

Principal Anatomy Particularities in Dromedary Compared to Ox: Digestive and Respiratory Systems [†]

Maya Boukerrou ^{1,*} , Rania Ridouh ¹, Faiza Tekkouk-Zemmouchi ¹ and Claude Guintard ²

¹ Gestion Santé et Productions Animales Research Laboratory, Institut des Sciences Vétérinaires El-Khroub, Université Frères Mentouri Constantine 1, Constantine 25000, Algeria; anatomiste27@outlook.fr (R.R.); ftekkouk@yahoo.fr (F.T.-Z.)

² Unité Anatomie Comparée, Ecole Nationale Vétérinaire de l'Alimentation et de l'Agroalimentaire, 44300 Nantes, France; claude.guintard@oniris-nantes.fr

* Correspondence: maya.boukerrou@doc.umc.edu.dz

† Presented at the 10th International Seminar of Veterinary Medicine: Camelids in Algeria & Maghreb, Constantine, Algeria, 20–21 December 2022.

Abstract: The dromedary, also called the one-humped camel, can live and adapt well to the harsh and hot climate of the desert due to its functional anatomical particularities. Both the dromedary and the ox are known as artiodactyls. Anatomically, they have a few similarities but many differences. This paper aims to review the digestive and respiratory anatomy of the two species and enumerate their main particularities. The camel's mouth is thick and unique; it helps them to be selective with regard to food and to avoid any thorny plants. The nostrils of the dromedary are slit-like, with wings that can close to ensure protection against the wind and the sand; they also have a role in the conservation of water. Contrary to the ox, the dromedary's lungs are not lobulated, and the diaphragm has a unique structure. Unlike the bovids, camelids have only three distinct digestive chambers instead of four; there is no clear distinction between the third and fourth chambers. In addition, they have glandular sac areas called "water cells" instead of papillae in the rumen. Their liver is lobulated, and without a gall bladder.

Keywords: comparative anatomy; dromedary; ox; digestive; respiratory



Citation: Boukerrou, M.; Ridouh, R.; Tekkouk-Zemmouchi, F.; Guintard, C. Principal Anatomy Particularities in Dromedary Compared to Ox: Digestive and Respiratory Systems. *Biol. Life Sci. Forum* **2023**, *22*, 13. <https://doi.org/10.3390/blsf2023022013>

Academic Editors: Amira Leila Dib, Said Boukhechem, Hithem Bougherara and El-Hacene Bererhi

Published: 6 April 2023



Copyright: © 2023 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

1. Introduction

Camelidae includes six species: the Bactrian camel (*Camelus bactrianus*; two humps), the dromedary camel (*Camelus dromedarius*; one hump), llamas, alpacas, guanacos, and vicunas [1]. The dromedary is an animal that is frequently cited as an example of adaptation and resistance to harsh environmental conditions. This is due in part to its anatomy, particularly its digestive and respiratory systems, which are distinct from those of other domestic ruminants. The dromedary and the ox both belong to the order of the artiodactyls, the first to the Tylopoda sub-order and the second to the Ruminantia sub-order [2]. They share several anatomical characteristics (extern and intern anatomy). However, there are some anatomical features specific only to camels. Due to these anatomical particularities, the camel is able to survive in the hot and dry conditions of the desert. The purpose of this paper is to document the main anatomical particularities between these two large ruminants' digestive and respiratory systems.

2. Material and Methods

This paper includes 5 manuscripts: 4 research articles [1,3–5] and one review paper [6]. It focuses on the main differences between the digestive and respiratory systems of the dromedary and the ox.

3. Results and Discussion

The results are shown in Tables 1 and 2.

Table 1. Some particularities of the digestive tract between the dromedary and the ox [1,4,7,8].

