

Original Research Paper

Body Measurements of Four Types of Camel Breed in Algeria

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Abstract:

In Algeria, the Sahara covers more than 85% of the total area. The dromedary is the only species able to valorize this desert ecosystem. The characterization of Algerian camel populations using morphological characterization is the first step to managing and preserving this important resource. Two hundred and seventy-seven heads belonging to four breed types of Algerian camel (Targui, Steppe, Sahraoui, and Ouled Sidi Cheikh) were randomly selected from five regions of Algeria (Ouargla, El Oued, Ghardaia, Laghouat, and El Bayadh). The purpose of this study was to determine the effect of breed types, sex, and age groups on some body measurements of these animals. Body measurements were taken using metric tape (height at withers, head length, body length, neck length, tail length, and chest girth). The body weight was estimated using a barometric formula. Averages of height at wither, head length, body length, neck length, tail length, chest girth, and body weight were 177.5±9.71 cm, 50.64±6.13 cm, 149.2±15.04 cm, 114.1±14.09 cm, 57.88±13.22 cm, 174.4±24.57 cm, and 293.9±64.03 kg respectively. The results also revealed that body measurements were significantly affected by the type of camel and the age groups. The Ouled Sidi Cheikh camel had the highest values of head length, body length, tail length, and chest girth. Moreover, the Sahraoui camel had the highest values in height at wither, neck length, and body weight compared to other studied Algeria camel breeds. In terms of age, camels (8 to 9 years old) had significantly higher values in all body measurements than those (10 to 12 years old), while the animals in the first group (≤3 years old) had the lowest values. Furthermore, the results showed that sex affected significantly the body, the males had a significantly higher values than females (P< 0.01).

Keywords: Algeria, Camel, Breed, Body measurements, diversity.

خلاصة

في الجزائر، تغطي الصحراء أكثر من 85% من المساحة الإجمالية. الجمل العربي هو النوع الوحيد القادر على تثمين هذا النظام البيئي الصحراوي. يعد توصيف مجموعات الإبل الجزائرية باستخدام الخصائص المورفولوجية الخطوة الأولى لإدارة هذا المورد المهم والحفاظ عليه. تم اختيار مائتين وسبعين رأساً ينتمون إلى أربعة أنواع من الإبل الجزائرية (الترقيوي، السهوب، الصحراوي، أو لاد سيدي الشيخ) عشوائياً من خمس مناطق في الجزائر (ورقلة، الوادي، غرداية، الأغواط، البيض). الغرض من هذه الدراسة هو تحديد تأثير أنواع السلالات والجنس والفئات العمرية على بعض قياسات الجسم لهذه الحيوانات. تم أخذ قياسات الجسم باستخدام شريط مئري (الارتفاع عند الكتفين وطول الرأس وطول الجسم وطول الرقبة وطول الذيل ومحيط الصدر). تم تقدير وزن الجسم باستخدام صيغة barymetric. كانت متوسطات الطول عند الذيل وطول الرأس وطول الجسم وطول الرقبة وطول الذيل ومحيط الصدر ووزن الجسم 177.5 ± 9.71 سم، 50.64 ± 6.13 سم، 149.2 ± 15.04 سم، 114.1 ± 14.09 سم، 57.88 ± 13.22 سم، 174.4 ± 24.57 سم و 293.9 ± 64.03 كجم على التوالي. كما أوضحت النتائج أن قياسات الجسم تأثرت بنوع الإبل والفئات العمرية. كان للإبل أولاد سيدي الشيخ أعلى القيم من حيث طول الرأس وطول الجسم وطول الذيل ومحيط الصدر. علاوة على ذلك، كان لجمل الصحراوي أعلى قيم في الطول عند الذيل وطول العنق ووزن الجسم مقارنة بسلالات الإبل الجزائرية الأخرى المدروسة. من حيث العمر، كانت الإبل (من 8 إلى 9 سنوات) ذات قيم أعلى بكثير في جميع قياسات الجسم من تلك (من 10 إلى 12 سنة)، في حين أن الحيوانات في المجموعة الأولى (≥3 سنوات) كانت لها أقل القيم. علاوة على ذلك، أظهرت النتائج أن الجنس أثر على الجسم، حيث كان للذكور قيم أعلى من الإناث في جميع قياسات الجسم.

الكلمات المفتاحية: الجزائر، الجمل، السلالة، قياسات الجسم، التنوع

Introduction

The breeding sector in Algeria constitutes an essential part of the national economy through the creation of employment, especially the satisfaction of the local population's needs for animal products. The livestock sector represents the most important part of agricultural production. In 2013, it contributed to 33.8% of the

total agricultural production (M.A.D.R., 2013). This livestock has always represented an important source of support for the populations of dry regions.

