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Full Length Research Paper

Body and carcass linear measurements of rams fed graded levels of biscuit waste based diet

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This study was carried out to evaluate the body and carcass linear measurements in rams fed diets in which maize and wheat offal mixture was replaced with biscuit waste (biscuit water meal (BWM)) and *Leucaena leucocephala* leaf meal (*Lh*) mixture 0, 25, 50, 75 and 100%, respectively. The dietary treatments were designated as B0, B1, B2, B3 and B4, respectively. Twenty (20) apparently healthy Yankassa rams, 9 to 11 month old win an initial average live weight of 12.17 ± 0.33 kg were assigned into five groups of 4 animals per group, balanced for weight and randomly allotted to the dietary treatments in a completely randomized design experiment. Water was provided without restoration. Body linear measurements were obtained weekly during the trial that lasted for 91 days. At the end of the feeding trial, animals were subjected to a 16 h fast and slaughtered for carcass linear measurements. Results showed that treatment effect was significant (P<0.05) for all linear body variables except for body length and rump length of rams fed experimental diets. Also, carcass linear measurement of carcass length, internal and external cheat girt, length of distal parts of fore and hind legs, circumference of fore and hind legs, length and width of legs in rams improved significantly (P<0.05) when maize and wheat offal mixture was replaced with biscuit waste and *L. Luecocephala* meal mixture in the control diet. However, the rams treated on 25 and 50% biscuit waste meal and *L. leucocephala* meal mixture exhibited significantly higher (P<0.05) body and carcass linear measurements than the rams on other diets.

Key words: Body, carcass, linear, measurements, rams, biscuit waste, *Leucaena leucocephala*.

INTRODUCTION

Growth rate assessment is an important husbandry practice often carried out in livestock breeding and fattening programme. Tiamiyu et al. (2000) and Abdullai et al. (2003) at various times reported strong and positive correlation coefficient between body weight and linear body measurement (LBM). Thus the relationship existing among LBM variables provides useful information on performance, productivity and carcass characteristics of meat animals.

In the developing countries of Africa however, where several production bottle necks hamper efficient ruminant animal production; feed restriction as well as high cost of feed and occasioned feed scarcity; all combined to affect growth and carcass development thus reducing the quality and quantity of animal protein offered for sale in the market. Meanwhile, efforts have been intensified in the last few years into the use of cheaper industrial by products at various levels of dietary inclusions for livestock to determine their efficiency of utilization in terms of growth and production performance (Longe and Adetola, 1993). Therefore the replacement of maize with biscuit waste (BWM) as one of the industrial wastes becomes justifiable as many alternative sources had been ventured into Adu (1985), Adegbola et al. (1988) and Adegbola (2002) had found cassava by-products and rice milling waste to be effective replacement as energy rich feedstuffs in small ruminant feeding.

Biscuit water meal (BWM) is a palatable high energy feed produced from wheat flour, skinned milk powder, vegetable fat, sugar, salt and flavour materials. The meal was analyzed and found to contain substantial amount of nutrients such as protein, energy and minerals required

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Table 1. Ingredient composition of the experimental diets (%).

Ingredient	Diets				
	B0	B1	B2	B3	B4
Maize	32.50	24.37	16.02	8.13	-
Wheat offal	30.00	22.50	15.00	7.50	-
Leucaena leucocephala	-	7.50	15.00	22.50	30.00
Biscuit waste	-	8.13	16.05	24.37	32.50
Palm kernel cake	10.00	10.00	10.00	10.00	10.00
Brewer's dried grain	23.50	23.50	23.50	23.50	23.50
Premix	0.50	0.50	0.50	0.50	0.50
Oyster shell	0.50	0.50	0.50	0.50	0.50
Bone meal	2.50	2.50	2.50	2.50	2.50
Salt	0.50	0.50	0.50	0.50	0.50
Total	100.00	10.00	100.00	100.00	100.00

for animal growth and performance (Longe, 1986). The author also noted that the crude protein and energy contents were 10.80% and 4.70 MJ/kg, respectively. Also, BWM has no anti quality factor and could make a good replacement for maize and other cereal grains in fattening ram for slaughter. Earlier studies however showed that animals on a fattening programme would tend to use metabolizable energy more efficiently if provide as carbohydrate than as protein (M^c Donald et al., 1995). Ranjahan (2004) also reported that if a growing animal is provided with insufficient protein, the efficiency with which it utilizes metabolizable energy could probably be altered. So *Leucaena leucocephala* leaf lay meal was used in the present study to supplement the formulated feed as source of protein.

