Int. J. Morphol.,
41(3):971-974, 2023.

The Discovery of a Bone in the Anterior Fontanelle of the Skull of the Sheep (*Ovis aries*)

Descubrimiento de un Hueso en la Fontanela Anterior del Cráneo de la Oveja (*Ovis aries*)

Shaibu Mohammed Atabo[1,2]; Abubakar Abubakar Umar[3]; Sani Abdullahi Shehu[1,2,3] & Adamu Abdul Abubakar[4,5]

ATABO, S. M.; UMAR, A. A.; SHEHU, S. A. & ABUBAKAR, A. A. The discovery of a bone in the anterior fontanelle of the skull of the sheep (*Ovis aries*). *Int. J. Morphol., 41(3)*:971-974, 2023.

SUMMARY: A comparative study of the skull morphology was conducted using 270 prenatal and 750 postnatal skull samples from three breeds of sheep in Nigeria namely, Balami, Uda and Yankasa. A unique bone peculiar to the Yankasa breeds of sheep was found consistently at the centre of the anterior fontanelle in the young (day-old to 1 year). At two years of age and above, the bone was fused and disappeared completely. This brings the total numbers of the neurocranium bones of the skull in the Yankasa breeds to 8, as against the 7 bones documented in the ovine species. Due to the fact that this bone has not been described in the literature, we venture to name it the anterio-fontanelle bone (of Atabo).

KEY WORDS: Yankasa; Skull; Neurocranium; Anterior fontanelle; bone; Atabo.

INTRODUCTION

Balami, Uda and Yankasa are the three most common breeds of sheep in Nigeria, the Balami breed is the largest bodied predominantly found in the northeastern region of Nigeria, it is predominantly white and hairy, with a strongly convex face. The ear is large and pendulous. The tail is thin and long. Horns are prominent in rams but absent in the ewes (Popoola & Oseni, 2018). Mature weight is 40 to 65 kg in males and 30 to 45 kg in females. The Uda breed of sheep is a large but slightly smaller than the Balami, it is long-legged with a convex face (Yakubu & Ibrahim, 2011). The breed has a characteristic coat-colour pattern. The anterior (fore) half is black or brown while the posterior (rear) half is white. The ear is long large and pendulous. they predominant in the northwestern part of Nigeria. The Uda rams carry horns that became larger, wide and spiral as they mature. Horns are usually absent in the females. Mature live-weight are 30 to 45kg in females and 30 to 60 kg in males. (Yakubu & Akinyemi, 2010; Yakubu & Ibrahim, 2011). The Yankasa sheep is intermediate in size. It has a typical white coat-colour with dwarf patches around the eyes, ears, muzzle and sometimes feet, and they common in the northcentral part of Nigeria (Yakubu & Akinyemi, 2010; Yakubu & Ibrahim, 2011).

Popoola & Oseni (2018) classified Nigerian indigenous breeds of sheep based on their head conformation using multivariate analyses. The skeleton of the head (skull) is the most important complexly organized group of bones. Skull as a whole has three surfaces; dorsal surface, lateral surface (the skull-Orbit), and ventral surface of the skull. The bones of the skull are divided into two parts; the cranial (neurocranial) bones and facial (viscerocranial) bones. The neurocranial bones are the occipital, interparietal, parietal, frontal, temporal, sphenoid and ethmoid bones whereas the viscerocranial bones are maxilla, incisive (premaxilla), palatine, pterygoid, nasal, lacrimal, zygomatic (malar), vomer, turbinates, and mandible (Dyce *et al*., 2017). The skull is a flat bone that is relatively thin and expanded in two dimensions which provides protection for the brain and the organs of special senses (eyes, nose, ears and tongue) hence the need to study it.

Skull morphology is an important criterion in the assessment of species and breeds of animals and their genetic profiles (Shawulu *et al*., 2011). Künzel *et al*. (2003) also reported that the morphological studies of the skull are vital

[1]Department of Veterinary Anatomy, Bayero University, Kano, Nigeria.
[2]Department of Basic Sciences, School of Veterinary Medicine, St. Matthew's University, Grand Cayman, British West Indies.
[3]Department of Veterinary Anatomy, Usmanu Danfodiyo University, Sokoto, Nigeria.
[4]Department of Veterinary Surgery and Radiology, Usmanu Danfodiyo University, Sokoto, Nigeria.
[5]Department of Veterinary Medicine, College of applied health sciences, A'Sharqiya University, sultanate of Oman.