The dromedary is the most suitable livestock species for large Saharan areas; despite the harsh conditions of its environment, it manages to survive, reproduce and even produce. Camel breeding plays an irreplaceable role in the regional economy, where it is used for its various productions and services [(Oulad. B *et al.*, 2008) ; (Cherifi *et al.*, 2013)].

Of the 97 camel populations recorded on Earth, 26 are found in Africa, including 10 in Algeria (Harek *et al.*, 2017). In 2017, Algerian camel numbers were estimated at 381,882 head (Bettayeb, 2019).

Body measurement traits such as weight, height, length, and width play an important role in assessing the value of camel productivity and economy (Liu *et al.*, 2010). The purpose of this study was to determine the effect of breed types, sex, and age groups on some body measurements of the four Algerian camel breed types.

Materials and Methods

Study area and animals

The studied area covered the territories of the Wilayas (provinces) of Ouargla, El Oued, Ghardaia, Laghouat, and El Bayadh in Algeria (Fig. 1).

Ouargla province is located in the South-Est of Algeria, covering an area of 194 552 km², it remains one of the largest administrative communities in the country. Ouargla region is situated in the North-Est part of the northern Sahara. It is separated from the mountainous area by the limestone plateau of Tinrhert, it is a flat region of low altitudes, ranging from - 30 to 200 m (Dubost, 1991).

The wilaya of El-Oued, also called Souf, covers an area of 44,586.80 km². It is limited to the north by the wilaya of Khanchla, to the south-west by the wilaya of Ouargla, to the west by the wilaya of Djelfa, to the east by Tunisia, to the north-east by the wilaya of Tébessa, to the northwest by the wilaya of Biskra. (Bouselsal, 2016).

The wilaya of Ghardaïa is located in the south-east of the country, north of the northern Algerian Sahara. It is bordered to the north by the wilayas of Djelfa and Laghouat, to the west by El Bayadh and Adrar, to the south by Tamanrasset and the east by Ouargla. The regional climate is part of the Saharan bioclimatic stage with mild winters (average temperature of the coldest month = 11.5°C), hot summers (average temperature peaks in July of 35.5°C), and low annual rainfall (~ 50 –70 mm) (Heim et Mayaud, 1962).

The area of Laghouat is in southern Algeria, 400 km from Algiers. It covers an area of 25,052 km² with a population of 520,188 inhabitants. Its climate is continental in the northwest, with rainfall ranging from 300 to 400 mm. In the center and the south of the area, the climate is Saharan and arid (rainfall of 150 mm in the center and 50 mm in the south). Winter is characterized by white frosts and summer by heat and sandstorms (Andi, 2013).

The Wilaya of El Bayadh is geographically located between the 30-42' and 34-28' parallels of North latitude and the meridians of longitude 0-24' to the West, point 30 and 2-16' to the East. It occupies an area of 71,697 km² (NASP, 2003).

Two hundred and seventy-seven head of four breeds of Algerian camels were randomly selected from Algeria's five regions [Targui (n = 42), Steppe (n = 55), Sahraoui (n = 140), and Ouled Sidi Cheikh (n = 40)] according to sex (males = 132, females = 145) and six age groups: 3 years (n = 5), 3-5 years (n = 29), 6-7 years (n=61), 8-9 (n=50), 10-12 (n=67) and ≥12 (n=65).

Data collection

Using questionnaires filled out by direct interviews with camel owners, general descriptive information about different breed types of camels was obtained. The questionnaire was designed to obtain information on the general characteristics of camels.

Body measurements

The measurements were taken on standing animals with a measuring tape in cm. The following measurements were taken: The height at withers (WH) was measured from the ground level to the highest point of the withers. The chest girth (CT) was measured immediately behind the breast pad. The body length (BL) was measured from the shoulder Pars *Caudalis Tuberculi Majoris* to the hip *Tuber Ischiadicum*, while the neck length (NL) was taken from the point of the shoulder to the base of the neck. The head length (HL)

was measured from the tip of the pole to the muzzle, and the tail length (TL) was measured from the 1st coccygeal vertebra to the end of the tail. Body weights (PV) of animals were estimated according to the Boue (1949) formula ($P = 53 \text{ TAH}$, Where: P = body weight (kg), T = chest girth (m), A = barrel or abdominal girth (m). H = shoulder height (m)).

