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**Growth Performance and Carcass Characteristics of Yankasa Rams fed Varying Levels of *Panicum maximum*-Concentrate Mix under Intensive Feedlot in South Western Nigeria.**

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**Abstract**

The consumption of animal protein in Africa is far less than the recommended level for adequate human growth and development emphasizing the need to beef up livestock production especially in the sub-humid ecological zone through intensive management systems that prioritize the use of bigger animal breeds. This study evaluated the growth performance and carcass characteristics of Yankasa rams fed guinea grass (*Panicum maximum*) fodder supplemented with concentrate mix under intensive feedlot. Twenty yearling Yankasa rams (21.33±0.50 kg mean body weight) were assigned into five treatments at four animals each in a completely randomized design (CRD). The experimental diets consisted of *Panicum* fodder as the basal diet at 3% body weight of the rams and concentrate mix (maize, brewers’ dried grains, moringa leaf meal, urea, rice husk, vitamin-mineral premix and common salt at 25.00, 40.50, 16.00, 2.70, 14.50, 1.00 and 0.30% respectively). The concentrate mix was used to replace the basal diet at 0, 0.5, 1.0, 1.5 and 2.0% body weight of the rams and denoted as T1, T2, T3, T4 and T5 respectively and the feed offered adjusted weekly based on animal body weight recorded in the previous week. The mean feed intake did not differ significantly (p<0.05) among the treatments while diet supplementation significantly increased average daily weight gain and metabolic weight gain but decreased the feed conversion ratio with the highest value recorded in T1 (24.07±1.12) and the least in T5 (8.35±0.80). The carcass yield increased with the level of supplementation while the integrity of the relative organ characteristics was maintained. The supplementation of *Panicum* basal diet with concentrate mix improved Yankasa ram productivity and the best result was obtained at 2% body weight.

**Keywords**: Yankasa rams, *Panicum maximum*, concentrate supplement, weight gain, carcass.

**Introduction**

The consumption of animal protein in developing nations has always fallen short of expectation (Nkwocha *et al*., 2010). The total recommended protein intake for human growth and development is 85 grams (g) caput-1 day-1 out of which 39 g should be of animal origin but the consumption in developing countries at 33 g of protein caput-1 day-1 is 52 g below the recommendation (FAO, 2005). Therefore, there is need to increase livestock production in order to improve the nutritional status of Nigerians through the provision of high quality animal protein such as meat and milk. Sheep is an excellent food source for human consumption because mutton is a nutrient dense food that provides high quality protein, essential minerals and vitamins such as iron, zinc, vitamin B12 and omega-3 (Babiker *et al.,* 1990; Ozung *et al*., 2011).

Sheep breeds in Nigeria include West African Dwarf (WAD), Ouda, Yankasa and Balami. The predominant and indigenous breed of sheep in south western Nigeria is the WAD whose smaller size is an adaptation to adverse conditions (Agaviezor *et al*., 2013) and with lower quantities of products derivable from them compared to other breeds in the country. Mature rams have been transported and slaughtered to meet the shortfall in supply of the much-needed animal protein for consumption in the southwest, especially slaughter during the Muslim festivals (Sarma and Ahmed, 2011). The cost of transporting the rams has become prohibitive due to rising prices of petroleum products and vehicle spare parts, poor conditions of the roads and general insecurity occasioned by Boko Haram insurgency and incessant attacks by herdsmen. One of the strategies to meet the rising demand for animal protein in the south western states is the rearing of the bigger sheep breeds from the northern states.

The Yankasa is a meat breed of sheep found in the northern parts of Nigeria and not traditionally managed in the sub-humid southern zone of Nigeria but the descent from a common ancestor to the WAD sheep points to the fact that it can be managed in the sub-humid southern environment (Osaiyuwu *et al*., 2010; Yunusa *et al*., 2013). This sheep breed is mostly raised under semi intensive and extensive management systems whose feeding components affect productivity and result in economic loss due to seasonality in availability of feed, adverse weather conditions and poor husbandry practices (Ngere *et al.,* 1979).

