

Macroscopic Studies of the Lower Respiratory System of the Red Sokoto Goat (*Capra aegagrus hircus*)

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With 1 figure, 1 table

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Abstract

Samples of the lower respiratory tract from 16 adult red Sokoto goats were used for the present study. Sex differences were not taken into consideration. The trachea extended caudally from the larynx, at the level of the 2nd cervical vertebra to the level of the 3rd thoracic vertebra, where it gave off a tracheal bronchus to the cranial lobe and continued to the level of the 5th thoracic vertebra where it bifurcated into the right and left principal bronchi, just dorsal to the base of the heart. The trachea constituted 13.87 % of the total weight of the lower respiratory system. The mean number of tracheal rings was 11 ± 0.6 and the mean tracheal length was $200.21 \text{ mm} \pm 0.38$. Both right and left lungs had cranial, middle and caudal lobes. The right lung had an extra accessory lobe which was absent in the left lung. There was a very highly significant difference ($p < 0.001$)

between the weights of the right and left lungs. There was a very strong positive correlation between the weight of the lungs and the weight of the lower respiratory system ($r = 0.91$). The present study provides a reference anatomy for future research involving the lower respiratory system of the red Sokoto goat.

Keywords: Trachea, Lungs, Morphology, Red Sokoto goat

Introduction

The red Sokoto goat is a medium sized goat, prominent in the northern and middle belt regions of Nigeria (Haumesser, 1975). It is the most widespread and well known breed of goat in Nigeria. It has a uniformly dark red colour with short glossy hair. The red Sokoto goat is known for its suitability for leather production. It also has large mammary glands, suitable for milking. Knowledge of its anatomy is im-

portant in handling, breeding, disease diagnosis and treatment.

Extensive studies on the anatomy of the lower respiratory system of domestic ruminants have been reported in the literature (Nickel et al., 1973; Getty, 1975; Shafie and Abdelghany, 1978; Sajjadian et al., 2008; Cano and Pérez, 2009). Similar information for the red Sokoto goat is scarce, limiting comparative anatomical studies. Hence, the present study aims to provide a reference data on the anatomy of the lower respiratory system of the red Sokoto goat so as to provide needed information for future clinical and comparative anatomy involving the lower respiratory system of this indigenous breed of goat.

Materials and Methods

Sixteen adult red Sokoto goats, obtained from a market in Samaru, SabonGari Local Government Area of Kaduna State, were utilized for this study. Each animal was decapitated at the level of the foramen magnum to ensure an intact trachea. Mid-ventral incision, extending from the cervical region to a point below the xiphoid cartilage, was performed to expose the thoracic viscera. The anatomical disposition of the lower respiratory tracts was evaluated *insitu*. Thereafter, the tracts were exteriorised *en mass*

and the photographs were taken with a digital camera (Soney Cyber-shot: 7.2 megapixels).

The lower respiratory tract of each goat was weighed using a sensitive electronic balance (Mettler balance P 1210, Mettler instrument AG. Switzerland; sensitivity: 0.001g). The lengths of the different segments of the tracts were obtained using a centimetre graded ruler and converted to millimetres. While their diameters were obtained using a vernier calliper (MG6001DC, General Tools and Instruments Company, New York; sensitivity: 0.01mm). Tracheal rings were counted with the naked eyes. The values obtained were subjected to statistical analysis using student's t-test. Values of $p < 0.05$ were considered significant.

Results and Discussion

Trachea

The trachea of the red Sokoto goat was a 'U' shaped cartilaginous and membranous tube that extended caudally from the larynx, at the level of the 2nd cervical vertebra to the level of the 3rd thoracic vertebra, where it gave off a tracheal bronchus to the cranial lobe and continued to the level of the 5th thoracic vertebrae where it bifurcated into the left and right principal bronchi,

just dorsal to the base of the heart. This branching pattern of the trachea is similar to that of the Jebeer Gazelle (Sajjadianet *al.*, 2008), the giraffe (Cano and Pérez, 2009) and pigs (Nakakuki, 1994a) in which the tracheal bronchus penetrated the cranial lobe of lung. The cervical part of the trachea was related dorsally to the M. Longus colli except for a small part caudal to the larynx where the oesophagus was interposed. The thoracic part of the trachea lay in the middle parts of the mediastinum. The M. trachealis is attached to the deep surface of the tracheal rings.

The trachea in the present study was composed of 50 to 55 cartilaginous rings with an average of 53 ± 0.6 rings. The number of the tracheal cartilages varies in animals of the same species due to the occasional fusion of some adjacent cartilages in some animals (Hogg, 1982). For example, while Barone (1997) recorded more than 200 cartilages in the giraffe, Cano and Pérez (2009) reported about a total of 100 cartilages (87 at the neck and 13 at the thorax) in the same animal. However, such fusion is seen most often in the pig and least often in the ruminants (Cano and Pérez, 2009). The lengths and weights of the trachea observed in the present study were represented in Table 1. The trachea in the present study

constituted 13.87 % of the total weight of the lower respiratory system.

