

Performance and linear body measurements of WAD goats fed *Panicum maximum* supplemented with cassava and *Aspilia africana* leaves

*¹Etido P. Umoren, ²Iso E. Iso, ¹Magnus I. Anya and ¹Aloysius A. Ayuk

¹Department of Animal Science, University of Calabar, Calabar, Nigeria.

²Department of Animal Science, University of Cross River State, Okuku, Nigeria.

*Corresponding Author's email: epumoren@unical.edu.ng, +2348036689785.

ABSTRACT

This study was undertaken to evaluate the effect of feeding *Panicum maximum* supplemented with *Aspilia africana* and cassava leaves on the performance and linear body characteristics of WAD goats between 4 and 5 months of age with an average body weight of 5.5 kg. Twenty-four intact male goats were randomly allotted to four treatments with six goats per treatment in a completely randomized design. The control diet (Treatment I) was solely *P. maximum* (SPM); (Treatment II) *P. maximum* + cassava leaves (PM 50%-CL 50%); (Treatment III) *P. maximum* + *A. africana* (PM50%-AA50%); and (Treatment IV) *P. maximum* + *A. africana* + cassava leaves (PM33.3%-AA33.3%-CL33.3%), respectively. Animals were housed with concrete floor; the pens used were raised at about 1m above the floor, with each compartment measuring 1.6 × 0.94 m and the experiment lasted for eight weeks. Feed intake (differences in fresh forage supplied and leftover) was obtained daily, and the weight gain and linear body parameters (using flexible measuring tape) were measured at weekly intervals. Data were analysed using GENSTAT v11 statistical package. Results showed that the mean weekly weight gain, mean daily feed intake were not significantly different ($p>0.05$) between the treatment groups. However, feed conversion ratio was significantly different ($p<0.05$). The linear body parameters were not significantly different ($p>0.05$), except for the height at withers. Based on the results, it was concluded that feeding goats with *P. maximum* should be encouraged and supplementation with cassava leaves at equal proportion (PM 50%-CL 50%) is recommended.

Keywords: Feeds resources, WAD goats, forages, supplementation

INTRODUCTION

Goats are multipurpose animals producing meat, milk, skin and hairs (Mataveia *et al.*, 2021, FAO, 2024). However, out of these products, meat is the major form in which goats are consumed in Nigeria (Alikwe *et al.*, 2011). Their potential for milk production is being harnessed by majority of smallholder owners who

domicile in Nigerian rural communities. In the subsistence sector, pastoralists and agriculturalists often depend on them for much of their livelihood and the meat is widely accepted and consumed in Nigeria, because there is no taboo against it (Ajagbe *et al.*, 2020). The demand for goat meat is very high especially in rural areas where it often commands higher market price than

beef (Odeyinka, 2000). The meat from goat is preferable to those from other animal species because of its flavour, tenderness and palatability (Idiong and Orok, 2008). They are indispensable in marriage and religious rites (Gefu *et al.*, 1994) and are an insurance against crop failure (Debela *et al.*, 2020). In southern Nigeria, goats are a ready source of family income and a good medium to establish friendship or restore peace in a community (Idiong and Orok, 2008; Toviesi *et al.*, 2024). The West African Dwarf (WAD) goat is a predominantly indigenous breed in southern Nigeria (Odeyinka, 2000). Goats constitute the largest group of small ruminant livestock in Nigeria, totaling about 73.8 million and also making up of 6.2 percent of the World's goat population, while the WAD goat has a population of about 15 million in Nigeria (CABI, 2022; Funmilayo and Williams, 2024).

Generally, the rearing of goats is mainly traditional; whereby they scavenge for food. Small ruminants suffer scarcity of feed supply and pasture quality in the humid region of West Africa, especially during the dry season when the natural vegetation is of poor nutritive value (Aye, 2007). Ahamefule and Elendu (2010) identified feed shortage as a major constraint to goat production in Nigeria.

