Blood	9.86	10.47	10.55	0.185	NS

NRO = No rice offal, 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)

There was significant (P<0.05) differences on most of the carcass traits with varying levels of the rice offal fed to the animal. 0% as the highest value, closely followed by 20% level of inclusion and lastly 30%level of inclusion. Even though 20% and 30% level of inclusion of rice offal was statistically similar (Table 4).

Table 4: Effect of feeding diet containing varying levels of rice offal on carcass yield of fattened Bunaji bulls.

	Level of inclusion				
Parameters	0	20	30	SEM	LOS
Fasted weight	317.00	329.00	319.75	10.964	NS
Slaughter weight	306.00	310.56	298.73	11.187	NS
Hot carcass weight	193.26	187.38	176.86	8.643	NS
Dressing %	60.88^{a}	59.92^{b}	55.12^{b}	0.889	*
Weight of dissectible beef	123.00	108.50	104.00	5.942	NS
Beef (% of carcass)	63.50^{a}	57.91^{b}	58.80^{b}	1.159	*
Bone yield	44.35	44.63	47.88	1.342	NS
Meat: bone ratio	2.78^{a}	2.44^{ab}	2.17^{b}	0.111	*
Legs	7.30^{c}	7.79^{b}	8.50^{a}	0.158	*
Hide	19.50^{b}	20.18^{ab}	21.10^{a}	0.380	*
Head	16.75	16.43	16.73	0.468	NS
Tail	3.40^{a}	3.04^{b}	3.37^{a}	0.055	*
Liver	4.00	3.85	3.58	0.150	NS
Spleen	0.78	0.74	0.78	0.026	NS
Heart	120	1.12	1.13	0.043	NS
Lungs	2.01	2.12	2.18	0.077	NS
Kidney	0.55	0.56	0.58	0.013	NS
Stomach with content	34.40	37.80	36.68	1.057	NS
Empty stomach	7.55^{b}	7.78^{b}	8.83^{a}	0.138	*
Intestine with content	12.10^{b}	14.65^{a}	14.81^{a}	0.535	*
Empty intestine	6.10^{b}	6.63 ^{ab}	6.98^{a}	0.203	*
Inguinal fat	2.85^{a}	2.24^{b}	2.65^{ab}	0.143	*
Kidney fat	3.86^{a}	3.60^{ab}	2.79^{b}	0.275	*
Abdominal fat	4.62^{a}	3.75^{b}	3.52^{b}	0.226	*
Intestinal fat	1.86	1.80	1.53	0.120	NS
Depth of chest fat	9.85^{a}	8.50^{b}	8.15^{b}	0.205	*
Testis	0.50^{b}	0.69^{a}	0.54^{b}	0.036	*
Longissimus muscle	1.25	1.46	1.32	0.095	NS
Rib muscle	2.17	2.33	2.00	0.098	NS
Blood	9.86^{b}	10.81^{a}	10.87^{a}	0.227	*

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).

There was no significant effect of rice offal type and level of inclusion (P<0.05) on most carcass parts except for the legs, hide, empty stomach, empty intestine, Kidney fat and abdominal fat which were significant (P<0.05).The 0% level of inclusion had the highest dressing percent, followed by20% parboiled rice offal, 20% raw rice offal then 30% raw rice offal with 30% parboiled rice offal having the least value. Though these differences were not statistically significant (P<0.05) Table 5.

The dressing percentage obtained in this study based on rice offal type (57.21-60.88), inclusion level (55.12-60.88) and interaction between rice offal type and inclusion level (53.69-60.88) were higher than the values of 52.50 to 53.98% reported by (Olayiwole *et al.,* 1979) and 50.2 to 53.6% (Olayiwole and Fulani, 1980) using intact Bunaji bulls. However, slightly higher dressing percentages (60.00%-61.00%) were reported by Cullision *et al.* (1976) for steers fattened on poultry litter, maize grain and soybean cake diets. The differences in dressing percentage between what is reported in the present study and those cited above could be due to high quality of the concentrate (maize grain and soybean cake) fed in those studies.