The genetic makeup and feeding systems play important roles in productivity, health and profitability of animal production enterprises. Even with potentially bigger breeds, the poor feeding that is characteristic of the traditional extensive management systems commonly practiced, in which the small ruminants roam around to eat natural pastures and household wastes, result in poorer weight gain and cause the animal to reach market size at a longer period (Mahajan *et al*., 1976). Therefore, the use of appropriate supplements and basal diets as a feeding strategy in order to balance the nutrient needs of the rumen microorganisms and the animals would ensure early maturity and improve productivity (Lakpini *et al*., 2002).

Several strategies advanced to achieve improved productivity in ruminants include the following: (1) fattening systems based on pasture such as guinea grass (*Panicum maximum*), elephant grass (*Pennisetum purpureum*), *Cynodon* spp and *Digitaria decumbens* which are abundant during the wet season and concentrates fed *ad-libitum*; (2) fattening systems based on the supply of feed and forage fed *ad-libitum* depending on farm facilities, consumer preference and economic circumstances (Bodas *et al*., 2014); and (3) feeding strategy based on feeding the animals with high energy and protein supplements (Konlan *et al*., 2012). These have necessitated the development of a fattening strategy for Yankasa rams based on *Panicum maximum* and concentrates made from locally-available ingredients. Mahgoub *et al*. (2000) observed that the increase in body weight is highly correlated with feed consumption because dry matter intake is a key determinant of growth. This makes an understanding of carcass analysis imperative in accessing the quality of feed fed to animals.

This study was carried out to evaluate the growth performance and the carcass characteristics of Yankasa rams fed *Panicum maximum* fodder supplemented with concentrate mix under intensive feedlot in south western Nigeria.

**Materials and Methods**

**Experimental site**

The experiment was conducted at the Small Ruminant Section of the Teaching and Research Farm, Ekiti State University, Ekiti State, south western Nigeria. The state lies entirely within the tropics and located between 4º45′-5º45′E and 7º15′-8º5′N. The seasonal distribution of rainfall is approximately 0.1% for late dry (January-March), 25.8% for early wet (April-June), 69.6% for late wet (July-September) and 4.5% for early dry (October-December) seasons. The mean annual rainfall is 1247 mm with relative humidity of 70 to 85%. The location is situated at about 437 m above seas level with a mean annual temperature of 26.2ºC

**Experimental animals and management**

Twenty yearling Yankasa rams of an average body weight of 21.33±0.50 kg were procured from ruminants’ market in Ajase-Ipo, Kwara State, Nigeria. The rams were quarantined for 30 days (NAPRI, 1984), treated against ectoparasites using ivermectin injection, dewormed with albendazole bolus to take care of endoparasites and injected intra-muscularly with oxytetracyline-long acting broad spectrum antibiotic as a precautionary measure against bacterial infections. The animals were allotted into five treatment groups and fed for a pre-treatment period of two weeks to enable them adapt to the experimental diets and the environment before the commencement of the actual experiment. Water was provided *ad libitum*.

**Experimental procedure**

The rams were randomly assigned into five treatment groups with four animals per group in a completely randomized design (CRD). The experimental diets consisted of *Panicum maximum* fodder as the basal diet at 3% body weight of the rams. Concentrate diet was formulated using maize (25.00%), brewers dried grains (40.50%), moringa leaf meal (16.00%), urea (2.70%), rice husk (14.50%), vitamin-mineral premix (1.00%) and common salt (0.30%). The concentrate mix served as the supplement to and replaced the basal diet at 0, 0.5, 1.0, 1.5 and 2.0% body weight of the rams (3.0:0; 2.5:0.5; 2.0:1.0; 1.5:1.5; and 1.0:2.0% body weight of rams) respectively and denoted as T1, T2, T3, T4 and T5 respectively. The amount of feed offered was adjusted weekly based on average body weight from the preceding week. Water was provided *ad libitum*.

**Data collection**

The experimental diets were supplied *ad libitum*, twice daily at 8:00 hr and 16:00 hr. The feed offered and feed refused were recorded for each animal in each group daily while animal weights, using a spring balance, were taken and weekly. The average daily feed intake and average daily weight gain were calculated over the 84 days experimental period. The average daily gain (ADG) was obtained by the difference between the final body weight and the initial body weight (kg) divided by the numbers of days in feed.