Indeed, traditional rangelands produce the cheapest source of nutrients for goats, and for a greater part of the year, grasslands do not supply sufficient nutrients to stock; the practice has been to supplement livestock diets with protein rich ingredients such as groundnut cake (GNC) to meet their daily nutrient requirements (Daramola *et al.*, 2005; Dung *et al.*, 2010). Goats also subsist

on household wastes and crop residues (Odeyinka, 2000). During the dry season, the traditional rangelands and crop residues available for ruminants after crop harvest are usually fibrous and devoid of most essential nutrients including proteins, energy, minerals and vitamins which are required for increased rumen microbial fermentation and improved performance of the host animal (Osuji *et al.*, 1995) resulting in weight losses, low birth weights, lowered resistance to disease and reduced animal performance (Onwuka *et al.*, 1989; Mamuad *et al.*, 2019; Zhou *et al.*, 2022). Seasonal availability of pasture regularly influences the production of goats and other ruminants' species with soybean meal (SBM) and cotton seed cake (CSC). Concentrate mixtures including cereal grains, cereal bran and oil seed meals have resulted in increased intake in intensive production systems, and such strategies have been the subject of several excellent reviews, including that of Bangani *et al.* (2002). Unfortunately, these supplements are often not fed due to their unavailability and their high costs (Nouala *et al.*, 2006; Olomola *et al.*, 2008).

Due to this scarcity of enough green fodder in the dry season, there is necessity to search for abundant but non-conventional feedstuffs and foliages which are cheap and not in high demand by human (Amaefule, 2002). With a large proportion of plants being used for the nourishment of various domestic animals naturally occurring browse species thus appear a vital component in the diets of sheep and goats; with goats particularly dependent on them to meet their nutrient requirements (Rinehart, 2008; Adamu *et al.*, 2021). A cheaper alternative

of enhancing utilization of low quality grass is by supplementation with the foliages of high nitrogen multipurpose trees or other agro-wastes (Asaolu et al., 2012; Oluwatosin et al., 2023; Dida et al., 2023; Umoren et al., 2024). Browse plants with high nutritive value have been successfully fed to small ruminants in alley farming systems (Fasae and Alokun, 2006). Studies have shown that multipurpose trees can be used as cheap protein supplements which can improve voluntary intake, digestibility and general performance of animals fed low quality feeds (Kakengi et al., 2001).

Furthermore, the crude protein content of principal forages such as guinea grass reduce to as low as 2 percent for the most part of the dry season, alongside reduced mineral and energy contents thus affecting intake and digestibility of dry matter (Dele et al., 2013; Dandara et al., 2025). Therefore, supplementation of such grasses (guinea grass) with forages rich in protein in livestock production systems for ruminants has increased, since protein is the most limiting nutrients in tropical animal diets (Ajayi et al., 2008).

Guinea grass (*Panicum maximum*) is one of the major pan tropical grasses and it is suitable for pasture, cut-and-carry, silage and hay. Many guinea grass cultivars have been developed for different purposes and agronomic situations (FAO, 2016). Feeding goats with guinea grass gives better results when it is supplemented with forages rich in protein (Phimphachanhvongsod and Ledin, 2002; Bamikole, 2003; Ajayi et al., 2008). Supplementation increases feed intake and nutrient utilization (Bamikole et al., 2001; Phimphachanhvongsod and Ledin, 2002).

Panicum maximum can be sown with companion legumes such as *Centrosema pubescens*, *Leucaena leucocephala*, *Pueraria phaseoloides* or *Macroptilium* (Cook et al., 2005).

Cassava is widely grown in Nigeria and the leaves are a potential source of protein available at farm level (Nwaobiala and Isaac, 2017). Fresh cassava foliage as the sole source of fibre and protein in a diet of liquid molasses and urea (3% urea) supported growth rates of almost 900 g/day and there was no advantage in providing additional soybean meal (Fasae and Yusuf, 2022). Supplementation with fresh cassava leaves improved the consumption and performance of cattle fed a basal diet of untreated rice straw (Do et al., 2002; Seng et al., 2001) and of goats fed a basal diet of spent brewer's grains, molasses and cage layer waste and other supplements (Seng and Rodriguez, 2001; Oni et al., 2010; Abatan et al., 2015; Oni et al., 2020; Fasae and Yusuf, 2022; Yaikyur et al., 2024). Cassava leaf is composed of leaves and tender stems, with high protein content (16.7 -39.9%) and with almost 85 percent of crude protein as true feeding (Yousuf et al., 2007; Fasae et al., 2017). If good harvesting technique is developed, cassava leaf has good potential forms and usage in Nigeria, there is enough cassava leaf for inclusion in diets of goat (Jiwuba and Jiwuba, 2020).

