

## Full Length Research Paper

# Morphometrical study of the mandiblar bone of female Yankasa sheep (*Ovis aries Linne*)

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The research was aimed at studying the morphometric analysis of the twenty (20) lower jaw bones (mandible) of female Yankasa breed of sheep in relation to their ages postnatally using standard biometrical tools. The study was conducted in Sokoto metropolis, through daily marked visitation. The samples were obtained and classified according to age; group 1 (0-6months), group 2 (6months-1year), group 3 (1-2years), group 4 (2-3years), group 5 (3years-above). The ages were estimated on the basis of the eruption and wearing of the teeth. All morphometric data examined were expressed as Mean  $\pm$  SD. The mean and standard deviation of the morphometric data of the horizontal and vertical ramus of the mandible of the Ewe at different postnatal age were determined and recorded. The results have shown that there is an increase in both horizontal and vertical ramus of the mandible of the Female Yankasa Sheep, though a drastic increase in size, shape and weight was observed from two(2) years to four (4) years of

age. Furthermore, the morphometric data of the Female Yankasa Sheep is comparable to other various sheep and goat breeds of ruminant with little variations that could be due to breed, geographical location, nutritional values, and weather of an area, genetic makeup and body scoring index of the breed. The present result provides a baseline data on the morphometric of the mandible Female Yankasa Sheep in the West African region of the world. It is therefore recommended that further work should be carried out on other breeds of sheep in Nigeria with other parameters using sophisticated biometrical equipment. The study has described the morphology and biometric characteristics of the female Yankasa Sheep and shows contribution for comparative model for other African local Ovine breeds in Nigerian and Africa at large.

**Keywords:** Anatomy, bone, female, morphometry, mandible, Yankasa sheep

## INTRODUCTION

Yankasa Sheep is among the breeds of sheep found in Nigeria, but is more widespread in the northern part of the country. The Yankasa is believed to have descended from a common ancestor with the West African Dwarf Sheep. Domesticated sheep are not native to Africa and they entered North Africa from the Levant via Egypt some 7000 years ago. All domestic African sheep are descended from this original stock (Salako, 2006).

Yankasa Sheep are primarily used as a meat breed, though they are also used for milk. In Nigeria, small

ruminants like the Yankasa are an important food source, and contribute an estimated 35% to the total meat supply (Anonymous 1). The coat colour of Yankasa is typically white with black patches around the eyes, ear, muzzle and sometimes the feet. The rams have curved horns and heavy hairy white mane. Some of the ewes have tassels on the neck. Mature weights are 25 – 40 kg for ewes and 35 – 50 kg for rams (Adu *et al.*, 1979).

Animal morphology shows considerable variation with respect to breed, age, sex, nutritional condition and

environmental factors, among others. Thus, measurements are important tools for comparison. In order to achieve a more objective racial assessment, numerous metrical studies have been carried out (Kunzel *et al.*, 2003; Brombin *et al.*, 2009). The shape and appearance of the head are important in determining the nature of an animal (Dyce *et al.*, 1996). The phenotypic appearance of an animal's head has been reported to depend on the shape of the mandible and is strongly related to breed specific skeletal features (Salako, 2006).

The mandible and teeth of a carcass can tell you with reasonable accuracy the age of a sheep, however, the analysis of wearing and eruption of teeth is more accurate in age estimation. Mandibles of lambs differ from those of adults. It has been known for a long time that although certain elements of the limbs of sheep ossify, at least in part in the fetus, yet they appear inconstantly in the adult. Such structures are the clavicle, fibula, and the second and fifth metacarpal and metatarsal bones (Gizaw *et al.*, 2011). Many researchers have been carried out on the morphometry and biometry of the mandible such as in the morphometrical and morphological parameters employed to establish data on the regional anatomy of the head of small ruminants (Sarma, 2006). Karimi *et al.* (2011) discussed the usage of morphologic and morphometric characteristics of mandibles in several basic and clinical applications in Mehraban sheep in Western Iran. The regional anatomy of the Kagani goat from Jammu region in India has been studied based on its morphological and morphometrical parameters (Sarma, 2006). Morphological parameters have been investigated in Sahel goat mandible describing bones of the mandible and how they differ among the ecotypes of the Sahel goats in Nigeria (Shawulu *et al.*, 2011). The importance of mandible in housing of brain and giving shape to the head create the need to study the developmental changes at different age intervals of sheep for better understanding of the breeding capability of the breed. However, there's paucity of information on the morphometry of the mandibular bones of Yankasa breed of sheep's in the world. This work was aimed at the biometrical analysis of the mandible, metacarpal and metatarsal bones in relation to the age at postnatal stage of the Female Yankasa Sheep. To determine the morphometric data of the component of the mandible bone and mandible at postnatal stages in relation to age. To determine the morphometric data of the component of the metacarpal bones in relation to age. To determine the morphometric data of the component of the metatarsal bones in relation to age.

