DF-603
[1-5]

RESEARCH ARTICLE Agricultural Science Digest, Volume Issue : ()

Morphometric Study of the Algerian Dromedary Population Reguibi (*Camelus dromedarius* L. 1758)

OUDINI Elhadi[1,5], BABELHADJ Baaissa[1,2], BENAISSA Atika[1], DIB Madjed[1], RIDOUH Rania[3], TEKKOUK-ZEMMOUCHI Faiza[3], GUINTARD Claude[4]

10.18805/ag.DF-603

ABSTRACT

Background: The morphometric study of the Algerian dromedary population, specifically the Reguibi breed (Camelus dromedarius), involves analyzing various physical measurements and characteristics of these camels. Morphometric studies aim to understand the phenotypic diversity within a population, which can provide insights into their adaptation, genetic variability and potential for selective breeding or conservation efforts.

Methods: This study used 60 live dromedaries from the Tindouf slaughterhouse in Algeria's extreme southwest. The animals, 30 males and 30 females, were adults over the age of five years old who grazed in Tindouf's southwestern regions. After four measurements, the substernal void index and live weight were calculated.

Result: The mean live weights for males were 507.9 kg ± 97.3 kg and 445.6 kg ± 63 kg for females. The average withers height was 1.94±0.10 m for males and 1.84±0.10 m for females. The findings were compared to previous studies on Sahraoui, Targui and Steppe Camels. To the best of our knowledge, this is the first study of the Reguibi population in this region.

Key words: Biometry, Body measurements, Dromedary, Reguibi population.

INTRODUCTION

The dromedary is the iconic animal of North Africa (Camps, 1996), bred for its products (milk, meat) rather than its traditional uses (riding, agricultural work) (Faye *et al*., 2012). Eco-dromedary seems to adapt to environmental constraints and the evolution of various farming systems (Guintard and Babelhadj, 2018). Climate change in this part of the world has already been observed for several decades (Faye, 2013) and is characterised by low rainfall with a long drought period (Bourzat, 1987), followed by short but violent rains, resulting in a decrease in natural resources and the need for rational water resource management (Faye *et al*., 2014).

The camel species has long been overlooked in scientific research (Narjisse, 1989). However, it has received special attention in recent years (Benaissa, 1989) because it evolves in environments with limited food resources and ecoclimatic conditions (Meguellati-Kanoun *et al*., 2018) and where rearing other animal species would be more expensive (Senoussi *et al*., 2017). The Algerian camel population was estimated to be 416,519 head in 2020 (FAOSTAT, 2020). The Tindouf region (Fig 1) is in the western Sahara, in Algeria's central geographical area for camel breeding and has approximately 64044 heads (MADR, 2021).

Zoometry is the calculation of the live weight of an animal based on simple body measurements. This estimate is based on regression equations with highly correlated animal measurements (Graber, 1966 in Babelhadj *et al*., 2016a; Boujenane, 2019). This research was part of a larger effort to characterise and standardise local populations (Oulad Belkhir *et al*., 2013; Babelhadj *et al*., 2017). The aim was to compare and determine *biometric* measurements from a homogeneous group of adult male and female camels from the Reguibi population.

[1]Laboratory of Ecosystems Protection in Arid and Semi-Arid Zones. Kasdi Merbah, Ghardaia Road 30000 Ouargla, Algeria.
[2]Ecole normale supérieure de Ouargla, Algeria.
[3]Laboratory of Health Management and Animal Production, Institute of Veterinary Sciences, University of Constantine, 25100 El Khroub, Algeria.
[4]National Veterinary School of Food and Agrifood, Nantes Atlantique-Oniris, Gachet Street, Cs 40706, 44307 Nantes Cedex 03, France.
[5]Laboratoire de recherche sur la phoeniciculture, Université Kasdi Merbah, route de Ghardaïa 30000, Ouargla, Algérie.