This advantage could be exploited to reduce cost of input in feed, while improving goat production and enhance animal protein supply. Cassava leaf is well balanced, except for a deficiency of sulphur-containing amino acids. The presence of hydrocyanic acid and tannins is considered

(Matovu and Alçiçek, 2021). The new global search for sustainable forage suitable for feeding livestock with anti-anaemia and anti-infective bacteria of natural sources has led to the investigation of many more Nigerian plants now than previously (McKay, 2025). One of such plants *A. africana*, which belongs to the family; *Asteraceae*, and it is a common weed of field crops in West Africa and sometimes found in fallow land, especially the forest zone (Etim *et al.*, 2021).

Aspilia africana is commonly used to feed livestock, particularly cattle, sheep, goats and rabbits and are known to have both nutritive and medicinal values (Etim *et al.*, 2021). Moreover, the seed oil of *A. africana* contains a variety of fatty acids, with a significant presence of polyunsaturated fatty acids (PUFAs: linoleic acid and linolenic acid), followed by saturated fatty acids (SFAs: palmitic acid) and monounsaturated fatty acids (MUFAs: oleic acid) (Obuzor and Nkom, 2010), and the presence of diterpenes, kaurenoic acids and grandifloreic acids from the leaves (Etiosa *et al.*, 2017).

Linear body measurements provide better information on the body weight as they are very important traits in goat production (Mathapo *et al.*, 2025). This measurement is known to be affected by environmental conditions of the animal (Assan *et al.*, 2024). The body size has been largely estimated using weighing scale, while the body conformation has generally been described by visual appraisal giving rise to the need of measurement using instruments like measuring tape to measure different body parts (Lukuyu *et al.*, 2016).

Shoyombo *et al.* (2015) pointed that

external body measurements have been used to contrast variation in size and shape. However, the biological relationship existing among the linear body traits may be different if these body dimensions are treated as bivariate rather than multivariate, since body measurements are inter-correlated both genetically and phenotypically (Akanno and Ibe, 2005). Additionally, in cases where weighing scales are not available, linear body measurements provide good estimates for body weight (Slippers *et al.*, 2000). This study aimed at providing information on the growth performance and linear body measurements of WAD goats fed *P. maximum* solely (SPM); *P. maximum* supplemented with cassava leaves (PM 50% - CL 50%); *P. maximum* and *A. africana* leaves (PM 50% - AA 50%) at equal levels; and a combination all the three fresh green forages (PM 33.3% - AA 33.3% - CL 33.3%) at same diet composition levels.

MATERIALS AND METHODS

Experimental site

The research was carried out at the Department of Animal Science Teaching and Research Farm, Faculty of Agriculture of the University of Calabar, Calabar, Cross River State, Nigeria. Calabar lies on 4° 19' N of the equator and longitude 8° 20' E on the Greenwich meridian. The average daily temperature ranges from 25° to 30°C, with a relative humidity between 70 and 90 %, and has an average annual rainfall of 1830 millimeters (NiMet, 2025).

Management of experimental animals

The study involved twenty four (24) West African Dwarf (WAD) goats of between 4 and 5 months of age with an average body weight between 5 and 6 kg that were purchased from the Watt market in Calabar. The animals were housed; the pens used were raised at about 1m above the floor, with each compartment measuring 1.6×0.94 m. The pens were thoroughly washed and disinfected with detergent and Izal, respectively. After which they were allowed to dry up for 14 days so as to break the disease cycle. Wooden slabs were constructed and placed on the floor for the animals which also generated heat for them.

When the animals arrived at the unit, they were allowed to rest 14 days and fresh forages were given to them throughout the day. The animals were vaccinated, dewormed and allowed for adaptation period of two (2) weeks. The twenty-four (24) goats (bucks) were balanced for weight and randomly allotted to four (4) dietary treatments (I, II, III, IV) in a completely randomized design (CRD) experiment. Six goats were assigned to an experimental diet with each goat representing a replicate, feeds were given in the morning (8:00am) and left over weighed the following morning and discarded before fresh feeds were given to the animals. Clean and fresh water was offered *ad-libitum*. The weight using a suspended weighing scale with a sensitivity of 100 g (FOREVER SCALES 25 kg.100 g, China) of each goat and linear body measurements, using a flexible plastic measuring tape, were taken weekly.

