Osteometry of Dromedary Metapods: Case of the Algerian Population Targui (*Camelus Dromedarius* Linne, 1758)

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Abstract: Our research was realized on a numerically homogeneous sample of 60 dromedaries of Targui population that is originally from the Hoggar (Tamanrasset, extreme Southern Algeria). The animals are adults (30 males and 30 females) they are from 5-10 years old and over 10 years old destined for slaughter. The canon bones (metapodials) were taken from the slaughterhouse ofthe city of Ouargla (one left metacarpus and metatarsus of each animal), they were cooked and dried then weighed and measured (16 variables per animal). Gracility index of bones were calculated with 6 indexes per animal. The analysis of variability and the correlations between variables allows in the framework of the realization of archeo Zoology references to consider the ability to grasp certain parameters of living animal from bone measurements. Seven linear parameters of each metapodial were calculated. Sexual dimorphism appears clearly at the level of metapodial.

INTRODUCTION

If there is an animal often taken as a typical example of adaptation to the environment, it is the dromedary; more than any other if we trust current opinion, we can say with "An animal always bears the stamp of the environment in which it lives. The desert and especially the sandy one puts its mark on its inhabitants as well. In addition, to various adaptations related to the behavior and physiology those which affect the morphology are added here".

Moving system: Mammals of the desert regions, especially, her bivors are forsed to remedy the poverty of their envirenoment by fast extented movements also their limbs are exceptionally developed wherethis kind of

adaptation allows the easy passage from one pasture to another and the increase of their area of food investigation. In this sens, the dromedary responded to the adaptation's needs by a special conformation of its locomotor system like the gazelle, the antelope, the Saharan sheep and the zebu of the Sub-Saharan areas.

Foot as proof of the camel's adaptation, always the anatomical compounment of its foot is cited. In fact, we couldn't say that it is suitable for the desert in general. Indeed, without functional nails, the dromedary walks on its thickened epidermis. Therefore, his foot corresponds well to the sandy soil. However, sandy soils do not form the majority of the Sahara but stony and rocky soils occupy most of this desert too. So, the dromedary's foot do not constitute an adaptation to desert life in general.

In ruminants, the metapod where cannon bone is an element of skeleton frequently found whole or slightly altered during archaeological excavation. Its osteometric analysis gives interesting information about the animal morphological type[1] the gender[2, 3] the height at the withers[4] or even about its live weight.

MATERIALS AND METHODS

The Targui population is the most represented and the most slaughtered after the Saharaoui population in the slaughterhouse of Ouargla town. This work involved 60 adult dromedaries, 30 males and 30 females from a Targui population.

Targui population: Is the ultimate racing dromedary, very tall on thin and dry limbs with a gray dress with very short and thin fur. It is the dromedary of the Tuaregs of the North. We find it in the central Sahara, the Hoggar and the extreme Algerian South (Tamanrasset). It is very often found a little further in the north, because it is very often used as a breeder and of course, for camel racing.

Targui or race of Northen Tuaregs: Excellent mehari, saddle animal by excellence, often required in the Sahara as a breeder. Distributed in Hoggar and Central Sahara.

Regarding to animals sutdied in this research, they are subjects over 5 years old, slaughtered at the slaughter house in Ouargla town, Algeria (Fig. 1).

For each of both sexes, two age groups have been formed: Animals from 5-10 years old, so-called young adults (JA, 15 males and 15 females)and animals over 10 years old, so-called adults (A, 15 males and 15 females).

NB: For the determination of the age, we used the experience of breeders and butchers by examination of the dentition which remains the most common method used by camel riders.

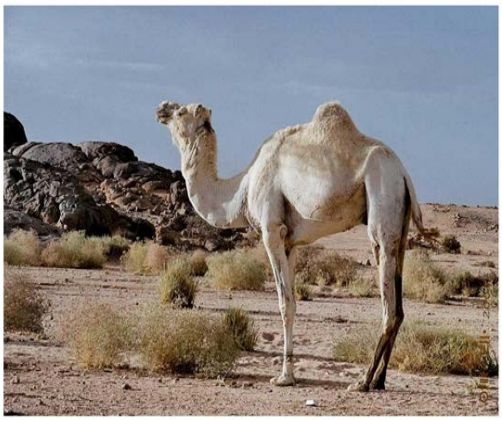

Fig. 1: Dromedary Targui population

After the slaughter, the left anterior and posterior cannon bones were removed respectively below the carpus and tarsus then numbered in order to be identified and linked with the origenal animal. The limbs were divided at the level of the carpo-metacarpal joint for the thoracic limb and tarso-metatarsal for the pelvic limb.The phalanges were severed at the metacarpophalangeal and metatarsophalangeal joints as well. Therefore, 60 metacarpals and 60 metatarsals of the left side formed the study databases. Subsequently, these 120 metapods were subject to other operations.

Skinning: This operation was difficult because of the thickness of the skin, so, after the separation of the metapodes from the carcass, the skinning was entrusted to a specialized slaughterer of dromedaries.

Cooking: This step allowed to separate the bones from the associated soft tissues with maximum comfort and efficiency. This operation required the use of a large capacity pot, suitable for cooking the anatomical parts. There is no rule of duration but it should be sufficient to achieve adequate soft tissue softening. Too long cooking is also not desirable since the bone tissue can be damaged over time. In practice, a boiling period of 4-5 h is sufficient.