## MATERIALS AND METHODS

### Study area

The study was conducted in Sokoto metropolis, the capital of Sokoto state of Nigeria. Geographically, the

state is situated on Latitude 12° 15N and 05°E, and is 308m above the sea level. Sokoto State occupies an area of short grass and Savanna vegetation in the South and thorn in the North. It shares boundaries with Zamfara State to the East, Niger Republic to the North, and Kebbi State to the West and South West (Sokoto, 2001). The State was ranked second in the nation livestock population with an estimated number of 3million cattle, 3.85 million sheep, 4 million goats, 0.8 million camels and 2 million poultry (Buhari, 2008). These animal species are the major sources of proteins to the inhabitant of the state, and over 75% of them are reared in traditional free range system, living in close association with human settlements (Buhari, 2008).

### Sample design

A cross sectional study design was used. This study design was employed due to its being best suited for investigation of permanent factors such as breed, sex and blood types in animals (Eng, 2003). Purposive sampling (Non-probability sampling) was used in this study based on Patton, (1990) and Salako, (2006). The fresh heads from slaughtered Yankasa Sheep were selected based on the known breed characteristics, good health and lack of skeletal abnormalities (Olopade and Onwuka, 2005c; Ahmadu, 2001).

### Sample collection

Ten heads of sheep's along with their canon and crus bones identified as female Yankasa sheep's aged 0-6months and older were collected from Sokoto state modern abattoir after slaughter of animals. The heads were selected based apparently on the good health of the animals noting characteristics such as lack of congenital deformities or any scars on the mandibles (heads) from trauma (Olopade and Onwuka, 2005). The sampling was stratified according to age; 2 (0-6months), 2(6months-1year), 2(1-2years), 2(2-3years), 2(3years-above) for the mandible and mandible. For the metacarpal and metatarsal bones, the left and right forelimb had two metacarpal bones each and the left and right hind limb had two metatarsal bones each as well. Therefore four metacarpal and metatarsal bones were collected for each age group with the same stratification for the mandible giving a total of 20 metacarpal and 20 metatarsal bones. The age was estimated on the basis of the eruption of the permanent teeth as a guide (Vatta *et al.*, 2006). Following slaughter, the heads were severed at the occipitoatlantal joint, and the heads, canon and crus bones were properly tagged according to their respective ages and placed in clean bags as a final process of sampling. The heads were later processed for morphometric analysis in the Anatomy laboratory of the Faculty of Veterinary Medicine

at Usmanu Danfodiyo University Sokoto, Sokoto State (Table 1).

**Table 1.** Age estimation features and categorization of yankasa sheep.

Parameters	Sheep estimated age range	Groups
Milk teeth	0-6months	1
0 pair of incisor	6months-1year	2
1 pair of incisor	1-2years	3
2 pairs of incisor	2-3years	4
3 pairs of incisor	3years-above	5

### Preparation of the samples

Skinning and defleshing of the heads and limbs were done by using dissecting equipments such as scalpel, knives, forceps and scissors. The cheek muscles, eyes, tongue and nasal cartilages were removed. Hot water maceration method was employed; the mandibles and limbs were boiled with each of them in their respective polythene bags to avoid mixing the limbs and mandibles up. A detergent and potash was added to the boiling water to fasten the cooking process, the boiling lasted for five hours. After the boiling process, the mandibles were removed from the polythene bags and scalpel blades, knives and forceps were used to scrape the remaining flesh. Finally, the mandibles and limbs were washed with detergents and rinsed accordingly to avoid mix up and was left to dry for 3 days in the laboratory.

