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Camel Anatomy; More Than Just a Hump

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Abstract

The one-humped camel (*Camelus dromedarius*) is capable of living in extreme, arid environments due to its numerous anatomical adaptations. Its modified features of the muscular system, integument, skeletal system, and several internal organs allow this animal to survive in such harsh environmental conditions. Many of these adaptations allow for conservation of energy and water as well as improvement of locomotion to acquire scarce resources. In this paper we will look more closely at some of these adaptations and determine their function in promoting the survival and reproduction of the one-humped camel in desert environments.

Keywords

camel, anatomy, hump, camelus, dromedarius, desert, anatomy

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ABSTRACT

The one-humped camel (Camelus dromedarius) *is capable of living in extreme, arid environments due to its numerous anatomical adaptations. Its modified features of the muscular system, integument, skeletal system, and several internal organs allow this animal to survive in such harsh environmental conditions. Many of these adaptations allow for conservation of energy and water as well as improvement of locomotion to acquire scarce resources. Learning more about these adaptations allows us to better understand their function in promoting the survival and reproduction of the one-humped camel in extreme desert environments.*

It would be foolish to drive a Lamborghini across the Atlantic Ocean, right? Would it make sense to fly a helicopter through a subway station? Of course not. These vehicles are not designed to function in those particular environments. This concept parallels the subject of comparative anatomy. Organisms have evolved over time in order to function properly in certain environments. Their specific adaptations are unique to each individual species and have been naturally selected as favorable traits for the organism's niche. This idea explains the extreme variation amongst living creatures, and exploring the driving forces for the presence, shape, size, and location of anatomical features allows us to further understand the concept of evolution and natural selection. The "vehicle" discussed in this essay is the one-humped camel (*Camelus dromedarius*) and how its specific anatomical features allow it to flourish in such harsh, arid environmental conditions.

The dromedary camel is a large, even-toed ungulate with one hump on its back. Many of its anatomical adaptations are aimed at conquering the problems faced by most desert species including lack of food and water, sandy or stony ground surface, thorny plants and trees, and a hot, windy climate (Faran et al). Starting at the cranial end, the camel has long eyelashes and a third, clear eyelid to help protect its eyes from the intense sun and blowing sand. They have a slit-like closable nostril which prevents blowing sand from entering the nasal canal (Gebreyohanes and Assen). Their nostrils also have the ability to trap water vapor upon exhalation. This water vapor is then reabsorbed into the body as a means of conserving water. Their mouths are composed of a split, hairy upper lip and a tough, leathery dental pad to allow for feeding on thorny desert plants. The tongue is very mobile and composed of many hard papillae which allows for manipulation and ingestion of thorny plants in cooperation with the slow, lateral movements of the jaw. The esophagus is extremely flexible and is lined with a high concentration of mucosa cells, allowing for the movement of hard, dry materials (Faran et al). The ears are covered by thick, long hairs to protect from blowing sand and also have a high acoustic ability to allow the camel to hear sounds from far distances (possible food, water, other camels) (Soliman).

Moving away from the head, the camel's neck is long and arched, allowing it to reach high plants and see further distances over the desert sand (again, possible prey, water, other camels) (Faran et al). It has a thick coat which provides insulation from the intense heat. The fur becomes lighter in color during the hotter summer months in order to reflect more light and avoid sunburn. Sweat droplets evaporate directly from the skin rather than from the hair tips (like other mammals) in order to conserve energy and further cool the skin (Gebreyohanes and Assen). Camels also have leather-like, thick fur pads on the knees and elbows to protect their skin when laying down on the hot desert sand. The camel also possesses a pedestal structure on its sternum. This pedestal is a thick pad of tissue covered by a thick layer of fur which raises the body off the ground when the camel is laying down. This pedestal functions to lift the body off the hot sand, thus preventing burning of the skin and overheating of the organs and also allowing for cooling air to pass underneath the body (Faran et al). Arguably the most popular feature of camels, the hump, is actually composed of adipose tissue, not water. This large region of fat storage has the ability to become metabolized in order to produce energy and water under circumstances of extreme starvation or thirst (Soliman).

Now moving more distal on the camel, its four legs are long and thin in order to maximize the height of the body above the hot sand and ground. These long limbs also allow winds to flow under the body, further cooling it. Long legs also enable the camel to reach high trees and bushes for food sources, and enable better vision for further distances (again, possible food, water, other camels). Camel feet contain large foot pads with two toenails in front that allow them to effectively maneuver across the desert sand. This broad leathery pad disperses the weight of the animal over a wider surface, preventing their feet from sinking into the loose, hot sand (Gebreyohanes and Assen). These limb adaptations are very important for camel locomotion as well as regulation of temperature.