Corresponding Author: BABELHADJ Baaissa, Ecole normale supérieure de Ouargla, Algeria.
Email: babelhadj.baaissa@ens-ouargla.dz

How to cite this article: OUDINI, E., BABELHADJ, B., BENAISSA, A., MADJED, D., RIDOUH, R., Faiza, T.Z. and GUINTARD, C. (2024). Morphometric Study of the Algerian Dromedary Population Reguibi (*Camelus dromedarius* L. 1758). Agricultural Science Digest. doi: 10.18805/ag.DF-603.

Submitted: 29-02-2024 **Accepted:** 01-04-2024 **Online:** 24-04-2024

MATERIALS AND METHODS

Animals

The Reguibi camel is a long, energetic and harmonious animal. It is 2 - 2,15 m tall. It is used for racing and remote travel. The head is elongated and carried high on a long, tapered neck with a flat forehead. The ears are small. The hump is relatively developed, high and well extended at the base. Limbs are long, strong and muscular. The coat is short

and thin, it is longer on the shoulders of the males. It is an excellent rustic saddle animal. It can be used in all terrains. It served in the army run under the name of Mehari. This name designates very racy animals (Meyer, 2023). It lives in the western Sahara and south of Oran (Bechar, Tindouf) (Benaissa, 1989).

The Reguibi population took centuries to develop its rusticity (Fig 2), gradually adapting to the very restrictive natural conditions in the region. Highly esteemed in Tindouf, it is also the symbol of the R'GUIBET tribe, whose ancestor was Sidi Ahmed R'GUIBI. That is why most breeders rely on this population to renew their herd. The breeders are still required to protect this camel population. Due to its average size and milk production, it is used for saddling (Harek *et al*., 2017).

This preliminary work involved 60 adult dromedaries, 30 males and 30 females, all belonging to the Reguibi population. They were over 5 years old and were slaughtered at the communal slaughterhouse in Tindouf (southwest Algeria) between June 2020 and September 2022.

Method

For each sex, two age classes were formed: animals between 6 and 10 years of age, called young adults (JA) and animals over 10 years of age, called adults (A). For each individual, four biometric measurements were taken before slaughter: height in the withers (W), thoracic circumference (TC), abdominal circumference (AC) and substernal void (SSV). The three measurements were used to estimate the live weight of the animal (LW) according tothe BOUE biometric formula:

$$LW = 53 \times TC \times AC \times W$$

The carcass weight for each animal was also recorded.

Height in the withers (W), substernal void (SSV) and chest (C) were measured in metres using a 2.5 m height gauge (Fig 3). The following formula was used to calculate the substernal void: W - C = SSV. The thoracic circumference (TC) at the straps' passage, the sternal callus and the abdominal circumference (AC) were all measured with metric tape and the hump was included. The biometric formula of Boue (1949) was used to calculate a live weight (kg):

$$LW\ (kg) = 53*TC*AC*W$$

This formula is the most commonly used to compare different populations in the Maghreb dromedary (Babelhadj *et al*., 2016b). The teeth were examined to determine the age. Experienced camel drivers and butchers used this method. Height and body circumference measurements were taken to the nearest centimetre. The precision of the live weight (LW) and carcass weight (CW) was done to the nearest kilogram. The evolution of the substernal gracility index with age was studied.

$$SGI = \frac{SSV}{C}$$

Statistical analysis

Statistical data was processed using R computer software for the measured variables or indices. The statistical parameters of position (mean, minimum, maximum) for each

Fig 1: Geographical location of Tindouf region, Algeria.

Fig 2: Reguibi camel in the Tindouf region (Algeria); left adult male, right adult female.

measured variable were calculated in the male and female samples, respectively. The standard deviation estimated the variability σ and the CV coefficient of variation:

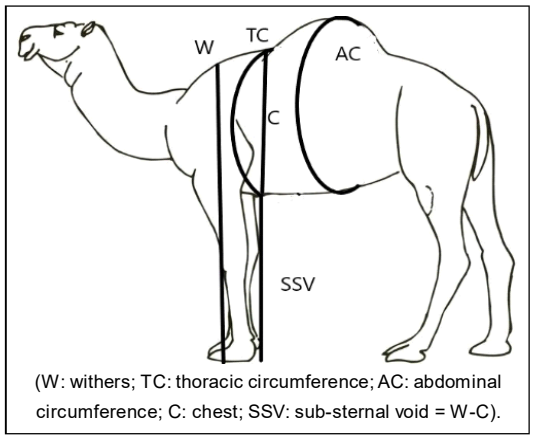
$$CV\ \% = \frac{\sigma}{m} \times 100$$

The ratio between the standard deviation σ and the mean m), the latter allowing to remove the unit of measurement.