Received: 2021-11-25 Accepted: 2022-07-12

in classification as phenotypic appearance of an animal's head depends on the skull and is strongly related to breed-specific skeletal features. These parameters can also be a basis for the study of interactions between heredity and environment (Onar, 2001). Osteomorphometric studies of the skull have been documented in adult/postnatal sheep across some regions of the world such as Kosovo Bardhoka sheep (Gündemir *et al*., 2020), Chilean Suffolk Down sheep (de la Barra *et al*., 2020), Egyptian native sheep (Awaad *et al*., 2019), Indian Madras Red sheep (Sundaram *et al*., 2019), Iraq Indigenous sheep (Ahmed & Mahmood, 2018), Iranian Zell (Thin-tailed) sheep (Abbasabadi *et al*., 2020), Iranian Mehraban sheep (Dalga *et al*., 2018), Indian Jammu sheep (Sarma *et al*., 2007), Polish Heath sheep (Baranowski, 2017), Spanish sheep (Martín & García-Gonzalez, 2015), Spanish Xisqueta (Parés I Casanova *et al*., 2010), Iranian Afshari sheep (Masoudifard *et al*., 2008). Except for the work done by Atabo (2021) and Ahmad (2008), there is a paucity of information on prenatal and postnatal developmental morphological studies of the skull in sheep in Nigeria. In an effort to provide baseline data on the developmental morphology of the skull of sheep, morphological studies of the skull of sheep breeds in Nigeria was carried out and hereby report unique finding observed in the study.

MATERIALAND METHOD

A total of 270 sheep heads of three (3) prenatal age groups consisting of 90 each of Balami, Uda and Yankasa breeds (Table I) and 750 sheep heads of five (5) postnatal age groups, consisting of 250 each of Balami, Uda and Yankasa Nigerian breeds of sheep (Table II) obtained from the slaughtered animals from in the Nigerian abattoirs were used for this study. The heads were macerated using the methods described by Atabo (2021). A study involving the comparative developmental morphology of the skulls of the three breeds was performed. The study was approved by the Institutional Animal Care and Use Committee (IACUC) of the Usman Danfodiyo University Sokoto with the reference no. UDUS/FAREC/2019/AUP-RO-5.

Table I. Number of prenatal/fetal samples collected per breed of sheep.

Age groups	Balami	Uda	Yankasa	Total
1st trimester	30	30	30	90
2nd trimester	30	30	30	90
3rd trimester	30	30	30	90
Total	90	90	90	270

Table II. Number of postnatal samples per breed of sheep.

Age groups	Balami	Uda	Yankasa	Total
Day-old	50	50	50	150
6 months	50	50	50	150
1 year	50	50	50	150
2 years	50	50	50	150
3 years	50	50	50	150
Total	250	250	250	750

RESULTS

A bone was found at the centre of the anterior fontanelle at birth (postnatal stage), the bone was roughly circular and absent in the prenatal/fetal stages (Figs. 1 to 3). The bone was peculiar to both sexes of Yankasa breeds and absent in all the prenatal and postnatal stages of Balami and Uda. In the Yankasa, the bone exists and persist from birth to 1 year of age (Fig. 4), from 2 years and above the bone was found to have disappeared and probably fussed with the surroundings bones (Frontal and Parietal bones) (Fig. 5).

The bone was small and roughly circular, it increased in size from day old to 1 year of age, at day old, its average longitudinal and horizontal distances were 1.5 mm and 1 mm respectively, while at 1 year its average longitudinal and horizontal distances were 2.5 mm and 2 mm respectively. Before its fusion, a small and circular bone was observed at the center of the anterior fontanel at the frontoparietal suture in the Yankasa breeds of sheep.