Looking inside the body cavity, we can observe several adaptations in camel organs that contribute to the animal's ability to occupy a desert niche. Of significant importance are the urinary and digestive systems. Camels have very long loops of Henle, four to six times longer than those of cattle (Soliman), which contribute both to concentrating urine and reducing its flow. These long loops allow for maximum water reabsorption, thus conserving water. Similarly, the large intestines of camels are extremely long, allowing for maximum water absorption from ingested food. These two structures contribute to the camel's production of extremely small amounts of concentrated urine and hard, dry fecal balls (Soliman).

In addition to modified organs, camels also have adaptations to their blood cells. Typical mammalian red blood cells are circular while camels' are ovular in shape, resembling human sickle cells. This adaptation allows blood to continually flow even if the organism is extremely dehydrated, a very common occurrence in the desert (Soliman). Camel red blood cells also are unique due to their ability to extend their life span when dehydrated. When hydrated, camel erythrocytes typically have a life span of 90 to 120 days. However, when dehydrated, this number increases to around 150 days. This is a favorable adaptation because producing new erythrocytes requires the use of both energy and water, resources which are extremely scarce in an arid environment (Gebreyohanes and Assen). Therefore, increasing red blood cell life span conserves water and energy, a common theme among most camel adaptations previously discussed.

Male camels also exhibit interesting anatomical adaptations in their testicular morphology, which varies during different seasons of the year. Camels are seasonal breeders who show sexual activity during a specific period of the year called "rutting season." This breeding period is associated

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with significant modifications to the morphology of genital organs. In males during the rutting season, spermatogenesis is at its highest, thus causing a significant increase in the size and weight of the testes. Leydig cells, typically inactive during non-breeding seasons, become active, larger, and more abundant, contributing to more testosterone production. Increased activity in the Sertoli cells, involved in the maturation of sperm cells, is also observed during the rutting season. While the time period and duration of rutting varies among different camel species and different geographical locations, these morphological changes are exhibited throughout the camel population (Pasha et al). One possible explanation for this behavior is the conservation of energy and resources throughout the year until the camel feels confident in the availability of resources at that time period. It is at this time when the male camel is able to spend more energy on reproduction, rather than constantly spending energy on reproduction throughout the year, wasting valuable resources for unsuccessful breeding. Another explanation could involve a change in morphology of the female camel reproductive system, which would require the male to adapt accordingly. While camels do have a scrotum to house their testes, this significant influx of reproductive activity may be caused by the environmental temperature reaching ideal conditions for testosterone production and sperm cell maturation, a factor determined by the climate during rutting season.

Organisms have been evolving for years in order to better survive and reproduce in different environments. Traits which may seem absurd or useless to one organism may be the key to survival for another. The one-humped camel exhibits numerous adaptive traits which enable its survival in the dry climate of desert lands around the world. Studying these anatomical features allows us to better understand the lifestyle and behavioral and physiological characteristics of this organism, and also encourages us to draw connections between organisms with similar adaptations.

References

Faran N, Choudhary S, Sunita. Anatomical adaptation of the dromedary camel (Camelus dromedaries) to desert environment. *Recent Research Trends in Veterinary Sciences and Animal Husbandry.*1:5. 12 Feb 2018. Pp 61-68. Accessed 2 Nov 2018.

Gebreyohanes M and Assen A. Adaptation Mechanisms of Camels (Camelus dromedarius) for Desert Environment: A Review. *Journal of Veterinary Science & Technology* 8:6. 6 Nov 2017. Accessed 2 Nov 2018.

Pasha R, Qureshi A, Rehman Z, Khamas W. Seasonal anatomical changes in the testis of the one-humped camel: a review. *Eur J Anat* 17:3. 27 Mar 2013. Pp 132-141. Accessed 2 Nov 2018. URL:http://eurjanat.com/web/paper.php?id=130013rh

Soliman M. Functional Anatomical Adaptations of Dromedary (Camelus Dromedaries) and Ecological Evolutionary Impacts in KSA. I*nternational Conference on Plant, Marine and Environmental Sciences*. 1-2 Jan 2015. Accessed 2 Nov 2018. URL:http://iicbe.org/upload/1552C0115058.pdf