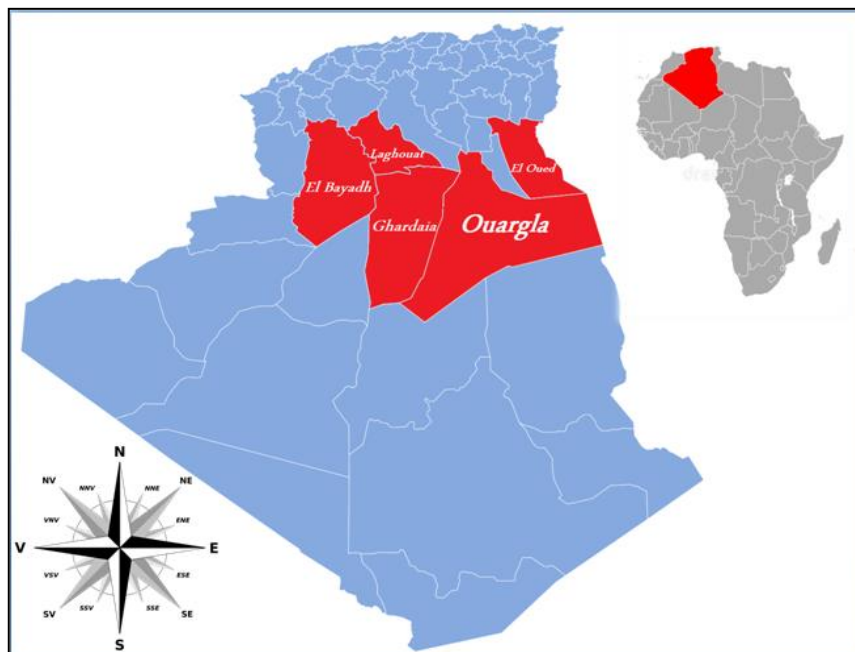


Figure 1: Algeria map showing Camel breeding regions.

Statistical analysis

The collected data have been analyzed using Excel software and Rstudio software (version 4.0.2), which is an integrated environment for data manipulation, calculation, and graph preparation. However, it is not just another statistical environment (such as SPSS or SAS, for example), but also a complete and self-contained programming language (Vincent Goulet, 2016). Comparison plots named Clonograms were made to compare different types of camel breeds and different age groups and also to observe the difference between camel bulls and she-camels. The impact of the regions, breeds, and sex on the seven body measurements has been assessed using ANOVA and the Post Hoc test. The Shanon-Weaver diversity index was computed to provide insight into the species diversity of our studied environment.

Results and Discussion

The normality distribution test has been performed before any statistical test using the Shapiro Wilk test in Rstudio. The p-value is equal to 0.81, which suggests that our data set follows the normal distribution. The graph analysis does not reveal any out-group in our study.

The data in Table (1) present the means and standard errors of the body measurements of four Algerian camel breed types. The results of this study revealed that the averages of height at withers (WH), head length (HL), body length (BL), neck length (NL), tail length (TL), chest girth (CT) and body weight (PV) were 177.5 ± 9.71 cm, 50.64 ± 6.13 cm, 149.2 ± 15.04 cm, 114.1 ± 14.09 cm, 57.88 ± 13.22 cm, 174.4 ± 24.57 cm and 293.9 ± 64.03 kg respectively.

ANOVA and post hoc test of the different body measurements and the Breeds

The effect of camel breed types on all body measurement parameters studied was highly significant ($P < 0.01$) (Table 1, 2 and 3). Steppe camels showed the lowest records in head length, neck length, chest girth and body weight, those results are inferior to those of Meghelli *et al.*, (2020). In height at withers, Targui recorded the lowest measure. Ouled Sidi Cheikh camel had highly significant ($P < 0.01$) in head length, body length, tail length and chest girth. Moreover, Sahraoui camel had highly significant ($P < 0.01$) in height at withers, neck length, and body weight. These findings are inferior to those of Meghelli *et al.*, (2020).

Table 01: Average values of body measurements.

Main effect	No	WH(Cm)	HL(Cm)	BL(Cm)	NL(Cm)	TL(Cm)	CT(Cm)	PV(Kg)
Breed		**	**	**	**	**	**	**
Targui	42	171.61	55.19	152.99	112.01	73.56	182.36	286.48
Steppe	55	174.33	46.85	155.87	107.49	55.29	133.13	210.66
Sahraoui	140	180.40	49.66	143.85	117.01	51.87	183.45	321.62
Ouled Sidi Cheikh	40	175.35	59.42	165.55	113.25	82.20	198.93	316.92
Sex		**	*	**	**	**	**	**
Male	132	182.52	52.66	163.83	120.45	67.46	183.10	330.12
Female	145	173.12	51.29	153.31	108.71	62.57	165.73	261.41
Age group		**	**	**	**	**	**	**
<3 yrs	5	160.80	43.60	130.20	79.40	46	170.20	249.28
3-5 yrs	29	172.07	45.74	135.34	108.55	49.10	172.45	280.22
6-7 yrs	61	176.45	49.09	141.89	114.98	57.08	176.12	291.34
8-9 yrs	50	178.38	52.99	157.89	119.05	61.11	177.21	325.59
10-12 yrs	67	177.14	52.19	156.22	117.52	60.51	175.16	303.54
>12 yrs	65	172.59	51.45	153.55	116.83	56.75	173.59	290.51
Overall mean	277	177.5 ±9.71	50.64 ±6.13	149.2 ±15.04	114.1 ±14.09	57.88 ±13.22	174.4 ±24.57	293.9 ±64.03