We pointed out thatbones of young dromedaries, named locally "Theni" aged more than 5 years (replacement of the claws) are composed ofseveral pieces which are joined by a soft tissue (cartilage) that melts almost entirely by prolonged cooking. The bone ends, called epiphyses, change with the progress of ossification and are welded to the rest of the bone at the age of over five (the dromedary is young Adult) (JA).

Dissection: The operation is done after cooking using a small knife allowing the extraction of the bone out of its

soft tissue envelope. The tissues spontaneously dissolve as well as the remaining flesh pieces and the metapod are extracted, cleaned again with water and then dried. It is thus ready and the identification could be done. A plastic food bag was used to wrap each limb which will be labeled later to avoid possible confusion between different parts.

It should be noted that in constrat to the osteometric studies carried out on other ruminants which are satisfied with the only metacarpus, we took in consideration the metatarsus because the dromedary's weight in the front either the back is not equalcontrarly to cattles. Indeed, the back of a dromedary is often very muscular while the front, head and neck included are more developed. Several measurements were made on each bone.

Two weight measurements: The weight of each bone after drying using a food scale (Zenati Electronic Brand Electronic Food Scale, precision per gram) noted PMC and PMT as mass of the entire metapod, respectively metacarpus and metatarsus:

- Seven linear measurements were performed using a digital caliper
- Technical characteristics of the caliper
- Measured scale : 0-200 mm/0-8 in
- Sensitivity: 0.01 mm
- Resolution: 0.01 mm/0,005 in
- Precision : +-0.03 mm/0,001in
- Repeatability: 0.01mm/0,005 in
- Measuring system: linear measurement capacity of 0-200 mm
- Display: LCD
- Maximum speed measurement : 1,5 m sec^{-1}
- Working temperature: 5-40°C
- Humidity influence: no effect at relative humidity below 80%

Measured according to the nomenclature supplemented for whole bones by Guintard :linear measures, respectively metacarpus/and metatarsus. For this last, the same acronym as for the metacarpus is used but with a final T. These seven measures are as follows:

GL/GLT: Maximum length of metapod,measured along the major axis of the bone and which translates its general elongation.

Bp/BpT: Maximum width of the proximal articular surface or proximal epiphysis, measured according to the medio-lateral axis.

Dp/DpT: Maximum thickness of the proximal articular surface, measured according to the dorso-palmar axis.

d/dT: Body width at mid-height of the long length of the diaphysis, measured according to the medial-lateral axis.

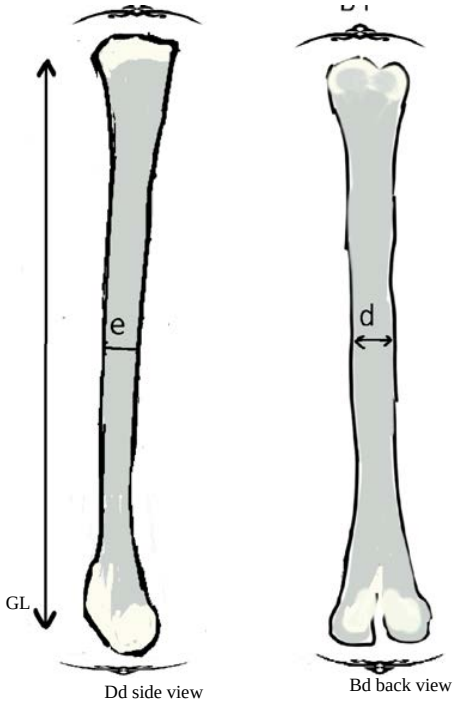

Fig. 2: Linear measurements made with digital calipers

e/eT: Thickness of the body mid-height the long length of the diaphysis, measured according to the dorso-palmar axis. Body thickness at mid-height of the long length of the diaphysis, measured according to the dorso-palmar axis.

Bd/BdT: Maximum width of the distal epiphysis, measured according to the medio-lateral axis.

Dd/DdT: Maximum thickness of the distal articular surface, measured according to the dorso-palmar axis. The measures symbolized by letters are explained in Fig. 2.

On the other hand, despite the morphological complexity of the distal part, we deemed the number of measurements carried out is enough. The proximal part being flat and has uniform contours. We will notice that there is at least one measurement for each segment of the metapod, according to all the axes considered (except of course the length which concerns the entire bone). From the previous linear parameters for each bone, six indices of gracility were calculated: three for the metacarpus [Bp/GLd/GL and e/GL] and three (their equivalent) for the metatarsus [BpT/GLT, dT/GLT and eT/GLT]. Before presenting the measurements carried out, it is advisable to place the reference points on which they are based on.

Statistical data processing was carried out using Xlstat computer software for the measured variables. The simple statistics presented allows to describe the osteological characteristics of different age and sex classes.

Table 1: Male metacarpus, values of osteometric parameters.