L. leucocephala leaf meal has high crude protein of high digestibility and is also high in minerals and vitamins (Smith and Hourtet, 1987; Odeyinka et al., 2003). It reduces cost of feed production as well as implement in performance during animal production since *L. leucocephala* could be available for most part of the dry season (Odeyinka et al., 1995; Eniolorunda and Rowaiye, 2008). There is therefore a need to reduce dependence on conventional feedstuffs for livestock production and intensify research into evaluating lesser known or unexploited sources of food supply. The objective of this study was therefore to evaluate both the body and carcass linear developments in Yankassa rams fed graded levels of biscuit waste and *L. leucocephala* meal mixture.

MATERIALS AND METHODS

Experimental diets

Five formulated diets in which biscuit waste meal and *L. leucocephala* leaf hay replaced maize and wheat offal mixture at 0, 25, 50, 75 and 100%, respectively were used in the present study. The dietary treatments were designated as B0 (control), B1, B2, B3, and B4 in the trial that lasted 91 days. Sundried on large tarpaulin sheets for four days to eliminate protozoa and fungi as well as to reduce bacterial contamination. *L. leucocephala* leaf (*Ll*h) was the other last ingredients obtained from the University Teaching and Research Farm. The leaves were also sundried on large tarpaulin sheets for 3 days. The consignment of BWM and *Ll*h were separately ground in a hammer mill to allow for proper mixing with the other ingredients (Table 1).

Twenty Yankassa rams, 9 to 11 month old with an initial average live weight of 12.16 ± 0.34 kg were purchased from a village market around Zaria and used for the trial. The animals were quarantined on arrival for 8 weeks and treated against internal and external parasites using a broad spectrum LA antibiotics, Pfizer product (Oxytetracycline HCl and Ascaricide, Bayer product (Asuntal) and an antihelmiting Pfizer product (Banminth II) at 12.50 m/kg BW. During this period, animals were managed intensively and group fed with cowpea hay, maize offal and breweries dried grain. Also, they have free access to clean drinking water.

At the commencement of the experiment animals were divided into five groups of four rams per group and balanced for similar weight with each group randomly assigned to one of the dietary treatments. They were housed in individual pens (120 × 1.00 × 1.20 m) under a well ventilated building in which bedding material was periodically placed and later removed. Animals were fed at 3.50% of their body weight, provided with clean drinking water and mineralized salt lick. These animals were weighed once weekly and the level of feeding adjusted depending on live wieght changes.

Measurements

The following linear body measurements were obtained in the morning before animals were offered forage: Body length was measured from the point of shoulder (anterior part of scapula) to the tuber ischium; chest girth was measured as a circumference at the point immediately posterior to the shoulder, height at withers was measured at the highest point at the withers; depth of chest was taken as the vertical measurement from the dorsum to ventral side of greatest depth of the chest, rump length was measured between and point and the iscluim bone; rump width was measured as the distance between the two ends of lam bar bone dorsum; height of pelvics was measured the length of pelvics bone; width of pelvics was measured as the distance between the two ends of the pelvics bone; shoulder point width was measured as the distance between the two ends of scapula bone; width of chest was measured between the two forelegs cranial; head length was measured from the point above the horns to the snout or lips; head width was

Table 2. Chemical composition of biscuit waste and *Leucaena leucocephala* meals.