Different superscript letters mean within the same column are significantly different at ($P < 0.05$)

** : Significance different $P < 0.01$

* : Significance different $P < 0.05$

Table 02: ANOVA of the different breeds and all body measurements.

		Number	sum squared	Mean squared	F-value	Probability of F
WH(Cm)	Breeds	4	3448	1149.2	13.89	0.0006
	Residuals	277	22587	82.7		
HL(Cm)	Breeds	4	3356	1118.7	43.46	0.002
	Residuals	277	7028	25.7		
BL(Cm)	Breeds	4	12978	4326	23.87	0.000008
	Residuals	277	49480	181		
NL(Cm)	Breeds	4	3957	1319.1	7.083	0.000134
	Residuals	277	50842	186.2		
TL(Cm)	Breeds	4	27033	9011	115.9	0.002
	Residuals	277	21226	78		
CT(Cm)	Breeds	4	121491	40497	244.7	0.002
	Residuals	277	45182	166		
PV(Kg)	Breeds	4	516990	172330	76.57	0.002
	Residuals	277	614410	2251		

Table 03: Post hoc test of the different breeds and all body measurements.

Breeds	p adj (WH)	p adj (HL)	p adj (BL)	p adj (NL)	p adj (TL)	p adj (CT)	p adj (PV)
Sahraoui-Ouled Sidi Cheikh	0.09	0	0	0.7	0	0.000004	0.98
Steppe-Ouled Sidi Cheikh	0.97	0	0.03	0.4	0	0	0
Targui-Ouled Sidi Cheikh	0.43	0.01	0.004	0.9	0.0004	0.00002	0.09
Steppe-Sahraoui	0.0002	0.003	0.0000002	0.00007	0.06	0	0
Targui-Sahraoui	0.0000004	0	0.0007	0.2	0	0.96	0.0002
Targui-Steppe	0.47	0	0.72	0.4	0	0	0

The camel sex had a significant influence on the height at withers, body length, neck length, tail length, chest girth, body weight ($P < 0.01$), and head length ($P < 0.05$). The data also showed that male camels had higher body measurements than females (Tables 1, 4, and 5). These results are similar to those mentioned by Dioli *et al.*, (1992), Mehari *et al.*, (2007), and Amir *et al.*, (2015), who stated that male camels are usually taller and heavier weight than females. The higher values of the measured parameters according to the sex might be due to physiological, morphological and activities in the different sexes.

Table 04: ANOVA of Sex and all body measurements.

		Number	sum squared	Mean squared	F-value	Probability of F
WH(Cm)	Sex	2	5916	5916	80.86	0.002
	Residuals	277	20119	73		
HL(Cm)	Sex	2	227	226.61	6.135	0.0139
	Residuals	277	10158	36.94		
BL(Cm)	Sex	2	6745	6745	33.29	0.0007
	Residuals	277	55713	203		
NL(Cm)	Sex	2	9477	9477	57.5	0.00001
	Residuals	277	45322	165		
TL(Cm)	Sex	2	9640	9640	68.64	0.000002
	Residuals	277	38619	140		
CT(Cm)	Sex	2	17698	17698	32.67	0.0009
	Residuals	277	148976	542		
PV(Kg)	Sex	2	307272	307272	102.5	0.002
	Residuals	277	824128	2997		

Table 05: Post hoc test of Sex and all body measurements.

Breeds	p adj (WH)	p adj (HL)	p adj (BL)	p adj (NL)	p adj (TL)	p adj (CT)	p adj (PV)
male-female	0	0.014	0	0	0	0	0

Table 06: ANOVA of age groups and all body measurements.