Age classes	Statistical parameters	Metacarpus							
		GL	BP	DP	d	e	Bd	Dd	PMC
Sex									
Males	n	15	15	15	15	15	15	15	15
Young males	m	390.5	74.7	50.8	37.9	35.2	95.8	45.7	719.1
adults	min	370	67.36	48.39	33.99	31.69	89.74	42.46	620
	max	406	80.15	53.59	42.29	40.83	99.94	48.20	805
	σ	9.51	2.97	1.78	2.29	2.43	3.67	1.67	55.76
	Cv (%)	2.43	3.85	3.30	6.05	6.84	3.83	3.66	7.75
	p	0.340	0.002	0.123	0.068	0.217	0.003	0.011	0.027
Males adults	n	15	15	15	15	15	15	15	15
	m	398	74.3	51.06	38.1	35.8	99.8	45.68	755.3
	min	370	67.20	42.30	33.20	31.15	94.60	37.20	620
	max	425	77.52	54.18	40.59	41.95	105.66	49.62	895
	σ	14.58	3.17	3.05	1.92	2.62	3.31	2.95	79.88
	Cv (%)	3.66	4.27	5.98	5.03	7.33	3.32	6.45	10.57
	p	0.077	0.006	<0.0001	0.042	0.383	0.098	0.00	0.596
Males	n	30	30	30	30	30	30	30	30
	m	394.3	74.5	50.9	38.1	35.5	97.8	45.7	737.2
	min	370	67.20	42.30	33.20	31.15	89.74	37.20	620
	max	425	80.15	54.18	42.29	41.95	105.66	49.62	895
	σ	12.68	2.98	2.42	2.08	2.49	3.98	2.4	70.14
	Cv (%)	3.22	4	4.8	5.5	7.02	4.1	5.2	9.5
	p	0.031	0.002	<0.0001	0.371	0.556	0.214	<0.0001	0.302

P: In bolding is significant. Limit of signification Alpha = 0.050 Legends: n: effective m: arrhythmic mean, min; minimum, max; maximum, σ; standard deviation; cv; coefficient of variation, p; p value; GL; Maximum length of the metacarpus, Bp: Maximum width of the surface articular proximal; Dp; Maximum thickness of the proximal articular surface; d; Width of the body at half height of the long length of the diaphysis; e; Thickness of the body at half height of the long length of the diaphysis; Bd; Width maximum distal epiphysis, Dd: Maximum thickness of the distal articular surface; PMC; metacarpal weight

RESULTS AND DISCUSSION

Overall results: Seven linear measurements and one weight measurement for the metacarpals, metatarsals and three gracility indexes for each type of metapod will be presented for the size of each age class for each of both sexes.

The results are interpreted objectively and especially, descriptive from the morphological unit point of view. This approach has the advantage of being able to have an overview of osteo-morphometry, it has a homogeneous degital sampling of both sexes which most interests the archaeozoologist, since, it allows to address the type of breeding. The analysis of sexual dimorphism is based on an examination of the population variability. All linear results are expressed in millimeters and weights ones in grams. The results of all osteometric parameters of the population, described by age class and by sex are grouped in (Table 1-4). The differences observed between the mean values of the age classes of males and females are significant for all the variables in constrat with the sheep breed Oulad Djellal.

In the Targui dromedary population, the metapod elongation parameters (GL&GLT), a little variable for males and females where CVvaries from (3.22 and 3.2) and (3.6 and 3.3%). Unlike the Saharaoui dromedary population (Adamou, 2013). Metapods weight parameters of different age classes of males and females is relatively variable CV equalling, respectively 9.5, 9.5% (equality between male metapods) and 11.9, 12.9% for the female metacarpus and metatarsus.

Thickness and width parameters (e&d) where CV varies on average, between 7.5&5.5% for males and (eT&dT) the CV is around 7.5&5.7 %. This significant variability of this coefficient eventually affects the ratio e/GL where the CV is about 7.72% (Table 5).

In other hand, the females portion of the diaphysis has equal CV values (e&d) CV is about 4.9&4.6& (eT&dT) CV is about 5.5% for both variables which matches with the Saharaoui population but different for the sheep breed Oulad Djellal.

The distal epiphysis part is the least variable of the metapod, the measures characterizing this bone part are those which have the lowest coefficients of variation, this bone part is therefore, the one which has the least tendency to vary in the Saharaoui dromedary population with sheep and goat domestic sheep in the sheep breed, Oulad Djellal.

If we examine the effect of age on the osteometric parameters in both sexes, we can see that males and females do not have the same tendencies. For females, the differences observed between the mean values for young adult Animals (JA) and for adult Animals (A) are never significant (Table 1-4). Whereas in the case of males Bd, BdT, PMC and PMT have systematically larger values for adults and this is significant but in the Saharaoui