Nutrient (%)	Biscuit waste	*Leucaena leucocephala*
Dry matter	9.85	88.18
Organic matter	90.85	71.67
Crude protein	9.65	21.75
Ether extract	2.10	15.90
Ash	5.25	3.00
Nitrogen free extract	77.00	50.70
Crude fibre	6.00	8.60
Neutral detergent fibre	50.60	49.90
Acid detergent fibre	31.60	30.60
Acid detergent lignin	2.98	15.90
Gross energy (MJ/kg)	3.20	2.14

measured as the distance between the two ends of head bone or forehead, while body girth was measured as the circumference of the animals taken dorso-ventrally round the body.

Slaughter of animal's carcass process

Two rams were randomly selected from each treatment and slaughtered at the end of the experiment. The animals were fasted for 16hours overnight but were provided with clean water before they were slaughtered. The fasted weights of the animals were taken and were slaughtered by severing both the jugular veins and carotid arteries at the atlanto- occipital arhuculation. The carcasses were properly bled. After bleeding, the head, feet and the skin were removed and weighed. The carcass were opened up and eviscerated. The carcass linear measurements were taken before they were chilled at 4°C for 24 h prior to cutting up. The measurements were made with a wooden tape according to Attah et al. (2004) as follows: carcass length was measured from the anterior edge of the syphilis to the middle of the edge of the visible part of the first rib; internal chest depth was measured from the ventral edge of the 9th thoracic vertebrae to the xiphoidcartilage in straight line; external chest depth was measured from the dorsal surface of the carcass over the 9th vertebrae to the xiphoidcartioliage in a straight line; length of distal part of hind leg was measured from the patella to the hip joint; length of distal part of foreleg was measured from the elbow to the hip joint, circumference of hind leg was measured around the patella and over the pin bones; circumference of foreleg was measured from the thickest portion between the elbow and shoulder; length of leg was measured from the medial mallelous of the tibia in a straight line to the edge of symphysis pubis (just under the coccigeal vertebrae of the tail); while width of leg was measured from the medial splitting line of the symphysis pubis to the joint of maximum thickness on the lateral surface of the leg.

Chemical analysis

Chemical components of biscuit waste, *L. leucocephala* meals and the test diets as shown in Tables 2 and 3 where analyzed according to the procedures of AOAC (2002). The various fibre contents were determined by the methods of Van Soest and Robertson (1985).

Experimental design and statistical analysis

Completely randomized design (CRD) was used for this experiment. Data collected were statistically analyzed for ANOVA using (SAS 2002). The means were separated with Dancan's multiple range test of the same software.

RESULTS AND DISCUSSION

The chemical composition of biscuit waste and *L. leucocephala* meals as test ingredient is presented in Table 2. Biscuit waste meal had higher DM, OM, MFE and GE (MJ/Kg) than *L. leucocephala* leaf meal which had higher CP, CF, C fat and Ash contents than biscuit waste meal. While the CP content obtained in the present study for BWM (9.65%) was lower than 10.80% reported by Longe (1986), it falls within the range of values (8.90 to 10.0) recorded for maize by Obiaha (1992) and Atteh (2002). However, the 21.75% CP obtained for *L. leucocephala* meal in the present study was higher than 14.76% CP report earlier by Eniolorunda and Rowaiye (2008). Inclusion of the two test meals could make the formulated diet rich enough to support adequate growth of ruminant animals. This was due to the fact that the meals contained sufficient nutrients required by the animals for growth and carcass development (Attah et al., 2004; Afolayan et al., 2006).

Table 3 shows the chemical composition of experimental diets as fed during the trial. Dry matter (DM) contents of experimental diets were high and varied between 92.62 and 93.08%. Also, crude protein (CP) content was higher for Bo (15.15%) but lower ($P<0.05$) for B4, (14.05%) thus indicating that CP decreased as the level of BWM increased in the diet in contrast however, crude fibre (CF) and ash content increased from Bo (11.20 and 8.56) to B4 (14.15 and 10.40), thus suggesting that the slight decrease in CP as the BWM increased in the diet was probably compensated for by the increasing level of crude fibre as the level of BWM in the diet increased.

Average values and standard error of means (SEM) for the linear body measurement of the same age grouped animals were presented in Table 4. Treatment effect

Table 3. Chemical composition of experimental diets.