Bronchi

The bronchi consisted of cartilaginous rings held to each other by connective tissues. The trachea gave off a tracheal bronchus at the level of the 3rd thoracic vertebra, before it continued caudally to the level of the 5th thoracic vertebra where it gave off two primary bronchi. The tracheal bronchus gave off dorsal and ventral branches that invaded the lobules of the cranial lobe. The primary bronchi gave off branches that invaded the remaining lobes. The number of rings that made up a primary bronchus ranged from 7 to 9. The macroscopic study of the bronchi in the red Sokoto goat shows that it is similar with the bronchi of other ruminants reported in the literature.

Lungs

The lungs of the red Sokoto goat were a pink coloured organ occupying most of the thoracic cavity. The right lung was composed of cranial, middle, caudal and accessory lobes while the left lung consisted of cranial, middle and caudal lobes only. The accessory lobe was absent in the left lung. Alsafy (2008) also reported the absence of an accessory lobe in the left lung of adult Baladi

goats using computed tomographic study technique. Furthermore, the cranial and accessory lobes are absent in the left lung of the Holstein cattle (Nakakuki, 1994b) and Japanese deer (Nakakuki, 1993) while the middle lobe is not found on the right lung in horses (Nomina Anatomica Veterinaria, 2005). The present study indicated that the cranial lobes were pointed; the accessory lobe was roughly triangular while the caudal lobe had a trapezoid shape. The cranial lobes of both right and left lungs were divided into cranial and caudal parts by interlobar fissures. Such division of the cranial lobe of both lungs is typical of ruminants (Nomina Anatomica Veterinaria, 2005). The present study also revealed that the cranial part of the cranial lobe of the right lung was twisted to the left while the cranial part of the cranial lobe of the left lung was twisted to the right in an *in situ* position.

The lungs constituted 82.71 % of the total weight of the lower respiratory system. There was a very strong positive correlation between the weights of the lower respiratory system and the weight of the lungs ($r = 0.91$). The right lung had a mean weight of $102.75 \text{ g} \pm 13.74$ while the left lung had a mean weight of $78.63 \text{ g} \pm 12.16$. There was a very highly significant difference ($p < 0.001$) between the

weights of the right and left lungs. The total lung weight was represented in Table 1. The absence of an accessory lobe in the left lung contributed to the relatively less weight of the left lung in the red Sokoto goat. In the present study, it was also observed that the cranial and accessory lobes were larger in the right lung than in the left lung. This conforms to the report of Getty (1975) who attributed this to the relatively larger right lung in ruminants.

Conclusion

The present work has shown that the anatomical disposition of the lower respiratory system of the red Sokoto goat is similar with that of other ruminants reported in the literature, except for difference in sizes.

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Table (1): Morphometric data of the lower respiratory organs of the red Sokoto goats (n = 16)

Parameter	Minimum	Maximum	Mean (\pm SEM)
Lower respiratory system weight (g)	142.00	391.00	210.00 \pm 29.33
Tracheal weight (g)	17.00	52.00	28.63 \pm 3.90
Weight of lungs (g)	119.00	339.00	181.38 \pm 16.25
Length of tracheal (mm)	190.00	220.00	200.21 \pm 0.38
Cranial tracheal diameter (mm)	15.06	20.00	17.48 \pm 0.54
Tracheal caudal diameter (mm)	16.01	20.00	17.76 \pm 0.69

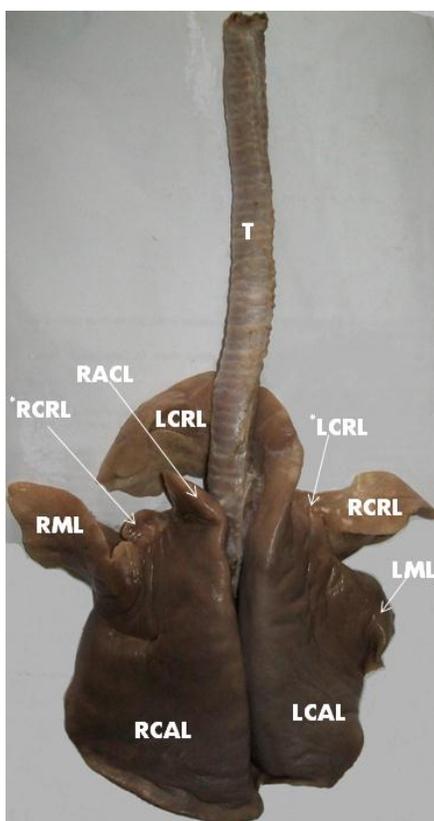


Fig (1): Ventral View of the Lower Respiratory System of the Red Sokoto Goat, illustrating T: trachea, RCRL: right cranial lobe (cranial part), *RCRL: right cranial lobe (caudal part), LCRL: left cranial lobe (cranial part), *LCRL: left cranial lobe (caudal part), RML: right middle lobe, LML: left middle lobe, RCAL: right caudal lobe, LCAL: left caudal lobe.