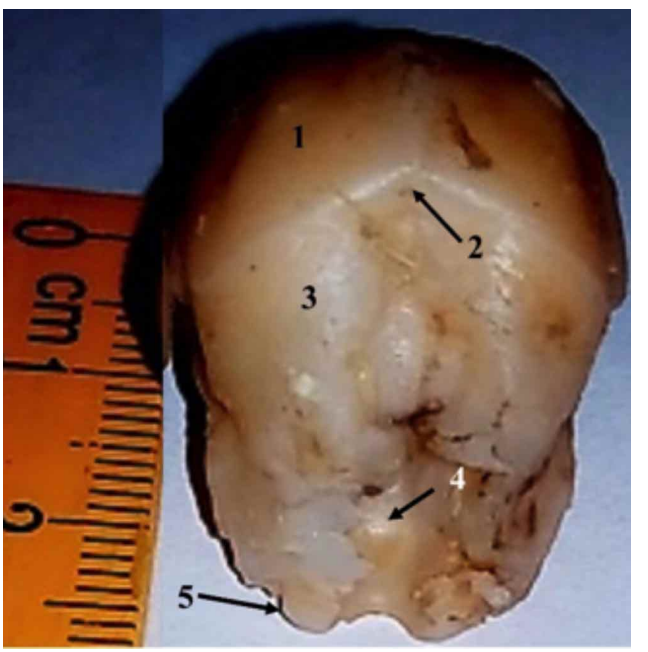

Fig. 1. 2nd trimester nuchal view of the Yankasa fetus showing; the frontal bone (1), centre of the anterior fontanelle (2), parietal bone (3), occipital bone (4), and occipital condyle (5).

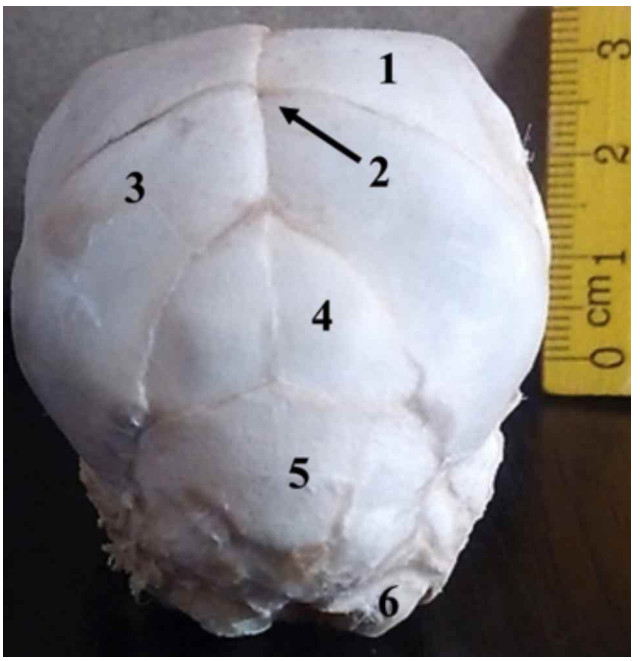

Fig. 2. 3rd trimester nuchal view of the Uda (A) and Yankasa (B) fetus showing; the frontal bone (1), centre of the anterior fontanelle (2), parietal bone (3), interparietal bone (4), occipital bone (5) and occipital condyle (6).