Experimental forages and proximate analysis

Panicum maximum and *Aspilia Africana*: *Panicum maximum* and *Aspilia africana* leaves were harvested, at vegetative/early bloom stage, from naturally grown pasture along the roadside of the University of Calabar Teaching and Research Farm. The forages were harvested every morning and sorted out before being fed to the animals. *P. maximum* was supplemented with *A. africana* and cassava leaves.

Cassava leaves: Cassava leaves were obtained from individual farmlands owned by the female farmers along the roadside of the University of Calabar Teaching and Research Farm. The forage was harvested in the morning and fed to the animals.

Prior to daily harvest, composite samples of the three forages were obtained for the estimation of dry matter and chemical properties using a forced air drying oven until constant weights were achieved. The dried samples were ground through a 1 mm screen and milled samples packed in plastic bags for subsequent chemical analyses. The dried samples were later analyzed for crude protein (CP) content and other chemical compositions according to AOAC (1995) method.

Experimental diets

The experimental diets fed to the animals in treatments I, II, III and IV were represented as shown in Table 1.

The experimental diets (Table 1) fed to the animals in treatment (I, II, III and IV) were represented as follows:

Treatment I (SPM): Solely *Panicum maximum* (100%)

Treatment II (PM-CL): *Panicum maximum* (50%) + Cassava leaves (50%)

Treatment III (PM-CL): *Panicum maximum* (50%) + *Aspilia africana* (50%)

Treatment IV (PM-AA-CL): *Panicum maximum* (33.3%) + *Aspilia africana* (33.3%) + Cassava leaves (33.3%).

Data collection

Feed offered and refusal records were taken on a daily basis; while body weight, weight gain and linear body measurements were taken on a weekly basis. Measurements were made by putting the goats into harness bags and weighed using a mobile hanging/hanging scale, also by using a flexible measuring tape for the linear body parts. The feed intake records were obtained daily by simply subtracting the leftover weights from the initial weighed amount given to the animal per day.

The body weight gain was obtained on a weekly basis by simple subtracting the initial weight from the final weight gain. Feed conversion ratio was calculated as the ratio of feed intake to the body weight gain. The parameters measured for growth performance included: Initial body weight (kg), final body weight (kg), weekly weight gain (kg), mean feed intake (kg), feed conversion ratio, and mortality (%). Similarly, linear body measurements (cm) were: Ear length, tail length, body length, sacral pelvic length, height at wither, and heart girth.

Statistical analysis

Data obtained in this study were subjected to the one-way analysis of variance (ANOVA)

in a completely randomized design using GENSTAT (2011) version 11, statistical software package, and where significant, Duncan Multiple Range Test was used for mean separation (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

Results

Proximate compositions of *P. maximum*, *A. africana* and cassava leaves are presented in Table 2. The crude protein content was 17.50, 24.50 and 28.87 % for *P. maximum*, *A. africana* and cassava leaves, respectively with cassava leaves recording the highest value. Ether extract content of *P. maximum* and cassava leaves was 3.50 %, while that of *A. africana* was 3.00 %. Crude fibre was highest in *P. maximum* (38.00 %) followed by *A. africana* (21.00%) then cassava leaves recorded the least crude fibre content of 20.00 %. The Cassava leaves had relatively the lowest value for ash content (7.00 %), while *A. africana* recorded the highest ash content value (16.00%). Nitrogen free extract contents of the forages were high; 33.00, 35.50 and 40.63% for *P. maximum*, *A. africana* and cassava leaves respectively.

Table 3 shows the performance of West African Dwarf goats fed different forages. Result showed that treatment I recorded the best feed conversion ratio relative to other treatment groups. The result showed that the mean weekly weight gain was not significantly different ($p > 0.05$) among the treatment groups. Although, goats in treatment IV had the highest mean weekly weight gain of 575 kg. The mean

daily forage intake ranges from 0.1416 - 0.2770 kg for treatments I - IV. The variation among the treatment groups were however not significantly different ($p>0.05$).

Result for the linear body measurements of West African Dwarf goats fed *P. maximum*, *A. africana* and cassava leaves are presented in Table 3. The results showed that all the parameters measured, except height at withers, were not significantly different ($p>0.05$) between dietary treatments. However, goats fed *P. maximum* had the longest sacral pelvic length (2.58 cm), while goats fed diet II had the longest neck circumference (20.15 cm). Also, goats in treatment IV recorded the longest ear length (8.75 cm) and goats in treatment III had the highest height at withers (36.30 cm).