Table 2: Male metatarsals, values of osteometric parameters

Age classes	Statistical parameters	Metatarsals							
		GLT	BPT	DPT	dT	eT	BdT	DdT	PMT
Sex									
Males	n	15	15	15	15	15	15	15	15
Young	m	404.8	64	50.2	33.6	37.3	81.5	39.4	616.1
Males	min	392	60.62	47.47	29.27	33.85	77.50	37.31	515
Adults	max	415	67.63	55.85	38.81	44.99	85.37	42.46	725
	σ	7.60	1.99	2.17	2.41	2.71	2.49	1.38	54.52
	Cv (%)	1.98	2.97	4.33	7.15	7.26	3.060	3.51	8.85
	p	0.043	0.248	<0.0001	0.606	<0.0001	0.013	0.183	0.040
Males	n	15	15	15	15	15	15	15	15
Adults	m	411.6	64.776	51.7	33.5	37.7	84.8	39.9	648.3
	min	388	61.16	49.11	31.20	33.53	79.00	36.58	540
	max	435	69.44	56.03	35.65	42.95	88.41	43.54	750
	σ	1.96	2.29	2.35	1.33	3.01	2.80	2.06	62.90
	Cv (%)	3.4	3.53	4.54	3.97	7.98	3.31	5.18	9.70
	p	0.023	0.148	<0.0001	0.025	0.133	0.143	0.573	0.230
Males	n	30	30	30	30	30	30	30	30
	m	408.2	64.4	50.9	33.6	37.5	83.1	39.6	632.2
	min	388	60.62	47.47	29.27	33.53	77.50	36.58	515
	max	435	67.63	55.85	35.65	41.98	88.41	43.54	750
	σ	11.6	2.1	2.4	1.9	2.8	3	1.7	60.1
	Cv (%)	3.2	3.3	4.6	5.7	7.5	3.7	4.4	9.5
	p	0.024	0.293	<0.0001	0.206	0.004	0.061	0.461	0.334

n: Effective m; arrhythmic mean; min; minimum; max; maximum; σ; standard deviation; cv; coefficient of variation; p; p value; GL; Maximum length of the metacarpus; Bp; Maximum width of the surface articular proximal; Dp; Maximum thickness of the proximal articular surface; d; Width of the body at half height of the long length of the diaphysis; e; Thickness of the body at half height of the long length of the diaphysis; Bd; Width maximum distal epiphysis; Dd; Maximum thickness of the distal articular surface; PMC; metacarpal weight p; In bolding is significant; Limit of signification Alpha = 0,050

Table 3: Females metacarps, values of osteometric parameters

Age classes	Statistical parameters	Metacarps							
		GL	BP	DP	d	e	Bd	Dd	PMC
Sex									
Young	n	15	15	15	15	15	15	15	15
Females	m	373.3	67.7	45	34.8	30.3	87.1	41.4	567.7
Adults	min	330	61.50	38.40	32.44	27.08	82.83	38.64	405
	max	394	71.29	48.46	39.15	33.67	90.10	43.44	705
	σ	16.03	2.66	2.43	1.88	1.52	2.30	1.57	82.37
	Cv (%)	4.29	3.93	5.40	5.40	5.04	2.64	3.78	14.51
	p	0.001	0.200	0.005	0.031	0.027	0.001	0.001	0.030
Females	m	376.9	67.5	46.2	33.9	31.1	87.8	41.5	563.7
Adultes	n	15	15	15	15	15	15	15	15
	min	354	63.10	44.25	31.34	29.36	82.85	38.84	460
	max	391	72.67	48.29	36.43	33.53	92.07	45.83	660
	σ	10.54	2.60	1.24	1.47	1.24	2.39	1.77	51.70
	Cv (%)	2.80	3.85	2.68	4.35	3.97	2.73	4.26	9.17
	p	0.151	0.102	0.006	0.524	0.252	0.349	0.092	0.136
Females	n	30	30	30	30	30	30	30	30
	m	375.1	67.6	45.6	34.4	30.7	87.5	41.5	565.7
	min	330	61.50	38.04	31.34	27.08	82.83	38.64	405
	max	394	72.67	48.46	39.15	33.67	92.07	45.83	705
	σ	13.4	2.6	1.9	1.7	1.4	2.3	1.6	67.6
	Cv (%)	3.6	3.8	4.3	4.9	4.6	2.6	3.9	11.9
	p	<0.0001	0.741	<0.0001	0.125	0.002	0.018	0.067	0.024

p: In bolding is significant. Limit of signification Alpha = 0.050. Legends; n; effective; m; arrhythmic mean; min; minimum; max; maximum; σ; standard deviation; cv; coefficient of variation; p; p value; GL; Maximum length of the metacarpus; Bp; Maximum width of the surface articular proximal; Dp; Maximum thickness of the proximal articular surface; d; Width of the body at half height of the long length of the diaphysis; e; Thickness of the body at half height of the long length of the diaphysis, Bd: Width distal epiphysis maximum; Dd; Maximum thickness of the distal articular surface; PMC; metacarpal weight