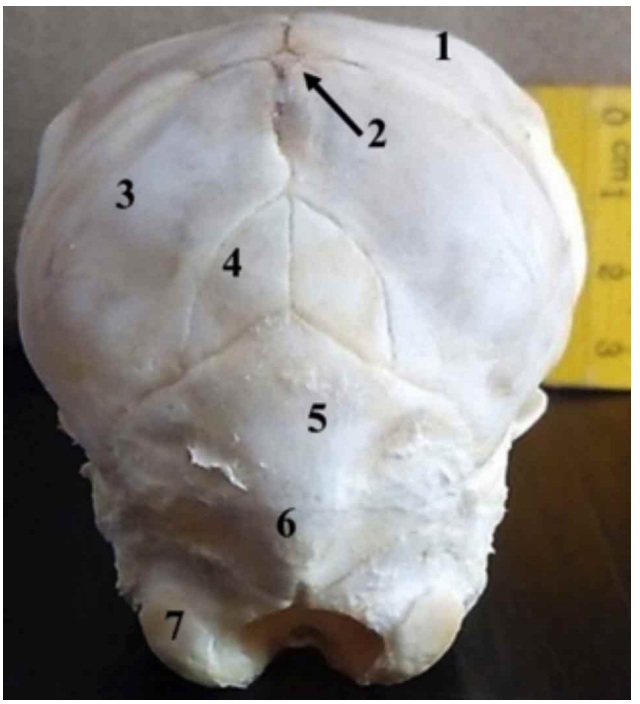

Fig. 3. The nuchal view of a day-old Yankasa fetus showing; the frontal bone (1), roughly circular anterior fontanelle bone (2) parietal bone (3), interparietal bone (4), occipital bone (5), external occipital protuberance (6) and occipital condyle (7).

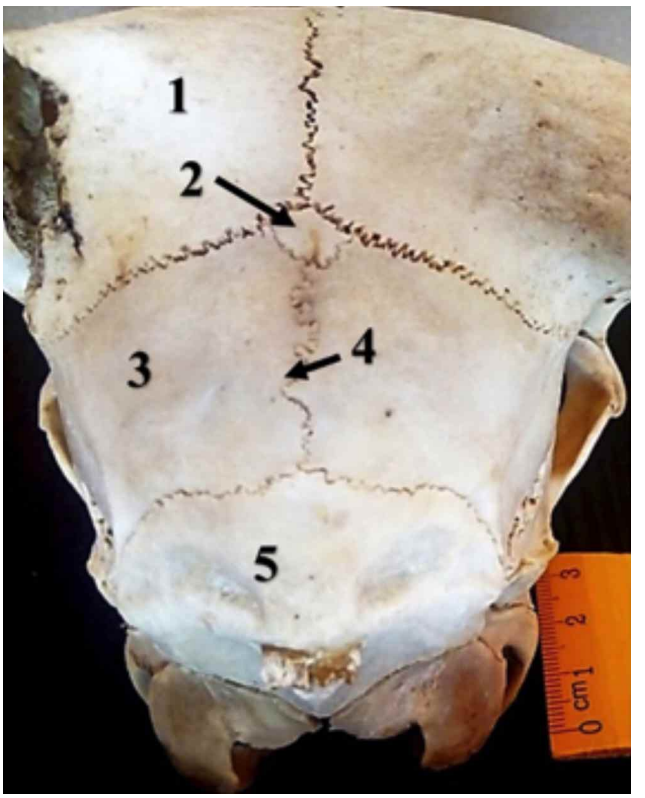

Fig. 4. The Nuchal surface of a 1-year old skull of a male Yankasa sheep showing the frontal bone (1), roughly circular anterior fontanelle bone (2), parietal bone (3), interparietal suture (4) and occipital bone (5).