Discussion

The highest value of crude protein recorded in cassava leaves agrees with the report of several authors (Fasae and Yusuf, 2022; Gundersen *et al.*, 2022) that cassava leaves are rich in protein (16.7 -40.0 % dry matter basis). This could be attributed to the reports by Oluwafemi and Omaku (2017) indicating that apart from lower methionine, lysine and perhaps isoleucine contents, the amino acid profile of cassava leaf protein compares favourably with those of milk, cheese, soybean, fish and egg.

The crude protein content of *P. maximum* and *A. africana* leaves was relatively high compared to the average value of 8 - 16% (*P. maximum*) and 7.70 to 20.65% (*A. africana*) reported for the most

part of the dry season (Dele *et al.*, 2013; Oko *et al.*, 2016; Kalu, 2021; Jamil *et al.*, 2024). This variation may be due the difference in the type of initial raw material. The content of crude protein also depends on the proportion of the leaves and stem. Some studies indicate that the decline in crude protein during the dry season might be linked to the plant transitioning from a vegetative state to its flowering stage. . The 24.50% crude protein content recorded in *A. africana* is comparable to the value obtained by others (Oko *et al.*, 2016; Kalu, 2021), and such higher crude protein content in *A. africana* during the rainy season may be beneficial for goats as forage.

The crude fibre showed that the diets have the potential to support intestinal movement and proper rumen function. Ash contents of the forages were relatively low at 16, 8 and 7% for *A. africana*, *P. maximum* and cassava leaves, respectively, suggesting high fibre content. The low nutrient content may be attributed to the stage of maturity of the forages at the time of harvest, since fibre content of forages increases as the forage matures and lignifications increases (Ademosun, 1994; Goetsch *et al.*, 2011). Nutrient composition also may be affected by factors such as type and level of fertilizer applied and variety of forage (Kebede *et al.*, 2024; Mao *et al.*, 2025).

Growth parameters studied were not significantly different ($p>0.05$) apart from the feed conversion ratio. The feed consumed did not reflect on the body weight gain of the animals. This could be as a result of improper digestion of the forages which could be due to high fibre content of the

forages (Tedeschi *et al.*, 2023). However, the result showed that goats in treatment IV placed on diet containing 33.3% *P. maximum*, 33.3% *A. africana* and 33.3% cassava leaves did not improve in weight despite the high intake observed, the animals consistently lost weight. This may be attributed to loss in the dietary nitrogen through the faeces and urine (urinary and faecal nitrogen) which would have been utilized for growth and weight gain (Adelusi *et al.*, 2016). The high forage intake observed in goats fed combination of three forages may probably be due to the fact that the forages were more palatable and therefore accepted by the animals compared to those fed solely *P. maximum*, *P. maximum* with cassava, and *P. maximum* with *A. africana* as this agrees with the report of Seng and Rodriquez (2001) and Kanyinji *et al.* (2017). It may also be due to the lower dry matter content, since animals are known to eat to satisfy their dry matter intake. Nsa *et al.* (2024) observed a non-significant relationship among goats fed different forages which correspond to the finding of this research and can be concluded that *A. Africana* and cassava leaves could possibly replace *P. maximum* in West African Dwarf goats' diets, with improved growth performance.

The feed conversion ratio observed in goats fed *P. maximum* showed that the animal effectively utilized the forages to their advantage. Most of the dietary nitrogen consumed may have been retained in the body and was effectively converted to muscle to increase the body mass. Hence, the best feed conversion ratio range for all

experimental diets (ranged 2.50 - 6.11) was lower than the report on WAD goats on *P. maximum* alone (17.55 - 24.53) of Fajemisin *et al.* (2020), and the lower the value of the feed conversion ratio, the more desirable the diet as the animals will want to consume more to produce a unit weight gain (Davison *et al.*, 2023). The high percentage mortality observed among the goats in all treatments may be as a result of the total restriction of the goats as they were not allowed free access they used to prior the total restriction of the goats as they were not allowed free access they were used to prior to the commencement of the feeding trial, this agrees with the findings by Iyasere *et al.* (2018) and Ikyume *et al.* (2023), who reported that confinement brings about factors of environmental stress such as physical discomfort, behavioural deprivation, emotional stress and changes in feeding. A change in the locality may also be responsible for the high mortality; also, the stress brought about by everyday or frequent interaction may probably be the reason for the high mortality.