Table 4: Metatarsal females, values of osteometric parameters

Age classes	Statistical parameters	Metatarsal GLT	BPT	DPT	dT	eT	BdT	DdT	PMT
Sex									
Young	n	15	15	15	15	15	15	15	15
Femeles	m	386.1	58.4	46.2	30.4	31.9	75.4	35.2	488.7
Females	min	340	50.22	43.13	26.85	27.91	69.62	30.06	315
Adults	max	405	63.91	49.04	33.03	34.59	79.76	38.41	600
	σ	16.14	2.871	1.98	1.76	1.68	2.59	2.28	80.32
	Cv%	4.18	4.92	4.28	5.78	5.26	3.44	6.48	16.44
	p	<0.0001	0.00	0.007	0.225	0.080	0.00	0.311	0.110
Females	n	15	15	15	15	15	15	15	15
Adultes	m	388.7	59.4	47.1	30.3	32.8	76.5	36.2	494.3
	min	370	56.97	44.99	28.35	30.42	73.46	34	405
	max	405	61.94	50.93	34.75	38.57	80.98	39.22	555
	σ	8.91	1.81	1.65	1.67	1.88	2.1	1.37	43.54
	Cv%	2.29	3.05	3.50	5.52	5.74	2.73	3.78	8.81
	p	0.317	<0.0001	0.011	0.014	<0.0001	0.210	0.058	0.038
Females	n	30	30	30	30	30	30	30	30
	m	387.4	58.86	46.66	30.34	32.4	75.99	35.7	491.5
	min	340	50.2	43.33	26.85	27.91	69.62	30.06	315
	max	405	63.9	50.93	34.75	38.57	80.98	39.22	600
	σ	12.8	2.4	1.8	1.6	1.8	2.4	1.9	63.5
	Cv%	3.3	4.1	3.9	5.5	5.5	3.1	5.3	12.9
	p	<0.0001	<0.0001	0.520	0.097	<0.0001	0.019	0.165	0.042

p; In bolding is significant. Limit of signification Alpha = 0,050 Legends; n; effective; m; arrhythmic mean, min; minimum; max; maximum; σ; standard deviation; cv; coefficient of variation; p; p value; GL; Maximum length of the metacarpus; Bp; Maximum width of the surface articular proximal; Dp; Maximum thickness of the proximal articular surface; d; Width of the body at half height of the long length of the diaphysis; e; Thickness of the body at half height of the long length of the diaphysis; Bd; Width distal epiphysis maximum; Dd; Maximum thickness of the distal articular surface; PMC; metacarpal weight

Table 5: Values of the metapodal grace indexes according to sex (%)

Sex	Statistical parameters	Bp/GL	d/GL	e/GL	BpT/GLT	dT/GLT	eT/GLT
Males	n	30	30	30	30	3030	
	m	0.18	0.10	0.09	0.20	0.11	0.12
	min	0.17	0.08	0.08	0.15	0.07	0.08
	max	0.20	0.10	0.11	1.5	0.09	0.11
	σ	0.008	0.006	0.007	0.2	0.1	0.1
	CV%	4	5.8	7.72	120.5	124.2	125.3
	p	0.130	0.035	0.190	0.342	0.070	0.087
Females	n	30	30	30	30	3030	
	m	0.18	0.09	0.08	0.15	0.08	0.08
	min	0.17	0.08	0.07	0.14	0.07	0.07
	max	0.19	0.10	0.09	0.16	0.09	0.10
	σ	0.006	0.004	0.004	0.005	0.004	0.005
	CV%	3.35	4.7	4.9	3.6	5.8	7.1
	p	0.035	0.645	0.450	0.464	0.410	<0.0001
Total population	n	60	60	60	60	6060	
	m	0.19	0.09	0.09	0.18	0.09	0.10
	min	0.166	0.08	0.07	0.14	0.07	0.07
	max	0.20	0.10	0.10	1.66	0.95	0.11
	σ	0.008	0.006	0.007	0.17	0.09	0.11
	CV%	4.38	5.92	8.07	97.78	101.17	105.47
	p	0.441	0.271	0.040	0.364	0.003	0.004

p: In bolding is significant. Limit signification of Alpha = 0.050

population, PMT, Bp, Dp, d, e, Bd, BpT, dT and eT have systematically larger values for adults and this is significant as well. These are primarily parameters of bone size or mass while the growth in bone length (GL and GLT) does not show any significant difference between both age groups. Therefore, females seem to have earlier growth than males. They reach their adult size from 6-7 years old and then the bone does not show any significant growth either in thickness or in length.

On the other hand, males are later and the metapods growth in length seems to be finished at the age of 10 years but the width of the portion of the distal epiphysis Bd continues to increase beyond 10 years. Among