Nutrients (%)	B0	B1	B2	B3	B4
Dry matter	92.62	93.08	93.02	92.95	93.05
Organic matter	84.06	83.83	83.36	83.15	82.65
Crude protein	15.15	14.48	14.30	14.17	14.05
Crude fibre	11.20	13.00	13.16	16.61	14.15
Ether extract	3.17	3.06	2.34	2.21	2.08
Ash	8.56	9.25	9.66	9.80	10.40
Nitrogen free extract	61.92	60.21	60.54	60.21	59.32
Nutrient detergent fibre	66.50	68.44	67.21	67.16	67.55
Acid detergent fibre	38.95	32.12	35.91	35.15	34.28
Acid detergent lignin	28.88	25.68	25.00	25.37	26.15
Gross energy (MJ/kg)	3.15	3.10	2.95	2.92	2.85

Table 4. Mean body linear measurement of Yankassa rams fed the experimental diets.

Nutrient (cm)	B0	B1	B2	B3	B4	SEM
Height at withers	64.25^{a}	64.25^{a}	61.00^{c}	59.00^{d}	62.50	1.35
Head length	25.24	24.40	24.35c	24.50	24.20	0.23
Rump length	17.30	17.32	17.27	17.17	17.15	0.17
Body length	53.88	54.00	54.01	53.88	53.75	0.30
Body girth	77.75^{b}	78.75^{a}	77.25^{b}	75.75^{c}	72.25	0.95
Chest girth	65.75^{b}	66.75^{a}	66.00^{ab}	65.75^{b}	63.85^{c}	0.83
Chest depth	29.50	31.25^{a}	30.20b	29.75^{c}	29.30^{c}	0.50
Head width	11.25^{a}	11.50^{a}	10.75^{b}	10.75^{a}	10.33^{c}	0.25
Shoulder point width	12.50^{b}	13.40^{a}	11.80^{c}	10.80^{d}	11.35^{c}	0.45
Rump width	11.25^{a}	110.40^{a}	9.90^{b}	9.75^{b}	9.50^{c}	0.20
Width of chest	9.60^{a}	9.75^{a}	8.70^{b}	8.65^{b}	8.65^{b}	0.20
Width of pelvis	11.50^{a}	11.58^{a}	11.25^{b}	10.90^{c}	10.55^{d}	0.25
Height of pelvis	61.50^{c}	66.50^{a}	64.50^{b}	64.00	63.75^{b}	1.50

abcd: Means within the same row with differing superscripts are significantly different (P<0.05).

was significant (P<0.05) for all measurements, except body length and rump Length of rams on such diet. The live animal measurement of height at withers (HW) which however varied from 59.00 to 64.25 cm was similar to average of 62.10 cm recorded for Yankassa sheep (Afolayan et al., 2006) but higher than the range (46.48 cm) recorded for West African Dwarf ram by Yakubu et al. (2005). The high HW obtained in the present study was probably due to the fact that Yankassa rams are usually taller than the dwarf breed type (Janssens et al., 2004). It was however noted that mean height at withers of rams on B1 was higher (P<0.05) than the values obtained for B4, B2 and B3 but compared favourably (P<0.05) with 64.24 cm recorded for the control group (Bo). body girth (BG) of rams on dietary treatment Bo and B2 were not significantly different (P>0.05) but were both lower (P<0.05) than B1 in which 25% biscuit waste and *L. leucocephala* meal mixture replaced the mixture of Maize and wheat offal in the control.

Also, replacement of maize and wheat offal mixtures with 25 and 50% biscuit waste and *L. leucocephala* meal mixtures resulted into significantly higher (P<0.05) chest girth (CG) in B1 and B2. Shoulder point width varied significantly (P<0.05) from one dietary treatment to the other with rams on B1 recording with widest width. Chest depth (CD), head length (HL) and height at pelvis followed the same pattern as chest girth in which the combination of feedstuffs at 25 and 50% seemed to be superior. Also, head width, rump width, width at chest and width at pelvis followed the same pattern as height at withers.