### Biometrical analysis and anatomical landmarks

The following biometrical measurements and appropriate indices were calculated using measuring tape according to Monfared, (2013a) and Salako, (2006) in Iranian native sheep, Kataba, (2014) in goat, Allouch, (2014) in bovine and Reda *et al.* (2016) in Black belly sheep. They were weighed with a digital weighing balance (Citizens Scale1 PVT, Ltd, model MP-600, with a sensitivity of 0.01g) and their widths were taking using a digital vernier caliper.

### Horizontal ramus of the mandible

- (a) Mandibular length: From the level of alveolar border of the incisive bone to the caudal border of the mandible.
- (b) Lateral alveolar border of the first premolar tooth to the mental foramen: Distance from the lateral alveolar border of the first premolar tooth to the mental foramen.
- (c) Caudal mandibular border to the mental foramen: Distance from the caudal mandibular border to the mental foramen.
- (d) Lateral alveolar border to mental foramen: Distance from the mental foramen to the lateral extent of the alveolar root of the lower incisor.

(e) Mandibular weight: The weight of the mandible was measured using digital weighing balance (Citizens Scale1 PVT, Ltd, model MP-600, with a sensitivity of 0.01g) in grams.

### Vertical ramus of the mandible

- (a) Ventral border of the mandible to mental foramen: Distance from the ventral border of the mandible to mental foramen.
- (b) Maximum mandibular height: From the highest point of the coronoid process to the basal level of the mandible.
- (c) Condylod fossa to the base of the mandible: Distance from the condylod fossa to the base of the mandible.
- (d) Caudal border of the mandible to the mandibular foramen: The vertical line from the mandibular foramen to the caudal border of the mandible.
- (e) Base of the mandible to mandibular foramen: Distance from the base of the mandible to mandibular foramen.
- (f) Mandibular angle to mandibular foramen: Distance from the mandibular angle to mandibular foramen.

### The horizontal ramus of the mandible

The mean and standard deviation of the morphometric features of the horizontal ramus of the mandible of the Ewe at different age intervals were determined. The mean mandibular lengths at different age intervals were;  $16.55 \pm 0.07$ ,  $19.05 \pm 0.07$ ,  $19.40 \pm 1.84$ ,  $19.60 \pm 0.28$  and  $19.80 \pm 0.28$  in centimeters with increase in length as they age. The mean distances from the lateral alveolar border of the first upper premolar tooth to the mental foramen at different age intervals were found to be  $2.75 \pm 0.35$ ,  $2.75 \pm 0.49$ ,  $3.00 \pm 0.00$ ,  $3.40 \pm 0.28$  and  $3.40 \pm 0.57$  all in centimeters with slight increase in distance. The mean distances from caudal mandibular border to mental foramen were found to be  $14.10 \pm 0.14$ ,  $15.60 \pm 0.14$ ,  $16.10 \pm 0.28$ ,  $16.25 \pm 1.48$  and  $16.50 \pm 0.28$  all in centimeters with increase in distance. The mean distances from lateral alveolar border to mental foramen were as follows;  $3.20 \pm 0.70$ ,  $3.50 \pm 0.28$ ,  $3.65 \pm 0.21$ ,  $3.75 \pm 0.70$  and  $3.80 \pm 0.28$  in centimeters respectively showing a slight increase in the distance. The mean mandibular weights measured in grams were as follows;  $97.40 \pm 1.98$ ,  $127.85 \pm 0.07$ ,  $136.00 \pm 20.51$ ,  $140.35 \pm 20.01$  and  $165.00 \pm 7.35$  showing an increase in weight as they age (Table 1).