Table 5: Effect of type and level of inclusion of raw or parboiled rice offal on carcass yield of fattened Bunaji bulls

	Level of inclusion and Type of rice offal						
Parameters	0	20RRO	30RRO	20PRO	30PRO	SEM	LOS
Fasted weight	317.00	308.00	319.50	350.00	320.00	15.505	NS
Slaughter weight	306.00	294.87	301.75	326.25	295.71	15.821	NS
Hot carcass weight	193.26	175.00	181.75	199.73	171.96	12.223	NS
Dressing %	60.88	56.79	56.77	57.05	53.69	1.257	NS
Weight of dissectible beef	123	101	114	116	94.00	8.403	NS
Beef (% of carcass)	63.50	57.79	62.53	58.03	55.07	1.639	NS
Bone yield	44.35	41.25	47.75	48.00	48.02	1.897	NS
Meat: bone ratio	2.78	2.45	2.37	2.42	1.97	0.157	NS
Legs	7.30	6.91	8.40	8.68	8.60	0.224	*
Hide	19.50	19.10	22.00	21.25	20.21	0.538	*
Head	16.75	16.25	16.85	16.60	16.62	0.662	NS
Tail	3.40	3.00	3.41	3.08	3.33	0.078	NS
Liver	4.00	3.85	3.48	3.85	3.69	0.213	NS
Spleen	0.78	0.83	0.80	0.66	0.76	0.037	NS
Heart	1.20	1.08	1.20	1.16	1.05	0.061	NS
Lungs	2.01	2.09	2.10	2.14	2.27	0.109	NS
Kidney	0.55	0.60	0.58	0.53	0.59	0.019	NS
Stomach with content	34.40	36.60	35.50	39.00	37.86	1.495	NS
Empty stomach	7.55	7.05	8.75	8.50	8.92	0.194	*
Intestine with content	12.10	15.05	14.75	14.25	14.88	0.757	NS
Empty intestine	6.10	5.75	6.50	7.50	7.42	0.287	*
Inguinal fat	2.85	1.87	2.45	2.60	2.85	0.202	NS
Kidney fat	4.95^{a}	2.78^{c}	2.85^{c}	3.60^{b}	2.73^{c}	0.389	*
Abdominal fat	6.00^{a}	3.24^{b}	3.63^{b}	3.75^{b}	3.42^{b}	0.320	*
Intestinal fat	1.87	1.60	1.50	2.00	1.56	0.170	NS
Depth of chest fat	9.85	8.00	8.35	9.00	7.95	0.290	NS
Testis	0.50	0.70	0.56	0.66	0.54	0.051	NS
Longissimus muscle	1.25	1.38	1.39	1.55	1.24	0.135	NS
Rib muscle	2.17	2.45	1.95	2.20	2.05	0.138	NS
Blood	9.86	10.33	11.23	11.28	10.50	0.321	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)

The weight of legs obtained in this study based on rice offal type (7.54 - 8.19), inclusion level (7.30 - 8.19) and interaction between rice offal type and inclusion level (6.91 – 8.68) obtained in this study is higher than the value reported by 6.3 - 7.0Kg (Olayiwole and Fulani, 1980) and 6.35 - 7.25Kg (Lamidi, 2005). The weight of hide based on rice offal type (20.20 - 20.32), inclusion level (19.50-21.10) and interaction between rice offal type and inclusion level (19.10 - 22.00) reported in this study is lower than values of 21.8 – 24.60Kg (Olayiwole and Fulani, 1980) and 21.30 – 22.15Kg (Lamidi, 2005). The value reported for head based on rice offal type (16.62-16.66), inclusion level (16.43-16.75) and interaction between rice offal type and inclusion level (16.25-16.85) in this study is higher than 13.8-15.50Kg (Olayiwole and Fulani, 1980) but fall within the range of 16.53-18.87Kg as reported by Lamidi (2005). However, the meat to bone ratio obtained in this study is similar to 2.4-2.6% reported by Madziga (2013) except for the value of 1.97 gotten for animals on 30% parboiled rice offal diet.

5. Conclusion

At the end of the feeding trial, it was concluded from the evaluation of the carcass composition of the bulls that the inclusion of raw or parboiled rice offal in the diet of bunaji bulls yielded high quality carcass (lean meat) because of low inguinal fat, kidney fat, abdominal fat and depth of chest fat compared with the control diets therefore it can be adopted by farmer.

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