Table 6: Male Targui correlation matrix

T males	GL (mm)	GLT (mm)	BP (mm)	BPT (mm)	DP (mm)	DPT (mm)	d (mm)	dT (mm)	e (mm)	eT (mm)	Bd (mm)
GL	1	0.916	0.315	0.419	0.369	0.217	0.408	0.282	0.033	0.190	0.306
GLT	0.916	1	0.375	0.506	0.450	0.244	0.435	0.338	0.145	0.309	0.415
BP	0.315	0.375	1	0.226	0.699	0.138	0.527	0.301	-0.018	0.434	0.451
BPT	0.419	0.506	0.226	1	0.442	0.351	0.441	0.250	0.301	0.321	0.576
DP	0.369	0.450	0.699	0.442	1	-0.157	0.582	0.108	-0.091	0.199	0.474
DPT	0.217	0.244	0.138	0.351	-0.157	1	0.175	0.459	0.552	0.562	0.316
d	0.408	0.435	0.527	0.441	0.582	0.175	1	0.658	-0.176	0.373	0.245
dT	0.282	0.338	0.301	0.250	0.108	0.459	0.658	1	0.308	0.631	0.016
e	0.033	0.145	-0.018	0.301	-0.091	0.552	-0.176	0.308	1	0.703	0.265
eT	0.190	0.309	0.434	0.321	0.199	0.562	0.373	0.631	0.703	1	0.358
Bd	0.306	0.415	0.451	0.576	0.474	0.316	0.245	0.016	0.265	0.358	1
BdT	0.453	0.580	0.172	0.661	0.341	0.306	0.285	0.062	0.219	0.236	0.724
Dd	0.248	0.439	0.505	0.457	0.693	-0.028	0.701	0.296	-0.089	0.232	0.407
DdT	0.144	0.292	0.150	0.462	0.229	0.362	0.303	0.217	0.435	0.408	0.258
PMC (g)	0.549	0.568	0.232	0.595	0.154	0.574	0.422	0.533	0.453	0.549	0.447
PMT (g)	0.498	0.569	0.245	0.563	0.197	0.588	0.439	0.610	0.483	0.580	0.422
Bp/GL	-0.456	-0.334	0.700	-0.097	0.374	-0.020	0.181	0.069	-0.034	0.267	0.201
d/GL	-0.187	-0.106	0.369	0.213	0.392	0.063	0.820	0.539	-0.200	0.290	0.072
e/GL	-0.390	-0.247	-0.141	0.106	-0.228	0.426	-0.326	0.167	0.907	0.572	0.126
BpT/GLT	-0.406	-0.391	-0.105	0.595	0.059	0.142	0.065	-0.051	0.189	0.055	0.231
dT/GLT	-0.175	-0.159	0.125	0.003	-0.115	0.363	0.471	0.875	0.248	0.502	-0.192
eT/GLT	-0.152	-0.059	0.315	0.146	0.041	0.504	0.227	0.529	0.684	0.931	0.220

T males	BdT	Dd (mm)	DdT (mm)	PMC (g)	PMT (g)	Bp/GL	d/GL	e/GL	BpT/GLT	dT/GLT	eT/GLT
GL	0.453	0.248	0.144	0.549	0.498	-0.456	-0.187	-0.390	-0.406	-0.175	-0.152
GLT	0.580	0.439	0.292	0.568	0.569	-0.334	-0.106	-0.247	-0.391	-0.159	-0.059
BP	0.172	0.505	0.150	0.232	0.245	0.700	0.369	-0.141	-0.105	0.125	0.315
BPT	0.661	0.457	0.462	0.595	0.563	-0.097	0.213	0.106	0.595	0.003	0.146
DP	0.341	0.693	0.229	0.154	0.197	0.374	0.392	-0.228	0.059	-0.115	0.041
DPT	0.306	-0.028	0.362	0.574	0.588	-0.020	0.063	0.426	0.142	0.363	0.504
d	0.285	0.701	0.303	0.422	0.439	0.181	0.820	-0.326	0.065	0.471	0.227
dT	0.062	0.296	0.217	0.533	0.610	0.069	0.539	0.167	-0.051	0.875	0.529
e	0.219	-0.089	0.435	0.453	0.483	-0.034	-0.200	0.907	0.189	0.248	0.684
eT	0.236	0.232	0.408	0.549	0.580	0.267	0.290	0.572	0.055	0.502	0.931
Bd	0.724	0.407	0.258	0.447	0.422	0.201	0.072	0.126	0.231	-0.192	0.220
BdT	1	0.401	0.456	0.467	0.455	-0.170	0.028	0.015	0.165	-0.227	0.030
Dd	0.401	1	0.494	0.241	0.293	0.282	0.593	-0.177	0.080	0.086	0.077
DdT	0.456	0.494	1	0.471	0.486	0.040	0.235	0.343	0.219	0.079	0.325
PMC (g)	0.467	0.241	0.471	1	0.951	-0.191	0.112	0.185	0.097	0.268	0.357
PMT (g)	0.455	0.293	0.486	0.951	1	-0.141	0.163	0.235	0.064	0.349	0.390
Bp/GL	-0.170	0.282	0.040	-0.191	-0.141	1	0.481	0.169	0.211	0.246	0.412
d/GL	0.028	0.593	0.235	0.112	0.163	0.481	1	-0.098	0.326	0.624	0.347
e/GL	0.015	-0.177	0.343	0.185	0.235	0.169	-0.098	1	0.346	0.301	0.697
BpT/GLT	0.165	0.080	0.219	0.097	0.064	0.211	0.326	0.346	1	0.148	0.211
dT/GLT	-0.227	0.086	0.079	0.268	0.349	0.246	0.624	0.301	0.148	1	0.584
eT/GLT	0.030	0.077	0.325	0.357	0.390	0.412	0.347	0.697	0.211	0.584	1

In bold. significant values (except diagonal) at alpha = 0.050 (bilateral test)

dromedaries as in the domestic sheep the diaphysis is the most variable part of the metapod in particular its thickness. The measure that characterizes it has the highest coefficient of variation with values significantly higher than the others.

In the Targui population T he big length is the least metapod variable portion unlike the Sahrawi population where the distal epiphysis is the least variable portion Babelhadj, 2012).The construction of a correlation matrix allows to visualize all of the correlation coefficients corresponding to each pair of variables (Table 6 and 7). For this study, two correlation matrixes were constructed affecting all measurements and ratios, obtained respectively from the set of metacarpals, then from the metatarsals, one for males and the other for females using CPA of the XLSTAT software.