		Number	sum squared	Mean squared	F-value	Probability of F
WH(Cm)	Age groups	6	3675	735	8.908	7.57e-08
	Residuals	277	22360	82.5		
HL(Cm)	Age groups	6	1575	315.03	9.691	1.58e-08
	Residuals	277	8809	32.51		
BL(Cm)	Age groups	6	16632	3326	19.67	<2e-16
	Residuals	277	45825	169		
NL(Cm)	Age groups	6	8576	1715.1	10.05	7.63e-09
	Residuals	277	46223	170.6		
TL(Cm)	Age groups	6	4448	889.6	5.503	7.64e-05
	Residuals	277	43811	161.7		
CT(Cm)	Age groups	6	10436	2087.2	3.62	0.00346
	Residuals	277	156238	576.5		
PV(Kg)	Age groups	6	152392	30478	8.437	1.95e-07
	Residuals	277	979008	3613		

The results also showed that the age of the camel had a highly significant ($P < 0.01$) effect on each measured parameter, this finding is somewhat in agreement with those of Ishag *et al.*, (2010), Elbashir *et al.*, (2011) and Amir *et al.*, (2015). The studied traits tend to increase from the 1st age group (≤ 3 years) to the 4th age group (8 – 9 years) and then decrease. This means that the camels reach maturity age within 8 to 9 years. Then many different measurements declined; this result is in line with those of Ishag *et al.*, (2013) and Amir *et al.*, (2015).

Table 07: Post hoc test of age groups and all body measurements.

Age group	p adj (WH)	p adj (HL)	p adj (BL)	p adj (NL)	p adj (TL)	p adj (CT)	p adj (PV)
(3-5 yrs) – (<3 yrs)	0.11	0.97	0.96	0.00009	0.99	0.9	0.99
(6-7 yrs) – (<3 yrs)	0.003	0.31	0.39	0.0000002	0.42	0.99	0.66
(8-9 yrs) – (<3 yrs)	0.0009	0.006	0.01	0	0.11	0.99	0.73
(10-12 yrs) – (<3 yrs)	0.002	0.016	0.00016	0.0000015	0.09	0.99	0.38
(>12 yrs) – (<3 yrs)	0.00001	0.39	0.001	0.0000001	0.4	0.96	0.13
(6-7 yrs) – (3-5 yrs)	0.28	0.099	0.23	0.25	0.06	0.01	0.001
(8-9 yrs) – (3-5 yrs)	0.05	0.0000015	0.000009	0.01	0.0009	0.14	0.004
(10-12 yrs) – (3-5 yrs)	0.12	0.00001	0	0.75	0.0002	0.005	0.00002
(>12 yrs) – (3-5 yrs)	0.00002	0.00017	0	0.078	0.05	0.001	0.0000001
(8-9 yrs) – (6-7 yrs)	0.92	0.0047	0.005	0.64	0.53	0.94	0.99
(10-12 yrs) – (6-7 yrs)	0.99	0.028	0	0.89	0.36	0.99	0.86
(>12 yrs) – (6-7 yrs)	0.009	0.19	0.000004	0.99	1	0.97	0.1
(10-12 yrs) – (8-9 yrs)	0.99	0.97	0.1	0.1	0.99	0.86	0.77
(>12 yrs) – (8-9 yrs)	0.23	0.65	0.79	0.92	0.54	0.57	0.08
(>12 yrs) – (10-12 yr)	0.03	0.97	0.72	0.52	0.37	0.99	0.69

The Shannon and Weaver Diversity Index

In order to know the diversity rate of the studied population, we calculated the Shannon and Weaver diversity index H' with the following formula: $H' = -\sum p_i \log_2 p_i$

Following the calculation of the diversity index of Shannon and Weaver H' in Excel we obtained a rate equal to 0.87 for the studied population (Table 2). This index is relatively high, which is probably a reflection of significant genetic diversity, it refers to many individuals with a wide variety of different traits. Genetic diversity is critical for a population to adapt to changing environments.

Table 8: Shannon and Weaver diversity index H' of each trait studied

Characters	H'
height at wither (WH)	0.85
head length (HL)	0.79
body length (BL)	0.92
neck length (NL)	0.91
tail length (TL)	0.77
chest girth (CT)	0.89
body weight (PV)	0.96
Mean	0.87

Conclusion

This study allowed us to generate matrices containing different biometric measurements on animals in order to look for a possible geographic and morphological differentiation between them. There is a high level of genetic diversity in the breeds studied; the Shannon and Weaver index is 0.87 for this population.

Generally, this study concludes that the Ouled Sidi Cheikh camel had the highest values in head length, body length, tail length, and chest girth in Algeria. Moreover, the Sahraoui camel had the highest values in height at wither, neck length, and body weight in Algeria. In addition, it concludes that camels (8-9 years) showed

the highest values in body measurements. The data also showed that male camels had higher body measurements than females.

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