The Mehari camels (*Camelus dromedarius*) in the Algerian northern Sahara: what are its characteristics and what types of farming vocations adopted in the Ouargla region?

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Abstract

To identify and characterise Mehari farming adopted in the region of Ouargla (Algerian Northern Sahara), 21 farms distributed through four representative zones of the Ouargla region were studied. For this purpose, the methodology embodied a systemic approach with an investigation tool based on interviews conducted through a semi-directive questionnaire. Two homogeneous groups of Mehari farms were identified by multivariate analysis (multiple correspondence factorial analysis (MCFA) and hierarchical ascending classification (HAC)): 67% of the Mehari farms were of a peri-urban and peri-oasis type with a racing vocation and 33% of the systems were of an intra-urban type with a socio-cultural vocation (Fantasia and parade). The study revealed the importance of these types of farming to the local populations, which still anchored in the daily life of local customs and have proven to be a real cultural heritage.

Keywords: camel racing, folklore, Mehari camel, Ouargla-Algeria, typology.

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Introduction

Camel husbandry contributes to encounter the major social challenges of the Mediterranean basin by combating desertification, encouraging poverty alleviation, promoting food security in the most fragile areas, and maintaining the population in rural areas (Salmi et al., 2018).

For local populations, the Arabian camel (*Camelus dromedarius*) was the traditional means of transportation that enabled them to move between different oases. It also played a central role in socio-cultural celebrations. However, facing climate change, the camel seems to be able to adapt not only to meteorological constraints (aridification of the environment), but also to changes towards more intensive farming systems. These changes lead to a better utilisation of camel products including milk, meat and wool (Faye and Konuspayeva, 2011).

In Algeria, the Arabian camel occupied in the past and still nowadays a pivotal place in the life of Saharan communities, especially in the northern Sahara (Senoussi, 2016). The latest official statistics reported a camel population at 448 546 head in Algeria for the year 2021 (FAO Stat, 2022).

Camel farming is an old activity of rural populations of nomadic origin in the region of Ouargla. Two types of camel farmers can be identified: (i) camel farmers in charge of driving and caring camels for production (meat, milk, wool, etc.) and (ii) Meharists, camel

owners or farmers who ride camels (Meharis) for saddle and for desert walking (Meharees). However, for easier reading, the two terms "Meharists" and "Meharis" will be used further in this paper to describe the second type of camel farmers.

Nowadays, more than ever, the Meharis deserve to be called "ships of the desert." Indeed, this is where the camel is experiencing a real boom. The objective of the present study was to identify and characterise the types of Mehari husbandry in the Ouargla region.

Material and Methods

Presentation of the study area

The study area (Ouargla region) which covers an area of 18289 km^2, is located in the Northern Algerian Sahara at about 800 km from the capital. The area is situated at the bottom of a large basin of the valley of Oued M'ya, bordered: in the North by the Daira of El-Hedjira, in the South by the Daira of Hassi Messaoud, in the West by the provinces of Ghardaïa and El Menia, and in the East by the Eastern Erg (Figure 1).

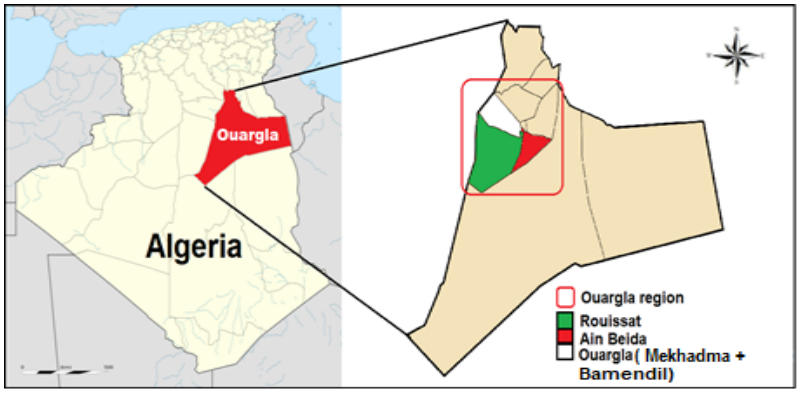

Figure 1. Adapted maps representing the study area.