In general, the growth performance of these goats was not significantly different ($p>0.05$), this could also be as a result of seasonal changes during when the research was carried out (i.e. the peak of the rainy season), and the weather was possibly too cold for the animals. There was high disease outbreak during this period coupled with the changes in nutritional patterns as well as environmental differences and well being of the goats at the initial stage of the research. Indicatively, the goats were transferred from an open market to a closed pen that was

demarcated using wood, wire mesh and aluminum that covered the half walls. However, slabs were made and placed on the floor to prevent the goats from having contact with the cold floor. These conditions in turn affected their feed intake and as such hampered their physical growth performance (Alvarez *et al.*, 2013; Thomsen and Houe, 2018).

The linear body parameters studied were not significantly different ($p>0.05$), except the height at withers. Since body weight and linear body measurements are related (Ozoje and Hebert, 1997), the result obtained for the linear body measurements of WAD goats fed *P. maximum*, supplemented with *A. africana* and cassava leaves is obviously related with the growth performance results obtained via total weight gained, this agrees with the findings of Slipper *et al.* (2000) and Rotimi *et al.* (2017), that linear body measurements provide good estimates for body weight.

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CONCLUSION

The study concluded that *P. maximum* and *A. africana* forages had no significant effect on the growth performance and linear body measurements of WAD goats. Therefore, the study indicated that *P. maximum* can be fed to WAD goats when supplemented with cassava leaves for better performance and improved linear body parameters.

RECOMMENDATION

The study encouraged a general supplementation of *P. maximum* based diets for WAD goats with known foliages, like *A. africana* and cassava leaves as they tend to improve the heights of the animals, and recommended the feeding of *P. maximum* and cassava leaves (PM50% -CL50%) at equal proportion, especially for small holder rural farmers where cassava harvesting is done all year round.

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Table 1: Experimental forages (diets)

Component / Ration	Treatment I (SPM)	Treatment II (PM-CL)	Treatment III (PM-AA)	Treatment IV (PM-AA-CL)
<i>Panicum maximum</i>	ad libitum 100%	50%	50%	33.3%
Cassava leaf	-	50%	-	33.3%
<i>Aspilia africana</i>	-	-	50%	33.3%

Table 2: Proximate composition of experimental forages

Ration/component	Crude protein (%)	Ether extract (%)	Crude fibre (%)	Ash (%)	Nitrogen free extract (%)
<i>Panicum maximum</i>	17.50	3.50	38.00	8.00	33.00
<i>Aspilia africana</i>	24.50	3.00	21.00	16.00	35.50
Cassava leaves	28.80	3.50	20.00	7.00	40.63

Table 3: Performance characteristics of WAD goats fed *Panicum maximum* supplemented with *Aspilia africana* and cassava leaves

Parameters	Trt I (SPM)	Trt II (PM-CL)	Trt III (PM-AA)	TrtIV (PM-AA-CL)	SEM
Number of animals/diets	6	6	6	6	0.7721
Initial weight (kg)	5.6667	5.8333	5.5000	5.9167	0.1589
Final weight gain (kg)	7.8500	8.0500	7.500	7.0500	0.971
Mean daily forage intake (kg)	0.6763	0.8375	0.7563	0.8675	0.1312
Mean weekly weight gain (kg)	0.2729	0.2770	0.2500	0.1416	0.8371
Feed conversion ratio	2.50 ^c	3.30 ^b	3.03 ^{bc}	6.11 ^a	2.5819
Mortality (%)	33.33	33.33	66.66	33.33	

^{a,b,c} Means with different superscripts on the same row are significantly different (p<0.05)

Table 4: Linear body measurements of WAD goats fed *Panicum maximum* supplemented with *Aspilia africana* and cassava leaves

Parameters (cm)	Trt I (SPM)	Trt II (PM-CL)	Trt III (PM-AA)	TrtIV (PM-AA-CL)	SEM
Tail length	7.79	7.95	8.01	7.52	0.08
Neck circumference	19.87	20.15	19.89	19.46	0.64
Body length	33.80	33.12	34.75	33.81	0.12
Heart girth	42.16	41.45	42.21	41.00	0.09
Ear length	8.59	8.68	8.71	8.75	0.02
Sacral-pelvic length	2.58	2.38	2.54	2.28	0.89
Height at wither	34.61 ^b	35.24 ^a	36.30 ^a	35.08 ^a	0.12

^{a,b,c} Means on the same row with different superscripts are significantly different (p<0.05).