	Dromedary	Ox
Mouth	Split upper lip and pendulous lower lip	Upper lip larger than the lower
Dental formula	I1/3 C1/1 PM3/2 M3/3	I0/4 C0/0 PM3/3 M3/3
Soft palate	Extensible and extruded	Not extruded
Salivary glands	Absence of monostomatic sublingual gland	Presence of monostomatic sublingual gland
Esophagus	Enters directly into the rumen	It joints the stomach between the rumen and reticulum
Stomach	3 distinct chambers Presence of glandular sac	4 distinct digestive chambers Absence of the glandular sac
Small intestines	40 m in length, large jejunum	40 m in length, jejuno-ileum
Large intestines	Extremely long (20 m) Blind caecum attached Helical colon	10 m in length, Blind caecum free S-shaped colon with loops
Accessory glands	Liver: lobulated Gall bladder: absent Spleen: not attached to the diaphragm	Liver: not lobulated Gall bladder: Present Spleen: attached to the diaphragm

Table 2. Some particularities of the respiratory system between the dromedary and the ox [3,4,8,9].

	Dromedary	Ox
Nostrils	Slit-like appearance	Separated by a large muffle
Trachea	66–75 incomplete rings of hyaline cartilage	45–55 rings of cartilage with a dorsal crest
Lungs	5 lobes [4] with absence of fissures	7 lobes with presence of fissures
Diaphragm	Ossified [5]	Not ossified

4. Conclusions

The digestive and respiratory systems of the dromedary have some anatomical particularities that allow him to survive in the desert, where food and water are infrequent and the environment is hot and windy [6]. These distinctions aid in our understanding of the camel's way of life and physiological properties.

Author Contributions: Conceptualization, M.B. and R.R.; methodology, M.B.; software, M.B.; validation, R.R., F.T.-Z. and C.G.; formal analysis, M.B.; investigation, M.B.; resources, M.B.; data curation, M.B.; writing—original draft preparation, M.B.; writing—review and editing, M.B., F.T.-Z. and C.G.; visualization, C.G.; supervision, F.T.-Z. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: No new data were created or analyzed in this study. Data sharing is not applicable to this article.

Acknowledgments: The authors would like to thank Amira Leila DIB for her invaluable guidance, and Nedjoua LAKHDARA for her assistance with the translation.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Soliman, M.K. Functional anatomical adaptations of dromedary (*Camelus dromedarius*) and ecological evolutionary impacts in KSA. In Proceedings of the International Conference on Plant, Marine and Environmental Sciences (PMES-2015), Kuala Lumpur, Malaysia, 1–5 January 2015; pp. 19–22.
2. Berkovitz, B.K.; Shellis, R.P. *The Teeth of Mammalian Vertebrates*; Academic Press: Cambridge, MA, USA, 2018.
3. Bello, A.; Onu, J.E.; Onyeanusi, B.I.; Umaru, M.A.; Suleiman, M.H.; Nzalak, J.O.; Atabo, S.M. Fetal Differentiation of the Lower Respiratory Tract of the One Humped Camel (*Camelus Dromedarius*): Gross Observation. *J. Hum. Anat.* **2017**, *1*, 000118.
4. Lechner-Doll, M.; Engelhardt, W.V.; Abbas, A.M.; Mousa, H.M. Particularities in forestomach anatomy, physiology and biochemistry of camelids compared to ruminants. *Options Méditerranéennes Ser. B. Etudes Et Rech.* **1995**, *13*, 19–32.
5. Wilson, R.T. The nutritional requirements of camel. In *Seminar on the Digestion, Nutrition and Feeding of Dromedaries*; Tisserand, J.L., Ed.; CIHEAM-IAMZ: Zaragoza, Spain, 1989; pp. 171–179.
6. Chase, M. Camel Anatomy; More Than Just a Hump. *Rev. A J. Undergrad. Stud. Res.* **2019**, *20*, 5.
7. Wilson, R.T. The nutritional requirements of camel. In Proceedings of the Seminar on the digestion, nutrition and feeding of dromedaries, Ouargla, Algeria, 27 February–1 March 1988.
8. Barone, R. *Comparative Anatomy of Domestic Mammals—Volume 3, Splanchnology 1: Digestive System and Respiratory System*; Vigot: Paris, France, 2009. (In France)
9. Ouajd, S.; Kamel, B. Physiological particularities of dromedary (*Camelus dromedarius*) and experimental implications. *Scand. J. Lab. Anim. Sci.* **2009**, *36*, 19–29.

Disclaimer/Publisher’s Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.