Table 5 showed the result of carcass linear measurements (CLM) of Yankassa sheep fed with graded levels of biscuit waste meal (BWM). The carcass length with a range of 42.75 to 52.25 cm were significantly different (P<0.05) from each other. The carcass was longest (P<0.05) at 25% but was not significantly different (P>0.05) from 0 (control) and 50%

Table 5. Mean carcass linear measurements of Yankasa rams fed the experimental diet.

Variable (cm)	B0	B1	B2	B3	B4	SEM
Carcass length	51.75^{b}	52.25^{a}	51.50^{a}	49.75^{b}	42.75	3.68
Internal chest girth	17.65^{b}	18.00^{a}	16.75^{b}	16.25^{c}	16.00^{c}	0.45
External chest girth	23.75^{b}	24.50^{a}	24.00^{ab}	22.85^{b}	22.25^{d}	0.50
Length of distal part of foreleg	20.15^{a}	20.25^{a}	19.50^{b}	19.50^{b}	19.00^{c}	0.18
Length of distal part of hind leg	19.75^{c}	20.00^{a}	19.50^{c}	19.25^{d}	19.00^{c}	0.20
Circumference of foreleg	18.00^{b}	20.25^{a}	20.15^{a}	18.25^{b}	18.25^{b}	1.15
Circumference of hind leg	22.75^{c}	25.25^{a}	23.25^{b}	22.25^{cf}	22.50	0.35
Length of leg	34.75^{a}	34.15^{b}	33.75^{b}	31.25^{c}	30.25^{d}	0.55
Width of leg	8.20^{a}	8.25^{a}	7.85^{b}	7.70^{bc}	7.65^{c}	0.15

abcd: Means within the same row with differing superscripts are significantly different (P<0.05).

inclusion levels of biscuit waste and *L. leucocephala* meal mixtures. The value was however lower compared to 78.00 and 77.50 cm obtained for South Africa Merino and Durmer sheep (Cloete et al., 2004). The discrepancy in length might be due to differences in age and breed of experimental animals. Carcass linear measurement of internal chest depth for animal on B_1 was similar (P>0.05) to the control (Bo) but higher (P<0.05) than the internal chest girth recorded for B2, B3 and B4, respectively. Also, the external chest girth for animals on B1 and B2 were similar (P>0.05) but were significantly higher (P<0.05) than Bo. Rams on B1 had the longest (P<0.05) length of distal part of foreleg but was not significantly different (P>0.05) from Bo length of distal part of hind leg was also higher (P<0.05) in B1 than the control (Bo). Rams on test diet in which biscuit waste and *L. leucocephala* leaf meal mixture replaced with mixture of maize and what offal in the control diet recorded wider (P<0.05) circumference of fore leg and shorter (P<0.05) length of leg compared to the control. However the recorded range (30.25 to 34.15 cm) for length of leg in the present study was longer when compared to 28.10 cm earlier reported by Koenen et al., 1995). Circumference of hind leg followed the same patterns of external chest girth while width of leg followed the same trend as length of distal part of fore leg.

The results showed that the rams treated on 25 and 50% biscuit waste mean and *L. leucocephala* leaf meal mixture exhibited significantly (P<0.05) higher body and carcass linear measurements than the rams on other diets. Hence, it appeared that B1 and B2 induced the response in the rams in terms of growth rate and feed efficiency thus contributing to better body and carcass development. However, the decline in carcass length, internal and external chest girth length of distal part of fore and hind legs, circumference of fore and hind legs length and width of legs or B3 and B4 as the inclusion level of biscuit waste and *L. leucocephala* meal mixture increased in the diet was probably due to the nutrient value of the feed (Table 3) and possibly by feed intake and digestibility as offered by the level of biscuit waste meal (Eniolorunda, 2010).

Conclusion

Result showed that the feeding of diets in which biscuit waste meal and *L. leucocephala* leaf meal mixture replaced maize and wheat offal meal mixture possibly influenced the growth rate and feed efficiency significantly thus contributing to improved body and carcass development for growing Yankassa rams when fed at 25 and 50% replacement levels.

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