At the end of the experiment two rams from each treatment were randomly selected and fasted for 24 hours to determine their fasted weights. Slaughtering operation was carried out using the local method of severing the jugular veins and the carotid arteries at the atlanto-occipital articulation. The carcasses were properly bled after which processing and weighing were carried out according to the methods described by Adu and Brickman (1981) and Fasae *et al*. (2011). The records taken were weight before bleeding, weight after bleeding, eviscerated weight, carcass length, chest depth, left carcass, right carcass, hind leg, hind shank, right shoulder, right leg, ribs, breast, fore shank, fore leg, flank, loin, head, neck, tail, scrotum, and internal organs.

**Chemical analysis**

Samples of the experimental diets were oven dried to constant weight and analyzed for proximate composition (crude protein, crude fibre, ether extract and ash) according to AOAC (2000).

**Statistical analysis**

The data were analyzed using one-way ANOVA of SAS (2008) method with diet as the source of variation and where significant differences exist, the Duncan Multiple Range Test was used to separate the means.

**Results**

The proximate compositions of the concentrate mix and *Panicum maximum* forage are presented in Table 1. The dry matter of the concentrate (92.15 g 100g-1) was higher than that of the forage (72.28 g 100g-1). The crude protein (CP) content of concentrate mix (16.65 g 100g-1) was higher compared to the CP of the forage (9.42 g 100g-1). The Gross Energy (GE) of concentrate (13.53 MJ kg-1) exceeded that of forage (9.58 MJ kg1) while the crude fibre (CF) of forage (31.58 g 100g-1) was higher than in the concentrate mix (26.48 g 100g-1).

Table 1: Proximate composition of *Panicum maximum*-concentrate mix fed to Yankasa rams

|  |  |  |
| --- | --- | --- |
| Parameters | *Panicum maximum* | Concentrate |
| DMCPCFEEAshNFEGross E0 (Kcal kg-1) | 72.28 9.4231.58 3.3011.3644.34 9.56 | 92.1516.6526.48 4.23 7.6045.0413.53 |

DM=Dry matter, CP=Crude protein, CF=Crude Fibre, EE=Ether extract, NFE=Nitrogen-free extract

The proximate composition of the experimental diets is presented in Table 2. The CP content of *Panicum maximum-*concentrate mix in T1 to T5 ranged from 11.64 to 14.97 g 100g-1 respectively. The NFE were 44.01, 44.01, 44.24 and 44.65 g 100g-1 in treatments T2 to T5 respectively while the GE varied from 12.90 MJ kg-1 in T2 to 13.35 MJ kg-1 in T5.

Table 2: Proximate composition of *Panicum maximum*-concentrate mix

|  |  |
| --- | --- |
| Parameters |  Level of concentrate (% BW of rams) |
| 0 | 0.5 | 1.0 | 1.5 | 2.0 |
| DMCPCFEEASHNFEGE (MJ kg-1) | 72.28 9.4231.58 3.3011.3644.3412.96 | 80.1111.6429.11 5.76 9.4844.0112.90 | 82.6212.9229.01 5.40 8.6644.0113.09 | 85.7114.5227.46 5.86 8.0144.2413.16 | 86.1114.9726.78 6.06 7.5444.6513.35 |

DM= Dry matter, CP= Crude protein, CF= Crude Fibre, EE = Ether extract, NFE= Nitrogen-free extract, GE= Gross energy.

Table 3 shows the growth performance of Yankasa rams fed *Panicum maximum*-concentrate mix in intensive feedlot. The mean feed intake varied between 656±32.2 and 689±61.10 g day-1 and not differ significantly among the treatments while the mean final weight and metabolic weight gains of rams were significant different (p<0.05). The mean final weight gain and metabolic weight gain increased from 2.35 kg and 1.76 kg-0.75 in the rams fed T1 to 10.96 kg and 6.75 kg-0.75 in the rams fed T5 respectively. The average daily weight gain (ADG) increased significantly (p<0.05) as the concentrate mix increased in the diet from 27.96±0.53 g d-1 to 80.35±4.06 g d-1 in T1 and T5 respectively. The rams fed T1 had significantly (p<0.05) higher feed conversion ratio (FCR) (24.07±1.12) while T5 had the least (8.35±0.80).