### The vertical ramus of the mandible

The mean and standard deviation of the morphometric features of the vertical ramus of the mandible of the

Yankasa Ewe at different age intervals were determined. The mean distances from the ventral border of the mandibles to mental foramen at different age intervals were;  $13.75 \pm 0.35$ ,  $15.40 \pm 0.99$ ,  $15.45 \pm 0.21$ ,  $15.60 \pm 0.57$  and  $15.85 \pm 0.21$  in centimeters with increase in distance as they age. The mean of the maximum mandibular distances at different age intervals were found to be  $10.55 \pm 0.21$ ,  $11.45 \pm 0.07$ ,  $12.15 \pm 0.49$ ,  $12.35 \pm 1.48$  and  $12.90 \pm 0.57$  all in centimeters with slight increase in distance. The mean distances from the condyloid processes to bases of the mandibles were found to be  $14.10 \pm 0.14$ ,  $15.60 \pm 0.14$ ,  $16.10 \pm 0.28$ ,  $16.25 \pm 1.48$  and  $16.50 \pm 0.28$  all in centimeters with increase in distance. The mean distances from the caudal border of the mandible to mandibular foramen were as follows;  $1.75 \pm 0.07$ ,  $2.05 \pm 0.07$ ,  $2.20 \pm 0.14$ ,  $2.35 \pm 0.21$  and  $2.40 \pm 0.28$  in centimeters respectively showing a slight increase in the distance. The mean distances from the base of the mandibles to the mandibular foramen were found to be  $4.55 \pm 0.35$ ,  $4.90 \pm 0.14$ ,  $5.15 \pm 0.07$ ,  $5.20 \pm 0.57$  and  $5.45 \pm 0.07$  all in centimeters with an increase in distance as they age. The mean distances from the mandibular angle to the mandibular foramen were as follows;  $3.55 \pm 0.07$ ,  $3.65 \pm 0.21$ ,  $3.80 \pm 0.00$ ,  $4.00 \pm 0.28$  and  $4.05 \pm 0.07$  all in centimeters with increase in distance as they age (Table 2 and Plates 1 and 2).

## RESULTS AND DISCUSSION

In the present study, the mean mandibular weights measured in grams was observed to be higher than that of the adult Barbados Black Belly Sheep as stated by Mohamed *et al.* (2016) but in line with that of Mehraban sheep (Karimi *et al.*, 2011), the Iranian Native sheep (Monfared, 2013b), the West African Dwarf goat (Olopade and Onwuka, 2005a), the Black Bengal goat (Uddin *et al.*, 2009), the Makhoz goat (Goodarzi and Hoseini, 2013), the Iranian Native goat (Monfared *et al.*, 2013a) and the Gwembe Valley Dwarf goat (Kataba, 2014). The mean mandibular lengths from group two and above were higher than the values obtained in the Barbados Black Belly Sheep (Mohamed *et al.*, 2016), Mehraban sheep (Karimi *et al.*, 2011), the Iranian Native sheep (Monfared, 2013b), the West African Dwarf goat (Olopade and Onwuka, 2005a), the Black Bengal goat (Uddin *et al.*, 2009) but within the same range with the Makhoz goat (Goodarzi and Hoseini, 2013), the Iranian Native goat (Monfared *et al.*, 2013a) and the Gwembe Valley Dwarf goat (Kataba, 2014). These variations maybe attributed to the nutritional differences of the animal.

The results showed that, the mean distances between the mental foramen to the lateral alveolar order of the first upper premolar tooth of the adults of Female yankasa Sheep's were shown to be higher than that of the adult Barbados Black Belly Sheep as stated by Mohamed *et al.*

(2016) but in line with that of Mehraban sheep (Karimi *et al.*, 2011), the Iranian Native sheep (Monfared, 2013b), the West African Dwarf goat (Olopade and Onwuka, 2005a), the Black Bengal goat (Uddin *et al.*, 2009), the Makhoz goat (Goodarzi and Hoseini, 2013), the Iranian Native goat (Monfared *et al.*, 2013a) and the Gwembe Valley Dwarf goat (Kataba, 2014).

Research values showed that within all the groups, the mean distances from the lateral alveolar border and the mental foramen were in accordance with the finding in the Mehraban sheep (Karimi *et al.*, 2011), the Iranian Native sheep (Monfared, 2013a), the Iranian wild goat (Monfared *et al.*, 2013a), Barbados Black Belly Sheep (Mohamed *et al.*, 2016) but slightly lower than West African Dwarf Goat (Olopade and Onwuka, 2005a), Black Bengal goat (Uddin *et al.*, 2009) the Makhoz goat (Goodarzi and Hoseini, 2013) and the Gwembe Valley Dwarf goat (Kataba, 2014). The above variations may be attributed to species difference between sheep and goat. The mean distances between the mental foramen to the ventral border of the mandible in the Barbados Black Belly Sheep (Mohamed *et al.*, 2016) was lower than the mean distances obtained from the various groups of Female yankasa Sheep.