Firstly, to study this phenomenon the correlations between the algebraic values of the variable differences was calculated. Only 188 in males and only 198 in females correlations are significant out of the 484 calculated, (significance limit at the alpha threshold = 0.050).

The metacarpus weight and the metatarsus weight are also perfectly correlated. Among the osteometric parameters, almost systematically, a metacarpal parameter and its metatarsal counterpart are correlated with a very

Table 7: Female Targui Correlation Matrix

T emelles	GL ((mm)	GLT (mm)	BP (mm)	BPT (mm)	DP (mm)	DPT (mm)	d (mm)	dT (mm)	e (mm)	eT (mm)
GL	1	0.947	0.669	0.621	0.584	0.448	0.383	0.552	0.186	0.358
GLT	0.947	1	0.596	0.634	0.612	0.441	0.393	0.553	0.211	0.312
BP	0.669	0.596	1	0.723	0.675	0.406	0.203	0.447	0.023	0.196
BPT	0.621	0.634	0.723	1	0.776	0.423	0.171	0.532	0.372	0.272
DP	0.584	0.612	0.675	0.776	1	0.510	0.014	0.365	0.471	0.459
DPT	0.448	0.441	0.406	0.423	0.510	1	-0.141	0.072	0.030	0.205
d	0.383	0.393	0.203	0.171	0.014	-0.141	1	0.738	0.212	-0.054
dT	0.552	0.553	0.447	0.532	0.365	0.072	0.738	1	0.401	0.258
e	0.186	0.211	0.023	0.372	0.471	0.030	0.212	0.401	1	0.651
eT	0.358	0.312	0.196	0.272	0.459	0.205	-0.054	0.258	0.651	1
Bd	0.330	0.251	0.431	0.427	0.567	0.404	-0.018	0.186	0.496	0.461
BdT	0.481	0.494	0.415	0.660	0.670	0.296	0.143	0.491	0.540	0.400
Dd	0.551	0.446	0.565	0.441	0.540	0.246	0.203	0.270	0.308	0.261
DdT	0.439	0.368	0.526	0.467	0.503	0.333	0.278	0.462	0.455	0.285
PMC (g)	0.578	0.628	0.358	0.478	0.513	0.214	0.640	0.604	0.607	0.337
PMT (g)	0.632	0.692	0.426	0.534	0.610	0.304	0.576	0.639	0.569	0.434
Bp/GL	-0. 353	-0.383	0.458	0.159	0.148	-0.022	-0.199	-0.094	-0. 204	-0.187
d/GL	-0. 365	-0.322	-0. 298	-0.303	-0.437	-0.480	0.719	0.320	0.058	-0.332
e/GL	-0.514	-0.457	-0.434	-0.097	0.014	-0.285	-0.071	-0. 020	0.747	0.323
BpT/GLT	-0.172	-0.207	0.316	0.625	0.371	0.089	-0.179	0.118	0.259	0.030
dT/GLT	-0.023	-0.062	0.107	0.179	-0.001	-0.235	0.601	0.797	0.332	0.085
eT/GLT	-0.199	-0.278	-0.155	-0.103	0.098	-0.062	-0.285	-0. 063	0.530	0.826

T emelles	Bd (mm)	BdT (mm)	Dd (mm)	DdT (mm)	PMC (g)	PMT (g)	Bp/GL	d/GL	e/GL	BpT/GLT	dT/GLT	eT/GL
GL	0.330	0.481	0.551	0.439	0.578	0.632	-0.353	-0.365	-0.514	-0.172	-0.023	-0.199
GLT	0.251	0.494	0.446	0.368	0.628	0.692	-0.383	-0.322	-0.457	-0.207	-0.062	-0.278
BP.	0.431	0.415	0.565	0.526	0.358	0.426	0.458	-0.298	-0.434	0.316	0.107	-0.155
BPT	0.427	0.660	0.441	0.467	0.478	0.534	0.159	-0.303	-0.097	0.625	0.179	-0.103
DP.	0.567	0.670	0.540	0.503	0.513	0.610	0.148	-0.437	0.014	0.371	-0.001	0.098
DPT	0.404	0.296	0.246	0.333	0.214	0.304	-0.022	-0.480	-0.285	0.089	-0.235	-0.062
d.	-0.018	0.143	0.203	0.278	0.640	0.576	-0.199	0.719	-0.071	-0.179	0.601	-0.285
dT	0.186	0.491	0.270	0.462	0.604	0.639	-0.094	0.320	-0.020	0.118	0.797	-0.063
e.	0.496	0.540	0.308	0.455	0.607	0.569	-0.204	0.058	0.747	0.259	0.332	0.530
eT	0.461	0.400	0.261	0.285	0.337	0.434	-0.187	-0.332	0.323	0.030	0.085	0.826
Bd	1	0.524	0.695	0.575	0.418	0.391	0.143	-0.267	0.205	0.284	0.048	0.312
BdT	0.524	1	0.439	0.527	0.438	0.494	-0.060	-0.225	0.139	0.332	0.231	0.104
Dd.	0.695	0.439	1	0.650	0.403	0.384	0.045	-0.203	-0.108	0.105	0.012	-0.006
DdT	0.575	0.527	0.650	1	0.430	0.421	0.131	-0.053	0.099	0.219	0.290	0.065
PMC.(g)	0.418	0.438	0.403	0.430	1	0.950	-0.241	0.207	0.141	-0.028	0.273	-0.034
PMT.(g)	0.391	0.494	0.384	0.421	0.950	1	-0.217	0.103	0.070	-0.021	0.268	0.026
Bp/GL	0.143	-0.060	0.045	0.131	-0.241	-0.217	1	0.066	0.060	0.595	0.167	0.038
d/GL	-0.267	-0.225	-0.203	-0.053	0.207	0.103	0.066	1	0.301	-0.056	0.616	-0.144
e/GL	0.205	0.139	-0.108	0.099	0.141	0.070	0.060	0.301	1	0.340	0.310	0.595
BpT/GLT	0.284	0.332	0.105	0.219	-0.028	-0.021	0.595	-0.056	0.340	1	0.293	0.151
dT/GLT	0.048	0.231	0.012	0.290	0.273	0.268	0.167	0.616	0.310	0.293	1	0.128
eT/GLT	0.312	0.104	-0.006	0.065	-0.034	0.026	0.038	-0.144	0.595	0.151	0.128	1