Table 4 shows the carcass characteristics of Yankasa rams fed *Panicum maximum-*concentrate mix in intensive feed lot. Rams fed the concentrate mix had significantly (p<0.05) higher pre-slaughter weight, slaughter weight, hot carcass weight, cold carcass weight, empty GIT weight, dressing percent, shoulder, neck, breast, leg, flank, mesenteric fat, kidney fat, rank, loin and shank percent weights relative to the control treatment. Rams fed with the highest level of concentrate daily gave the highest weights of 31.02 kg, 29.82 kg, 16.63 kg, 14.92 kg, 4.92 kg, 50.38%, 26.22%, 16.32%, 18.32%, 32.0%, 4.6%, 3.82%, 1.68%, 9.4%, 17.02% and 16.21% for all the above-mentioned carcass components respectively. However, the effects of the treatment diets were not significant on the skin, head and testes weights of the rams.

­Table 3: Growth performance of Yankasa rams fed *Panicum maximum-*concentrate mix in intensive feedlot

|  |  |
| --- | --- |
| Parameters |  Level of Concentrate (% BW of rams) |
| 0 | 0.5 | 1.0 | 1.5 | 2.0  |
| Feed intake g/dPanicum maximumConcentrateTotal Fl (g/d)Initial live weight (kg)Final live weightMean live weight gainMetabolic live weight gain (w/g 0.75)Average daily weight gainFeed Conversion Ratio | 6730673+53.3220.83+1.3623.18+0.65d2.32+0.20d1.76d27.96+0.53d24.07+1.12d | 59594689+61.1021.10+1.5025.29+2.16c4.19+0.31c3.14c37.38+1.32c18.43+0.63c | 476180656+32.221.56+2.026.32+1.81c4.76+0.76c3.57c42.5+2.06c15.43+0.68b | 400268668+50.1021.20+1.6828.29+1.33b7.09+0.32b6.31b63.22+3.22b10.56+1.02a | 325346671+34.4 21.98+2.0631.02+2.79a 9.04+0.76a 6.75a  80.35+4.06a8.35+0.80a |

 Means with different superscripts along the same row are significantly different (p<0.05)

Table 4: Carcass characteristics of Yankasa rams fed *Panicum maximum-*concentrate mix in intensive feedlot

|  |  |
| --- | --- |
| Parameters |  Level of Concentrate (% BW of rams) |
| 0 | 0.5 | 1.0 | 1.5 | 2.0 |
| Pre-slaughter weight (kg)Slaughter weight (kg)Hot carcass weight (kg)Cold carcass weight (kg)Empty GIT weight (kg)Dressing percent (%)Skin (%)Head (%)Shoulder (%)Neck (%)Breast (%)Leg (%)Flank (%)Mesenteric fat (%)Kidney fat (%)Rack (%)Loin (%)Shank (%)Testes (%) | 23.20±1.76d21.83±1.22d10.30±1.16c10.10±1.10d4.30±1.0144.20±0.70c26.70±0.5422.60±0.4620.80±0.39d9.80±0.76e8.30±0.22e24.40±0.68d3.00±0.25b1.20±0.21c0.40±0.76b8.60±0.0710.12±0.21e8.31±0.21e1.50±0.76 | 25.29±1.55c23.89±1.16c12.12±1.09b11.83±1.21c4.62±1.0647.92±0.81b27.62±0.3721.82±0.3521.62±0.66cd10.60±0.73d10.6±0.15d27.0±0.22c3.2±0.19b1.9±0.18b1.0±0.16a9.0±0.1312.1±0.61d12.0±0.09d1.4±0.76 | 26.32±1.61c24.62±1.23c12.68±1.19b12.02±1.26c4.72±1.1448.17±0.56b27.00±0.4421.83±0.5722.23±0.54c12.02±0.37c13.06±0.21c28.6±0.28c3.6±0.31b2.02±0.20b1.2±0.12a9.0±0.0813.60±0.58c13.06±0.16c1.6±0.76 | 28.29±1.57b26.78±1.34b13.93±1.13b13.02±1.24b4.80±1.0749.24±0.66a29.02±0.6222.20±0.5824.06±0.53b14.06±0.58b15.32±0.30b30.6±0.43b4.0±0.12ab3.42±0.14a1.6±0.13a9.2±0.1015.21±0.61b15.01±0.18b1.7±0.76 | 31.02±1.71a29.82±1.54a16.63±1.15a14.92±1.74a4.92±0.9850.38±0.58a28.82±0.7124.02±0.6326.22±0.34a16.32±0.45a18.32±0.29a32.0±0.55a4.6±0.26a3.82±0.16a1.68±0.11a9.4±0.0917.02±0.59a16.21±0.14a1.7±0.76 |