The mean distances obtained from the maximum mandibular height or lengths of all the groups as shown in table 1, were within the same range with the values obtained in the Mehraban sheep (Karimi *et al.*, 2011), the Iranian Native sheep (Monfared, 2013a), the West African Dwarf goat (Olopade and Onwuka, 2005c), the Black Bengal goat (Uddin *et al.*, 2009), the Makhoz goat (Goodarzi and Hoseini, 2013), the Iranian wild goat (Monfared *et al.*, 2013a) and the Gwembe Valley Dwarf goat (Kataba, 2014). However, the mean distances of the maximum mandibular height or weight of group 1 Sheep were in accordance with that of the adult Barbados Black Belly Sheep (Mohamed *et al.*, 2016), Mehraban sheep (Karimi *et al.*, 2011) and the Iranian Native sheep (Monfared, 2013b), but the values obtained from the rest of the groups were slightly higher than the obtained values.

The mean distances from the condyloid process to the base of the mandible on all the groups were observed to be slightly lower than those obtained in the adults of the Barbados Black Belly Sheeps (Mohamed *et al.*, 2016), the Mehraban sheep (Karimi *et al.*, 2011), the Iranian Native sheep (Monfared, 2013b) but within the same range with the West African Dwarf Goat (Olopade and Onwuka, 2005b), the Black Bengal goat (Uddin *et al.*, 2009), the Makhoz goat (Goodarzi and Hoseini, 2013), the Iranian wild goat (Monfared *et al.*, 2013a) and the Gwembe Valley Dwarf goat (Kataba, 2014) as shown in (Table 1). These variations maybe attributed to the genetic compositional differences of the animal.

The obtained results showed that the mean distances from the caudal border of the mandible to the level of the mandibular foramen (Table 2) of group 2 to 4 were

**Table 2.** Morphometric features of the horizontal ramus of the mandible of Yankasa Ewe (Mean±SD).

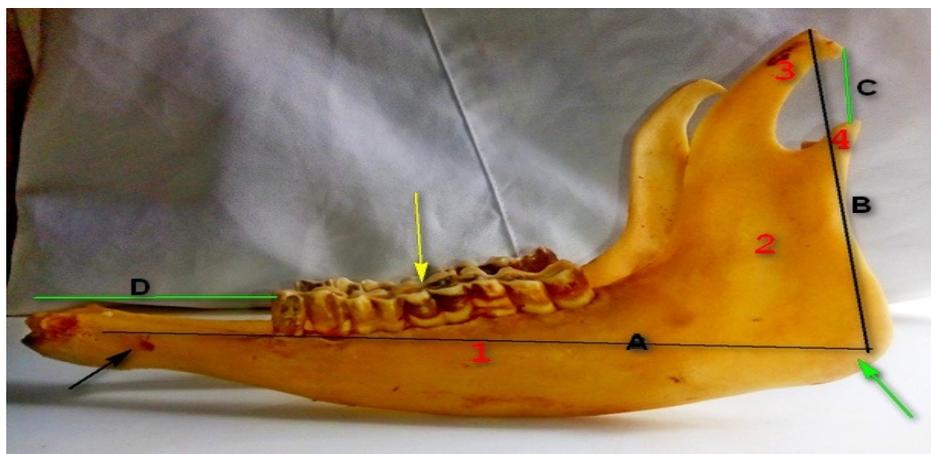
Parameters	Group 1	Group 2	Group 3	Group 4	Group 5
A	16.55±0.07 <sup>a</sup>	19.05±0.07 <sup>b</sup>	19.40±1.84 <sup>b</sup>	19.60±0.28 <sup>b</sup>	19.80±0.28 <sup>d</sup>
B	2.75±0.35 <sup>a</sup>	2.75±0.49 <sup>b</sup>	3.00±0.00 <sup>c</sup>	3.40±0.28 <sup>d</sup>	3.40±0.57 <sup>d</sup>
C	14.10±0.14 <sup>a</sup>	15.60±0.14 <sup>b</sup>	16.10±0.28 <sup>c</sup>	16.25±1.48 <sup>d</sup>	16.50±0.28 <sup>e</sup>
D	3.20±0.70 <sup>a</sup>	3.50±0.28 <sup>b</sup>	3.65±0.21 <sup>c</sup>	3.75±0.70 <sup>d</sup>	3.80±0.28 <sup>d</sup>
E	97.40±1.98 <sup>a</sup>	127.90±0.07 <sup>b</sup>	136.00±20.51	140.35±20.01 <sup>d</sup>	165.00±7.35 <sup>e</sup>