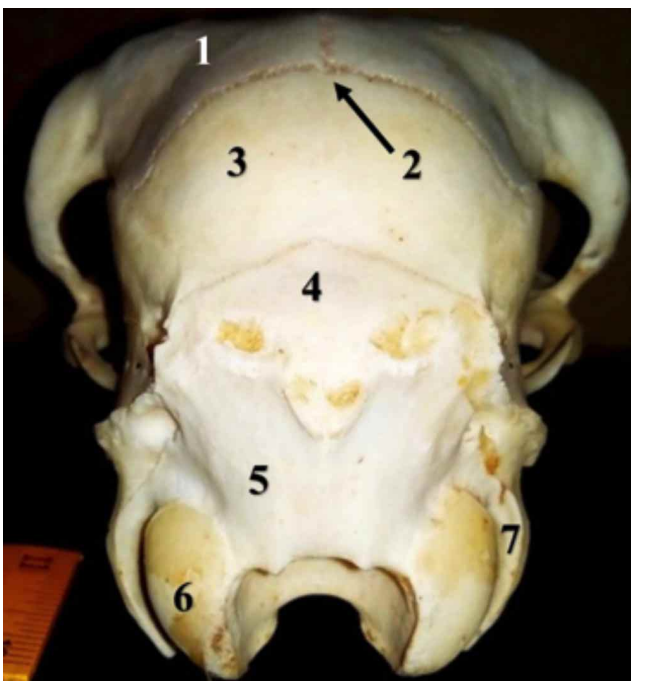

Fig. 5. Nuchal surface of the skull in female Yankasa showing; Frontal bone (1), centre of the anterior fontanelle (2), Parietal bone (3), interparietal part of occipital bone (4), occipital squama (5) occipital condyles (6) and paracondylar process (7).

DISCUSSION

It was documented that the number of the neurocranium and viscerocranium bones of the ovine species and other ruminants was 7 and 9 respectively (Choudhary & Singh, 2016; Dyce *et al*., 2017; Atabo *et al*., 2021). This study has further confirmed the presence of 7 and 9 neurocranium and viscerocranium bones of the sheep skulls respectively, however, the young Yankasa had an 8th neurocranium (the circular bone) found at the centre of the anterior fontanelle, while the Balami and Uda had the usual 7 neurocranial bones namely; occipital, interparietal, parietal, frontal, temporal, sphenoid and ethmoid bones. This 8th neurocranium in the Yankasa breeds of sheep in this study has to the best of our knowledge, not been reported before in the literature and thus, its clinical significance is yet to be known. A comparison with museum specimens however revealed that this circular bone was not seen in goat, cattle, dog, pig and man but it is present and well defined in young Yankasa breeds of sheep.

This small, roughly circular bone discovered at the centre of the anterior fontanelle of young Yankasa breed can be an aid in distinguishing the Yankasa breed from Balami, Uda, other breeds of sheep and species of animals, since a search of the literature yielded no information on this circular bone in the skull (anterior fontanelle) of any species of animals. Consequently, we venture to name this bone, the antero-fontanelle bone (of Atabo).

ATABO, S. M.; UMAR, A. A.; SHEHU, S. A.; ABUBAKAR, A. A.El descubrimiento de un hueso en la fontanela anterior del cráneo de la oveja (*Ovis aries*). *Int. J. Morphol., 41(3)*:971-974, 2023.

RESUMEN: Se realizó un estudio comparativo de la morfología del cráneo utilizando 270 muestras de cráneos prenatales y 750 postnatales de tres razas de ovejas en Nigeria, Balami, Uda y Yankasa. Un hueso único peculiar de las razas de ovejas Yankasa se encontró consistentemente en el centro de la fontanela anterior en las crías (de un día a 1 año). A los dos años de edad o más, el hueso se fusionó y desapareció por completo. Esto eleva el número total de huesos del neurocráneo en el cráneo en las razas Yankasa a 8, frente a los 7 huesos documentados en la especie ovina. Debido a que este hueso no ha sido descrito en la literatura, nos aventuramos a denominarlo hueso antero-fontanela (de Atabo).

PALABRAS CLAVE: Yankasa; Cráneo; Neurocráneo; Fontanela anterior; Hueso; Atabo.

REFERENCES

Abbasabadi, B. M.; Hajian, O. & Rahmati, S. Investigating the morphometric characteristics of male and female zell sheep skulls for sexual dimorphism. *Anat. Sci., 17(1)*:13-20, 2020.

Ahmed, N. S. & Mahmood, K. H. Development of mandible in indigenous sheep fetuses. *Iraqi J. Vet. Sci., 25(2)*:99-106, 2018.

Atabo, S. M. *Comparative Developmental Studies of the Skull of Three Nigerian Breeds of Sheep (Ovis aries)*. Ph.D. Thesis. Sokoto, Department of Veterinary Anatomy, Usmanu Danfodiyo University Sokoto, Nigeria, 2021.

Awaad, A. S.; Maksoud, M. K. M. A. & Fathy, M. Z. Surgical anatomy of the nasal and paranasal sinuses in Egyptian native sheep (*Ovis aries*) using computed tomography and cross sectioning. *Anat. Histol. Embryol., 48(4)*:279-89, 2019.