Means with different superscripts along the same row are significantly different

Table 5 shows the relative organs of Yankasa rams fed *Panicum maximum* concentrate mix in intensive feedlot. The effects of the diet treatments were similar (p>0.05) for all the parameters investigated.

Table 5: Relative organ characteristics of Yankasa sheep fed *Panicum-maximum*-concentrate mix in intensive feedlot

|  |  |
| --- | --- |
| Parameters |  Level of Concentrate (% BW of rams) |
| 0 | 0.5 | 1.0 | 1.5 | 2.0 |
| StomachKidneyLiverLungSpleenHeartSmall intestineLarge intestineCaecum | 13±0.121.10±0.103.80±0.074.80±0.080.61±0.111.60±0.097.50±0.105.30±0.051.50±0.07 | 15±0.061.26±0.044.00±0.064.60±0.010.58±0.031.70±0.078.00±0.045.48±0.042.00±0.06 | 15.80±0.021.11±0.034.20±0.054.60±0.040.49±0.031.58±0.027.40±0.045.76±0.031.78±0.02 | 15.2±0.051.2±0.034.0±0.044.8±0.050.62±0.041.62±0.037.1±0.036.20±0.061.8±0.04 | 16.40±0.041.20±0.064.10±0.085.00±0.020.62±0.041.82±0.038.60±0.016.50±0.052.00±0.06 |

Means with no superscript along the same row are similar (p>0.05)

**Discussion**

The crude protein (CP) content of *Panicum maximum* used in this study was less than 12.17 g kg-1 obtained by Fadiyimu *et al*. (2016) but exceeded 5.87 g kg-1 reported in Oluboyede *et al.* (2007). However, the CP value was above 7.7% which is the critical level recommended for small ruminants (ARC 1985). The crude fibre content was lower than 37.47 g kg-1 reported by Fadiyimu *et al*. (2007). The nitrogen free extract exceeded the 34.47 g kg-1 reported by Fadiyimu *et al.* (2007) and Oluboyede *et al*. (2007). The differences in the values of the proximate composition could be due to age and harvest season which may affect proximate analysis.

The concentrate had dry matter which was comparable to the range of 86.5 to 94.54 g kg-1 reported by Adegbola (1980). The crude protein content of the concentrate diet was above 12% minimum value recommended for growing small ruminants (Gatemby, 1995). The CP content of the concentrate mix was higher than the values obtained for most grasses, including *Panicum maximum* but lower than 20.11g kg-1 used to supplement the diet of confined lambs kept on *Bracharia brizantha* grass pastures (Prado *et al*., 2014). The CP values in the experimental diets T1 to T5 fell within the limit of 9 to 14% recommended for growing sheep (Aduku, 2005). Concentrates usually mean high quality low fibre diets of less than 18% crude fibre content (Van, 2006) but the fibre at 26.97 to 29.11g kg-1, moderate CP and high nitrogen-free extract would make the concentrate mix in this study a high energy and protein supplement (Oyedele *et al*., 2016).