Methodology

To identify and characterise the types of Mehari husbandry adopted in the Ouargla region, 21 farms were monitored for the period between May 2019 to November 2020. The main research questions of the present study were:

1. What place could be given to Mehari husbandry in the region of Ouargla?

2. What types of Mehari husbandry are existing in the study region? And

3. For what purpose(s)?

Supplementary materials

The methodology was based on a systemic approach with an investigation tool based on semi-directive interviews conducted with camel farmers. The farmers were selected according to a stratified sampling strategy in the Ouargla region: (1) Macro level: Ouargla region; (2) Meso level: four study areas: Ain Beida, Rouissat, Mekhadma and Bamendil (Figure 1); (3) Micro level: 21 Meharists randomly selected among farms representing diversified type of farm and vocation.

The questionnaire included two main axes: 1) the camel farmer (Meharists) and his household, and 2) the animals (Meharis). For each farm, the collected data were related to the period of adaptation and learning process, training, herd management, selection, feeding practices, health care and preparation for various events involving Meharis. The characteristics of the farms gathering as a whole 61 Mehari camels are reported in table 1. The age of the camel was given by the owner and confirmed by the dental formula (The

permanent dental formula for adult camels is [2 (I1/3, C1/1, P3/2, M3/3), and the deciduous dental formula for young camels is 2 (I1/3, C1/1, P3/2-3, M0/0)] (Faye et al., 2022). The strategy adopted by Meharists to select the Mehari is generally based on the animal's conformation, age and sex. The Meharis (Targui type) were housed in open-air enclosures, where they were raised on a diet specific to racing and festivity camels.

Table 1: Summary of Meharis* farms used in this study.

Farmer	Total number of camels	Number of Meharis	Age of Meharis (years)	Main activities
1	12	12	(6-12)	R
2	43	2	13 and 15	PFF
3	65	1	13	PFF
4	1	1	13	PFF
5	100	4	(6-12)	R
6	5	5	(6-12)	R
7	40	1	6	R
8	60	4	(6-12)	R
9	2	2	6 and 12	R
10	2	2	7 and 15	PFF
11	3	3	(8-15)	PFF
12	1	1	13	PFF
13	150	2	8	R
14	1	1	8	R
15	41	1	12	R
16	68	2	12	R
17	400	12	(6-12)	R
18	30	1	12	R
19	1	1	10	R
20	87	1	14	PFF
21	90	2	8 and 9	R

*Male Meharis were in all farms; R, race; PFF, parade and folkloric festivities.

Statistical analysis

Data were recorded in Excel sheets. For analysing the questionnaires, Multiple Correspondence Factorial Analysis (MCFA) was applied on a data table (i*j) containing the 21 camel farms (i) and 16 variables (j) including three illustrative (Age of owner, Mehari farming area and Monthly salary of trainer) in order to test their relationships (Table 2).

This analysis was followed by the Hierarchical Ascending Classification (HAC), according to the Euclidean distance and Ward's aggregation criterion, on the main factors in order to identify groups of Mehari farms based on their proximity. A contingency table was then created by crossing the classes issued from the HAC and all the descriptive variables to define the variables with a significant contribution to the classes by a Chi-square test. Only the variables significantly associated with the classes ($P<0.05$) were retained to describe the groups of homogeneous Mehari farms, defined as types of farms. The software used for these analyses was XLSTAT (Addinsoft, 2009).

Table 2: Characteristics of the two groups of Mehari farms identified by automatic classification: percentage of terms of each variables significantly contributing (chi² test) to the two groups.