RESULTS AND DISCUSSION

Males had a higher average value for all variables than females (Table 1). The mean values correspond to the Reguibi population (n= 60) standards for adult and young dromedaries weighing 476.7±87.14 kg live weight and standing 1.89±0.11 m tall at the height at withers. These findings show that the Reguibi population is heavier and longer than the Saharoui (n= 60) and Targui (n= 60), weighing 462.6±84.4 kg and 466.2±73.8 kg live weight for withers heights of 1.82±0.08 m and 1.88±0.07 m, respectively (Babelhadj *et al*., 2016). According to (Boujenane, 2019) No method is perfect, but when a scale is unavailable for determining a camel's weight, the formula of Field (1979), where estimated weight (kg) = 6.46 × 10-7 × (HW + CG + HG) 3.17, appears to be the best choice. At reverse, the formula of Wilson (1978) seems to be inaccurate and therefore, unreliable, raising the issue of its applicability. According to (Diop *et al*., 2020), the measurement of head width is very rarely ensured, only body measurements have been taken into account. The measurement data included different dromedary breeds from Morocco (Boujenane *et al*., 2019), Algeria (Oulad Belkhir *et al*., 2013), Tunisia (Chniter *et al*., 2013), Sudan (Ishag *et al*., 2011), Ethiopia (Yosef *et al*., 2018; Legesse *et al*., 2018), Nigeria (Tandoh and Gwaza, 2017), Saudi Arabia (Abdallah and Faye, 2013), Pakistan (Ghiasuddin Shah *et al*., 2014) and India (Kohler-Rollefson, 2011) where the abdominal circumference measurement is missing from all publications. The standard deviation of linear biometric measurements was very low in the study population and high in weight measurements.

Reguibi camels aged 5 years weighed 445.7±63.0 kg for a withers height of 1.84±0.09 m and a substernal void average of 1.05±0.08 m (Table 2). To compare the average performance measurements of camels from three populations, the Reguibi is heavier and longer than the two previously studied populations, the Sahraoui and the Targui (Babelhadj *et al*., 2017). On the other hand, the camels of the steppe camel population were heavier and more doubtful



(W: withers; TC: thoracic circumference; AC: abdominal circumference; C: chest; SSV: sub-sternal void = W-C).

Fig 3: Visualization of the measurements made on the animals.

Table 1: Biometric parameters of male Reguibi camels in Algeria.

Statistical parameters	W	VSS	TC	AC	C	SGI	LW
n	30	30	30	30	30	30	30
μ	1.94	1.08	2.05	2.39	0.85	1.28	508
Minimum	1.75	0.86	1.8	1.92	0.7	0.83	329
Maximum	2.16	1.3	2.47	2.94	1.03	1.86	831
σ	0.10	0.09	0.16	0.22	0.08	0.19	97.3
CV %	5.05	8.62	7.85	9.07	9.19	14.7	19.2

W: Withers; VSS: Substernal void; TC: Thoracic circumference; AC: Abdominal circumference; C: Chest; SGI: Substernal gracility index; LW: Live weight; σ: Standard deviation; CV: Coefficient of variation.

Table 2: Biometric parameters of female Reguibi camels in Algeria.

Statistical parameters	W	VSS	TC	AC	C	SGI	LW
n	30	30	30	30	30	30	30
μ	1.84	1.04	1.96	2.32	0.80	1.32	446
Minimum	1.75	0.94	1.78	1.92	0.7	0.96	317
Maximum	2.1	1.3	2.1	2.7	1.01	1.64	562
σ	0.10	0.08	0.09	0.20	0.07	0.15	63.0
CV %	5.37	7.46	4.62	8.63	8.69	11.4	14.1

W: Withers; VSS: Substernal void; TC: Thoracic circumference; AC: Abdominal circumference; C: Chest; SGI: Substernal gracility index; LW: Live weight; σ: Standard deviation; CV: Coefficient of variation.