abcde: means on the same rows with different superscripts are significantly different (P ≤ 0.05).  
 Key: Group 1 = 0-6months, Group 2 = 6months-1year, Group 3 = 1year-2years, Group 4 = 2years-3years, Group 5 = 3years and above.

**Table 3.** Morphometric features of the vertical ramus of the mandible of Yankasa Ewe (Mean±SD).

Parameters	Group 1	Group 2	Group 3	Group 4	Group 5
F	13.75±0.35 <sup>a</sup>	15.40±0.99 <sup>b</sup>	15.45±0.21 <sup>b</sup>	15.60±0.57 <sup>d</sup>	15.85±0.21 <sup>e</sup>
G	10.55±0.21 <sup>a</sup>	11.45±0.07 <sup>b</sup>	12.15±0.49 <sup>c</sup>	12.35±1.48 <sup>d</sup>	12.90±0.57 <sup>e</sup>
H	8.00±0.00 <sup>a</sup>	8.75±0.07 <sup>b</sup>	9.15±1.20 <sup>c</sup>	9.25±0.64 <sup>c</sup>	10.45±0.64 <sup>e</sup>
I	1.75±0.07 <sup>a</sup>	2.05±0.07 <sup>b</sup>	2.20±0.14 <sup>c</sup>	2.35±0.21 <sup>d</sup>	2.40±0.28 <sup>d</sup>
J	4.55±0.35 <sup>a</sup>	4.90±0.14 <sup>b</sup>	5.15±0.07 <sup>c</sup>	5.20±0.57 <sup>c</sup>	5.45±0.07 <sup>e</sup>
K	3.55±0.07 <sup>a</sup>	3.65±0.21 <sup>b</sup>	3.80±0.00 <sup>c</sup>	4.00±0.28 <sup>d</sup>	4.05±0.07 <sup>e</sup>

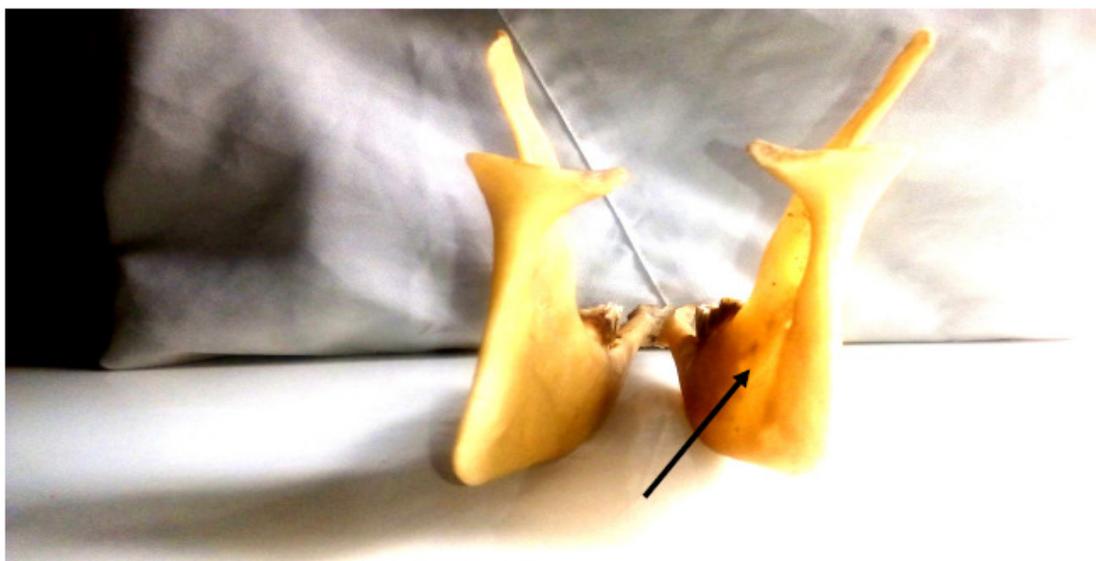
abcde: means on the same rows with different superscripts are significantly different (P ≤ 0.05).  
 Key: Group 1 = 0-6months, Group 2 = 6months-1year, Group 3 = 1year-2years, Group 4 = 2years-3years, Group 5 = 3years and above.