Variable	Terms	Value	Group1 (%)	Group2 (%)	P-value
Type of trainer used (TT)	TT-1	Salaried	85.71	0	< 0.001
	TT-2	Family	14.29	100	
Function of Mehari farms (FMF)	FMF-1	Race	100	0	< 0.001
	FMF-2	Parade and folkloric festivities	0	100	
Culling age (CA)	CA-1	-15 years	100	0	< 0.001
	CA-2	+15 years	0	100	
Common diseases (CD)	CD-1	Skin + respiratory diseases	0	100	< 0.001
	CD-2	Skin + respiratory + joint disorders + bone fractures	100	0	
Distance covered (DC, km)	DC-1	10-12 km	0	100	< 0.001
	DC-2	15-30 km	100	0	
Supplementary foods (SF)	SF-1	Beets	7.14	0	=0.03
	SF-2	Dry bread+ wheat bran	0	57.14	
	SF-3	Beets +carrots	50	0	
	SF-4	Carrots + orange + others	28.57	0	
	SF-5	Carrots	7.14	42.86	
	SF-6	Carrots+ olive oil + goat's milk	7.14	0	
State subsidies for barley (SB)	SB-1	Yes	100	0	< 0.001
	SB-2	Non	0	100	
Owner's activities (OA)	OA-1	Multifunctional	92.86	42.86	0.011
	OA-2	Camel farmer	7.14	57.14	
Age of owner (AO)	OA-2	Camel farmer	7.14	57.14	=0.01
	AO-2	40-60 years	71.43	14.29	
	AO-3	+60 years	0	42.86	
Mehari farming zone (MFZ)	MFZ-1	Peri-urban	42.86	14.29	=0.001
	MFZ-2	Intra-urban	7.14	85.71	
	MFZ-3	Peri-oasis	50	0	
Monthly salary of trainer (MST)	MST-1	0 DA	14.29	100	=0.001
	MST-2	10000-20000 DA	57.14	0	
	MST-3	20000-25000 DA	28.57	0	

DA, Dinar Algerian; MST-2,68.45-136.88 Euro; MST-3, 136.88-171.08 Euro.

Results and Discussion

Multiple correspondence factorial analysis (MCFA)

MCFA involved the qualitative listed in Table 2. The interpretation of the results was based on the reading of the first two axes, representing 82.70 % of the total variance, respectively 76.36% and 6.33% of the total inertia (Figure 2), and emphasising the domination of a single main factor.