Table 3: Biometric parameters of Reguibi camels (total population) in Algeria.

Statistical parameters	W	VSS	TC	AC	C	SGI	LW
n	60	60	60	60	60	60	60
μ	1.89	1.06	2.01	2.35	0.83	1.30	477
Minimum	1.75	0.86	1.78	1.92	0.7	0.83	317
Maximum	2.16	1.3	2.47	2.94	1.03	1.86	831
σ	0.11	0.08	0.14	0.21	0.08	0.17	87.1
CV %	5.76	8.24	6.86	8.91	9.53	13.1	18.3

W: Withers; VSS: Substernal void; TC: Thoracic circumference; AC: Abdominal circumference; C: Chest; SGI: Substernal gracility index; LW: Live weight; σ: Standard deviation; CV: Coefficient of variation.

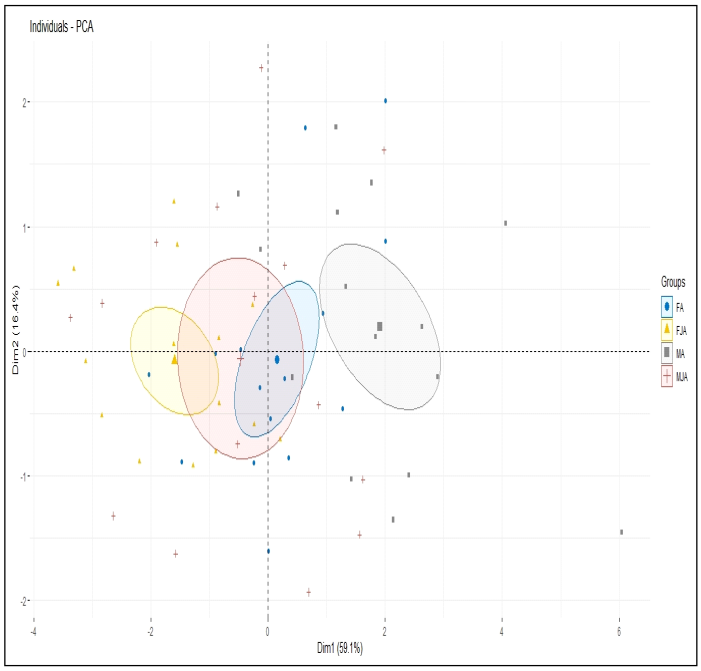


Fig 4: Principal component analysis (PCA) Four-class dispersion with ellipses.

than the Reguibi 482.59±59.99 for a height at the withers of 1.71±0.09 m (Babelhadj *et al*., 2021). In a study similar to those of Oulad Belkhir *et al*. (2013), the abdominal circumference of the Saharaoui was 1.638±0.199 and the Targui was 2.200±0.258, while the Reguibi was larger at 2.350±0.210 (Table 3). Adult females and young adult males overlaped. However, the two classes (young adult females and adult males) were separated from the young adult males classes (Fig 4).

CONCLUSION

This study allowed us to deepen for the first time the knowledge of the Algerian dromedary population, which is highly prized by the Reguibette breeders of the region and voracious in dromedary meat. This research has allowed us to better characterize the Reguibi population biometrically. Its size was compared to the Sahraoui, Targui and steppe camel populations. Several important characteristics of these dromedaries were also identified from the biometric analyses. In terms of size, the results show that the Reguibi camel is an excellent saddle animal. Furthermore, it is an important milk producer with a high gracility index, which explains the attachment and preservation of the breeders of this population.

ACKNOWLEDGEMENT

The authors thank Dr Ali MAMOUNE (Veterinary Inspector of the Tindouf slaughterhouses) for his contribution to this work.

Conflict of interest

The authors declare no conflict of interest for this manuscript.

REFERENCES

Abdallah, H.R., Faye, B. (2013). Typology of camel farming system in Saudi Arabia. Emir. J. Food Agric. 25(4): 250-260. doi: 10.9755/ejfa.v25i4.15491.