The lack of significant differences in feed intake in this study shows that rams supplemented with concentrate mix did not consume more feeds than the control diet. This differs from Nyako (2015) who fed Yankasa rams with concentrate and obtained significant differences in feed intake between the control and supplemented diets with values at 766.70 and 850.53g d-1 respectively. Mubi *et al.* (2008) also observed higher feed intake in growing heifers fed supplemented diet than the control treatment without supplement. The higher protein in diet has been attributed to the higher feed intake (Babayemi *et al.,* 2006). Although the crude protein increased from T1 to T5, the overall result did not agree with the findings of other researchers probably because of the moderate level of protein (14.97g kg-1) at the highest level of supplementation (T5) which was less than 20% and the higher crude fibre (>18%) than a typical concentrate diet (Oyedele *et al*., 2016). According to Van (2006), a concentrate mix would usually mean high quality low fibre diet of less than 18% crude fibre. The crude fibre content which varied between 26.97 to 29.11 g kg-1 in T2 - T5 could be due to the inclusion of rice husk, brewers’ dried grains and *Moringa oleifera* leaves which are high fibre and energy ingredients.

The significant increase in body weight gain in this study as the concentrate mix increased from 0% to 2.0% agrees with Nyako (2015) who obtained significant increase from 66.07 to 96.4 g head-1 day-1 in Yankasa rams fed cowpea hay with different supplements. The values in T1 to T4 fell below 80-93 g head-1 day-1 reported for Yankasa rams fed gamba grass supplemented with cowpea vines (Nyako *et al*., 2012). However, the weight gain in rams supplemented with concentrate mix in this study was higher than the average of 38 g day-1 in Yankasa sheep fed pasture supplemented with browse under semi-intensive management (Ikeobi and Faleti, 1996). This could be due to the adequate supply of energy and protein required for optimum growth performance of the rams fed diet treatments T2 to T5. Gatemby (1995) had noted the marked effect of the quality of food available on the growth of animals. Also, the results from Jabbar and Anjum (2008) and Mubi *et al.* (2012) showed that growth performance improved as the level of concentrate increased in the diet of sheep.

The highest FCR (24.07+1.12) in this study was recorded in T1. This means that animals fed the control diet had the poorest FCR. A similar trend was observed by Oluboyede *et al*. (2007) that WAD rams fed basal Panicum fodder supplemented with three types of concentrate had the poorest FCR. This implies that supplementation has positive effects on the live weight gain and FCR through maintenance of good rumen activities in the sheep (Jabbar and Anjum, 2008; Kabir *et al*., 2012). The increasing FCR as the level of concentrate increased indicated that the supplemented diets were being utilized in relation to increase in CP content which improved the total live weight gain and feed conversion ratio (Okoruwa *et al*., 2013).

The carcass characteristics of the rams increased significantly with the levels of concentrate mix. The rams fed 2.0% concentrate mix supplement gave the highest values in all the carcass traits except for the skin, head, testes and all relative organs. This corroborates the findings of Osuhor *et al.* (2009) that revealed high carcass weights and dressing percentage for Yankasa rams fattened with the highest level of dried poultry litter and maize. The dressing percentage range (44.20-50.38%) in this study is comparable to 43-48.2% obtained in Washera sheep fed urea-treated straw supplemented with graded levels of concentrate mix (Abebe *et al*., 2011). The increasing values of mesenteric and kidney fat agrees with Kumari *et al*. (2012) that fat content of meat was linearly increased with increasing proportion of concentrate fed to lambs.

The study has succinctly shown the at concentrate supplementation has positive effects on live weight gain of sheep and dressing percentage which may be due to differences in the nutritional composition of the experimental diets in terms of crude protein and energy (Okoruwa *et al*., 2013). The relative organs maintained their integrity irrespective of feeding supplementation. Carvalho and Medeiros (2010) had observed that diets with different energy levels did not affect organ weights in sheep.

**Conclusion**

This study evaluated the effect of supplementing *Panicum maximum* basal diet with varied levels of concentrate mix on the growth, yield and carcass quality of Yankasa rams. The results show that the treatments did not increase feed intake but improved feed conversion ratio, total live weight gain and carcass yield. The best result was obtained in Yankasa rams fed with 2% concentrate mix as percentage body weight.

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