**Plate 1.** Photograph of The Mandible of a Female Yankasa Sheep (Anatomical landmarks); Lateral view A. Horizontal ramus; B. Vertical ramus; 1 and 2. Ramus of the mandible; 3. Coronoid process; 4. Condylar process; Black arrow: Mental foramen.

comparable in accordance with the values reported for the adults of the Barbados Black Belly Sheeps (Mohamed *et al.*, 2016), but slightly higher than the Mehraban sheep (Karimi *et al.*, 2011), Iranian Native

sheep (Monfared, 2013a) and slightly lower than the Black Bengal goat (Uddin *et al.*, 2009), the Makhroz goat (Goodarzi and Hoseini, 2013) and the Gwembe Valley Dwarf goat (Kataba, 2014). The above variations may be



attributed to species difference between sheep and goat. However, group 1 values shown conformity with that of Mehraban sheep (Karimi *et al.*, 2011), Makhoz goat (Onar, 1999) and the Gwembe Valley Dwarf goat (Kataba, 2014) but higher than the Iranian Native sheep (Monfared, 2013a) and the Black Bengal goat (Uddin *et al.*, 2009).

The mean distances of the mandibular foramen to the base of the mandible on all the groups as shown in table 2, were within the same range with the values obtained in the West African Dwarf goat (Olopade and Onwuka, 2005a), the Iranian Native goat (Monfared *et al.*, 2013a), the Gwembe Valley Dwarf goat (Salako, 2006) and Mehraban Sheep (Onar *et al.*, 2005) but slightly lower than that of the adult Barbados Black Belly sheep (Mohamed *et al.*, 2016), Black Bengal goat (Uddin *et al.*, 2009), Makhoz goat (Goodarzi and Hoseini, 2013), Iranian wild sheep (Monfared, 2013b),

The mean distances from the mandibular angle to the mandibular foramen (as shown in table 2) of group 1 to 3 were similar to the value reported in adult Barbados Black Belly Sheep (Mohamed *et al.*, 2016) but higher mean values were obtained at the animal advance in age (group 4 and 5) as shown in table 2. The values obtained in all the groups on the mean distances from the mandibular angle to the mandibular foramen were in line with those obtained in the Iranian wild sheep (Monfared, 2013b), in the Makhoz goat (Goodarzi and Hoseini, 2013) and in the Gwembe Valley Dwarf goat (Onar, 1999).

## Conclusion

Based on the above findings, result have shown that there is an increase in both horizontal and vertical ramus of the mandible of the Female Yankasa Sheep, though a

drastic increase in size, shape and weight was observed from two(2) years to four (4) years of age. Furthermore, the morphometric data of the Female Yankasa Sheep is comparable to other various sheep and goat breeds of ruminant with little variations that could be due to breed, geographical location, nutritional values, and weather of an area, genetic makeup and body scoring index of the breed. The present result provides a baseline data on the morphometric of the mandible Female Yankasa Sheep in the West African region of the world. The information obtained from this study will help to bridge the existing gap on the normal anatomy (morphology and biometry), physiology, surgery and productive aspect of the breed in this area of the bone parts at postnatal stages of Yankasa Sheep in this part of the country.

## Recommendation

It is therefore recommended that further work should be carried out on other breeds of sheep in Nigeria with other parameters using sophisticated biometrical equipment.

## Authors' declaration

We declared that this study is an original research by our research team and we agree to publish it in the journal.

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