Babelhadj B., Adamou, A., Tekkouk-Zemmouchi, F., Benaissa, A., et Guintard, C. (2016a). Biometric study of camels from 2 Algerian populations; Saharaoui and Targui (*Camelus dromedarius* L.). Livestock Research for Rural Development. 28(30): Retrieved November 2, 2022, from http://www.lrrd.org/lrrd28/2/baai28030.html.

Babelhadj, B., Adamou, A., Thorin, C., Tekkouk-Zemmouchi, F., Benaissa, A., Guintard, C. (2016b). Comparative osteo-biometric study of the Saharaoui and Targui camel breeds (*Camelus dromedarius* L., 1758). Rev. Med. Vet. 167(3-4): 77-92.

Babelhadj, B., Benaissa, A., Adamou, A., Tekkouk-Zemmouchi, F., Raache, S., Babelhadj, T., Guintard, C. (2017). Morphozoometric approach of female camels (*Camelus dromedarius* L.) of the Sahraoui and Targui Algerian populations. Rev. Elev. Med. Vet. Pays Trop. 70(2): 65-69. doi: 10.19182/remvt.31483.

Babelhadj, B., Guintard, C., Benaissa, A., Thorin, C. (2021). Biometric characterization of the Steppe Camel (*Camelus dromedarius*) in Algeria. Rev. Elev. Med. Vet. Pays Trop. 74(1): 37-42. doi: 10.19182/remvt.36326.

Benaissa, R. (1989). The camel in Algeria, CIHEAM - Mediterranean option - Seminar Series - n 2: 19-28.

Boue, A. (1949). Barymetry test in the north African camel breeding and veterinary medicine review of tropical countries: p3.

Boujenane, I. (2019). Comparison of body weight estimation equations for camels (*Camelus dromedarius*). Trop. Anim. Health Prod. 51: 1003-1007. doi: 10.1007/s11250-018-1771-8. Epub 2018 Dec 11. PMID: 30539360.

Bourzat, D. et Wilson, R.T. (1987). Camel research in Africa. Rev. Sci. Tech. Off. Int. Epiz. 6(2): 375-382.

Camps, G., Peyron, M. and Chaker, S., "Dromedary", Berber Encyclopedia [Online], 17 | 1996, document D93, Online since 01 June 2011, connection on November 1, 2022. URL: http://journals.openedition.org/encyclopedieberbere/2119;doi:https://DOI.org/10.4000/encyclopedieberbere.2119.

Chniter, M., Hammadi, M., Khorchani, T., Krit, R., Benwahada, A., Ben Hamouda, M. (2013). Classification of Maghrebi camels (*Camelus dromedarius*) accor-ding to their tribal affiliation and body traits in southern Tunisia. Emir. J. Food Agric. 25(8): 625-634. doi: 10.9755/ejfa.v25i8. 16096.

Diop, A.K.M., Chrif Ahmed, M.S., Biya, M.B., Haki, M.L., Konuspayeva, G., Et Faye, B. (2020). «Comparison of camel phenotypes from Mauritania to ecotypes from Africa and Asia», Rev. Elev. Med. Vet. Pays Trop., Montpellier, France. 73(4): 247-254. doi: 10. 19182/remvt.31948.

FAOSTAT, (2020). Accessed January 2021, from http://www.fao.org/faostat/en/#data/QA.

Faye, B. (2013). Camel Farming Sustainability: The Challenges of the Camel Farming System in the 21st Century. J. Sustain. Dev. 6: 74-82.

Faye, B., Chaibou, M., Vias, G. (2012). Integrated impact of climate change and socioe/conomic development on the evolution of camel farming systems. Br. J. Environ. Clim. Change. 2(3): 227-244.

Faye, B., Jaouad, M., Bhrawi, K., Senoussi, A., Bengoumi, M. (2014). Camel breeding in North Africa; Current situation and perspectives. Rev. Elev. Med. Vet. Pays Trop. 67(4): 213-221.