Baranowski, P. Craniometric characteristics and cranial indices of Polish Heath Sheep rams – extended data. *Int. J. Morphol., 35(1)*:133-40, 2017.

Choudhary, O. P. & Singh, I. Morphological Studies on cranial cavity, nasal cavity and dentition of Indian Blackbuck (*Antilope cervicapra*). *J. Wildl. Res., 4(2)*:35-7, 2016.

Dalga, S.; Aslan, K. & Akbulut, Y. A Morphometrıc study on the skull of the Hemshin sheep. *Van Vet. J., 29(3)*:125-9, 2018.

de la Barra, R.; Carvajala, A. M. & Martínez, M. E. Variability of cranial morphometrical traits in Suffolk Down Sheep. *Aust. Vet. J. Sci., 52(1)*:25-31, 2020.

Dyce, K. M.; Sack, W. O. & Wensing, C. J. G. *Text Book of Veterinary Anatomy.* 5th ed. St. Louis, Saunders Elsevier, 2017.

Ecotypes of Goats(*Capra hircus*)in Nigeria. *J. Vet. Anat., 4(2)*:1-13, 2011.

Gündemir, O.; Duro, S.; Jashari, T.; Kahvecioglu, O.; Demircioglu, I. & Mehmeti, H. A study on morphology and morphometric parameters on skull of the Bardhoka autochthonous sheep breed in Kosovo. *Anat. Histol. Embryol., 49(3)*:365-71, 2020.

Künzel, W.; Breit, S. & Oppel, M. Morphometric investigations of breed-specific features in feline skulls and considerations on their functional implications. *Anat. Histol. Embryol., 32(4)*:218-23, 2003.

Martín, P. & García-Gonzalez, R. Identifying sheep (*Ovis aries*) fetal remains in archaeological contexts. *J. Archaeol. Sci., 64*:77-87, 2015.

Masoudifard, M.; Shojaei, B. & Vajhi, A. R. Radiographic anatomy of the head of sheep. *Iran. J. Vet. Surg., 3(4)*:41-8, 2008.

Parés I Casanova, P. M.; Kamal, S. & Jordana, J. On biometrical aspects of the cephalic anatomy of Xisqueta Sheep (Catalunya; Spain). *Int. J. Morphol., 28(2)*:347-51, 2010.

Popoola, M. A. & Oseni, S. O. Multifactorial discriminant analysis of cephalic morphology of indigenous breeds of sheep in Nigeria. *Slovak J. Anim. Sci., 51(2)*:45-51, 2018.

Sarma, K.; Sur, S. & Kalita, A. Gross anatomical studies on the skull of local sheep of Jammu region. *India J. Anim. Sci., 77(10)*:999-1001, 2007.

Shawulu, J. C.; Kwari, H. D. & Olopade, J. O. Morphology of the Bones of the Skull in the Sahel ecotypes of goats (*Capra hircus*) Nigeria. *J. Vet. Anat., 4(2)*:1-13, 2011.

Sundaram, V.; Dharani, P.; Gnanadevi, R., & Kavya, R. Studies on clinical anatomy of the maxillofacial and mandibular regions of the Madras Red sheep (*Ovis aries*) in India. *Folia Morphol. (Warsz.), 78(2)*:389-93, 2019.

Yakubu, A. & Akinyemi, M. O. An evaluation of sexual size dimorphism in Uda sheep using multifactorial discriminant analysis. *Acta Agric. Scand. Sect. A Anim. Sci., 60(2)*:74-8, 2010.

Yakubu, A. & Ibrahim, I. A. Multivariate analysis of morphostructural characteristics in Nigerian indigenous sheep. *Ital. J. Anim. Sci., 10(2)*:83-6, 2011.

Corresponding author:
Atabo, Shaibu Mohammed (D.V.M., M.Sc., Ph.D.)
Department of Veterinary Anatomy
Faculty of Veterinary Medicine
Bayero University
Kano -NIGERIA

E-mail: mohakosh@yahoo.com
smatabo.van@buk.edu.ng