In bold significant values (except diagonal) at alpha = 0.050 (bilateral test)

high coefficient : Therefore, it seems to be a harmony of construction between the front train bones and the back train bones which are particularly clear with the dromedary.

Gracility index: The slenderness index shows variations in the bones shape to different portions. d/GL is an index widely used for sexing the metapodes, it shows the width of the diaphysis, at constant length. Values of the different indexes calculated are grouped in Table 5 and are not significantly different between averages of males and those of females, except for BpT/GLT, dT/GLT and for eT/GLT (Fig. 3 and 4).

The metapods of the Targui dromedaries population appear very thin and slender in terms of thickness (Figure 4 and 5) this is found for both sexes: whether the most stocky male adults (d / GL = 0.10% for GL = 394.3 mm) or the most stocky female adults (d /GL = 0.09% for GL = 375.1 mm) at the metacarpals of our sample, the metatarsals appear slender and thin at the level of the width, the animals offer very extended bones and visually slender. The metatarsals of females are more slender than metacarpals, the metapods of females are as slender as the metapods of males.

Sexual dimorphism: Many researchers have proposed indexes allowing to quantify sexual dimorphism from metapods of ruminants[6-14] suggests a factor called DS (for sexual dimorphism: DS = [(male average-female average)/female average])) very simple which we calculated that allows us to get an idea about sexual dimorphism for the various parameters measured.

Fig. 3: Dorsal face of male and female adult left metapods, metacarpus (TM) and metatarsal (MT)

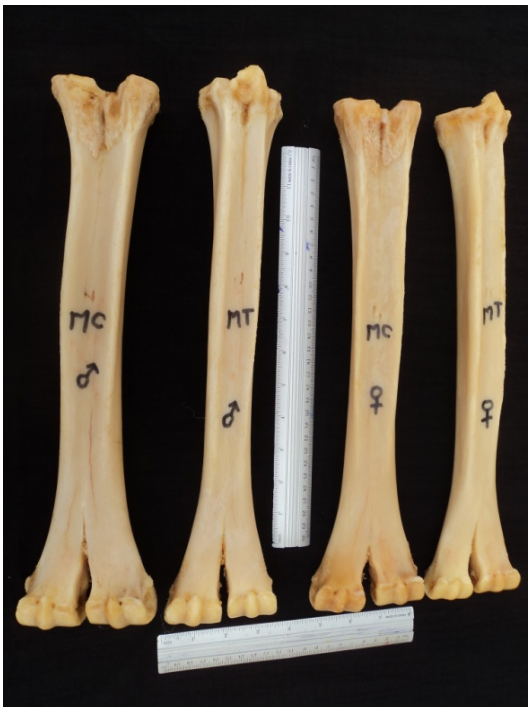

Fig. 4: Plantar face of male and female adult left metapods, metacarpus (TM) and metatarsal (MT

Sexual dimorphism appears very weak since it is about 0.11% for the 14 linear parameters, varying from 0.06% for GL to 0.15% for e and eT. The fact that there are very few of large or very big males in the sample studied which is homogeneous in terms of sex, the animals are very dimorphic and slender as found in dromedaries population Saharaoui.

CONCLUSION

This first exhausting approach to the osteometry of the Targui population osteometry allows to carry out the main features of character of this population which is originally from the Hoggar. he variability and the correlation between variables have been analyzed and provides reference data for archaeozoology. These data allows to reveal the most relevant measures that can be used to study the metapods which are very slender in the Camel Targui population. Seven linear parameters of each metapodes were calculated. The sexual dimorphism in this ruminants species is not entirely identical to what has been shown with the Saharaoui dromaory population, beef or Sheep. Finally and even if these first results must imperatively be confronted with comparison of an extensive corpus, it seems that the Camelus dromedarius species is particularly homogeneous in terms of overall variability.

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