Ghiasuddin Shah, M., Sarwar Qureshi, A., Reissmannn, M. (2014). Phenotypic and genetic differentiation of Pakistani camel breeds. Lambert Academic., Saar-brücken, Germany.

Graber, M. (1966). Study of the parasitic action of Thiabendazole on some helminths of domestic animals under some African conditions. II. Dro-medary. Rev. Elev. Med. Vet. Pays Trop. 19(4): 527-543. doi : 10.19182/ remvt.7388.

Guintard, C., Babelhadj, B., (2018). Morphotypes and developed animal strength. Comparison of two populations of Algerian Camels: The Sahraoui and the Targui (*Camelus dromedarius* L.). In : Animal source d'énergie, Investigations in pre-industriel Europe, Guizard F., Beck C. (Dir.), Valenciennes university press, France. 133-147.

Harek, D., Ikhlef, H., Bouhadad, R., Sahel, H., Cherifi, Y.A., Djallout, N., Khelifa Chelihi, S., El Mokhefi, M., Boukhtala, K., Gaouar, S.B.S., Arbouche, F. (2017). Genetic diversity status of camel's resources (*Camelus dromedaries* Linnaeus, 1758) in Algeria. Gen. Biodv. J. 1(1): 43-65.

Ishag, I.A., Eissa M.O., Ahmed, M.K.A. (2011). Phenotypic characteristics of Sudanese camels (*Camelus dromedarius*). Livest. Res. Rural Dev. 23: 99.

Kohler-Rollefson, I., (2011). The camel breeds of india in social and historical perspective. Anim. Genet. Res. 10: 47-56. doi: 10.1017/S101423390000328X.

Legesse, Y., Dunn, C.D., Mauldin, M.R., Ordonez-Garza, N., Rowden, G.R., Mekasha Gebre, Y., Kurtu, M.Y. (2018). Morphometric and genetic variation in 8 breeds of Ethiopian camels (Camelus dromedarius). J. Anim. Sci. 96: 4925-4934, doi:10.1093/jas/sky351.

MADR, (2021). Agricultural statistics for areas and production. Series B 2019. [Online] (page consulted on 10/05/2022) https://madr.gov.dz/.

Meguellati-Kanoun, A., Saadaoui, M., Kalli, S., Kanoun, M., Huguenin, J., Benidir, M. et Benmebarek, A. (2018). Location and spatiotemporal distribution of camel nu,bers in Algeria. Livestock Research for Rural Development. 41(30): Retrieved November 2, 2022, from http://www.lrrd.org/lrrd30/3/skso30041.html.

Meyer, C. ed. sc., (2023). Dictionary of animal sciences. [Online]. Montpellier, France, Cirad. [22/06/2023]. <URL : https://dico-sciences-animales.cirad.fr/ >

Narjisse, H. (1989). Nutrition and milk production in camels. Mediterranean option - Seminar Series - n 2: 165 p.

Oulad Belkhir, A., Chehma, A., Faye, B. (2013). Phenotypic variability of two principal Algerian camel's populations (Targui and Sahraoui). Emir. J. Food Agric. 25(3): 231-237. doi: 10.9755/ejfa.v25i3.15457.

Senoussi, A., Brahimi, Z., Beziou, S. (2017). Scope of camel breeding in Algeria and development prospects. Review of Bioressources. 7(1): 29-38.

Tandoh, G., Gwaza, D.S. (2017). Sex dimorphism in the one hump-camel (*Camelus dromedarius*) from selected populations in Nigeria. J. Appl. Life Sci. Int. 15(3): 1-10. doi:10.9734/JALSI/2017/37788.

Wilson, R.T. (1978). Studies on the livestock of Southern Darfur, Sudan 5. Notes on Camels. Trop. Anim. Health Prod. Pp: 10-19.

Yosef, T., Kefelegn, K., Mohammed, Y.K., Mengistu, U., Solomon, A., Tadelle, D., Han, J. (2018). Morphological diversities and eco-geographical structuring of Ethiopian camel (*Camelus dromedarius*) populations. Emir. J. Food Agric. 26(4): 371-389. doi: 10.9755/ejfa.v26i4.17021.