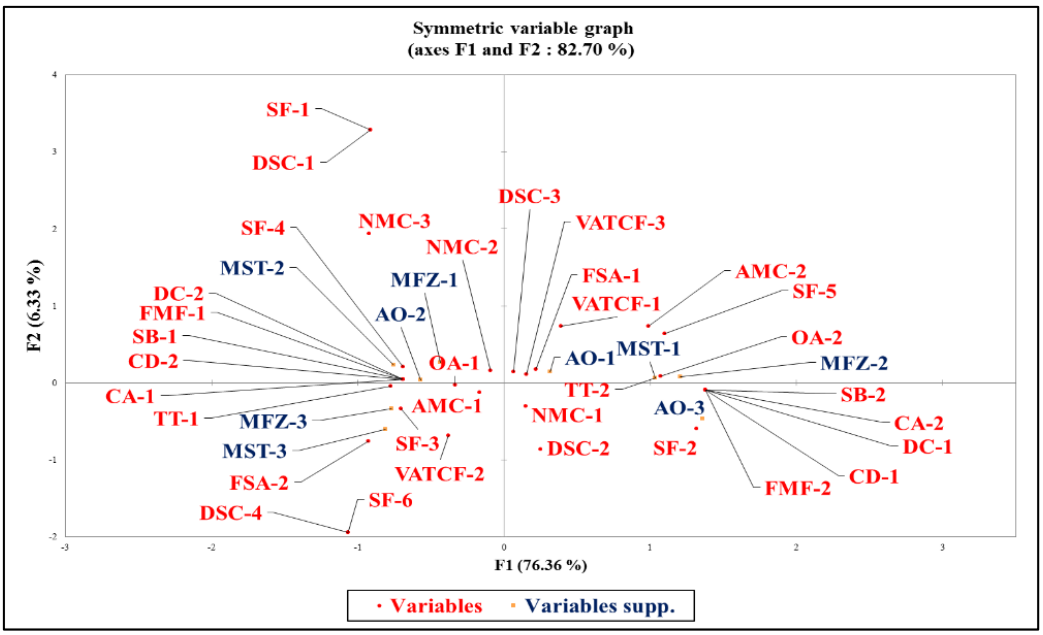

Figure 2. Projection of the mode of activity of the variables contributing significantly to the factorial plan (F1, F2) of the MCFA. OA: Other activity; TT: Type of trainer used; FMF: Function of Mehari farms; CA: Culling age ; CD: Common diseases; DC: Distance covered (km); SF: Supplementary foods; SB: Subsidies for barley; AO: Age of owner; MFZ: Mehari farming zone; MST: Monthly salary of trainer; AMC: Acquisition mode of camels; NMC: Number of Mehari camels; DSC: Drinking source of camels; FSA: Feed source for animals ; VATCF: Vocation for another type of camel farming.

The mode of activity is contributing significantly to the first axis (F1) allowed recognition of an opposition between:

(i) On the right side of the factorial plan (F1, F2): the old specialised Meharists, practising Mehari farming for festivities only. These owners had no trainers other than unpaid family members. Supplementation of the Meharis' diet was based on dry bread, wheat bran and carrots.

(ii) On the left side of the factorial plan (F1, F2): these were old or young multifunctional rural Meharists who had other activities apart from racing Meharis. The Meharists cultivated part of the feeds and purchased the remainder. They distributed carrots and beets as supplements. The coaches as well as the trainers of the Meharis were non-native employees.

The second factor included variables related to herd size in Mehari farms and the practice of other types of camel husbandry (Figure 2).

(iii) Upper part of the factorial plan (F1, F2): Meharists with large herds, specialised only in Mehari farming.

(iv) Lower part of the plan (F1, F2): Meharists with a small herd, practising camel fattening for slaughter in association with Mehari farming.

Hierarchical Ascending Classification (HAC)

HAC following MCFA allowed the regrouping of Mehari farms into homogeneous groups with similar characteristics. Applied to the 21 farms of our sample, it clearly identified two groups of homogeneous Mehari farms.

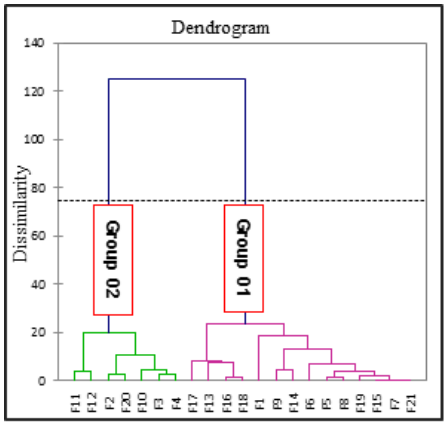

Figure 3. Mehari farms groups from the hierarchical ascending classification (HAC) with an interclass variance of 26.81%.

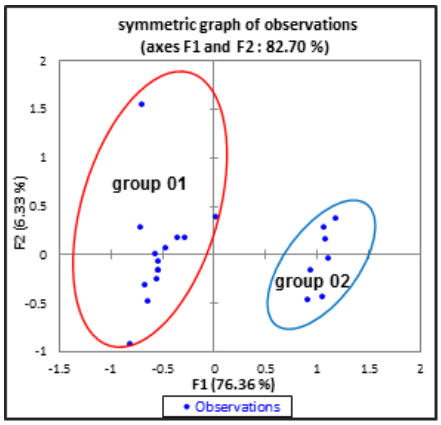

Figure 4. Projection of the cloud of individuals from 2 groups of Mehari farms on the factorial plan (1, 2) resulting from the MCA [group 1: camel race farms; group 2: camel farms for festivals].

Figures 3 and 4 with an interclass variance of 26.81%.

Chi-square tests were applied to the contingency tables crossing the two HAC classes to identify the variables that contributed significantly to the classes ($P<0.05$). The following variables did not contribute significantly to the construction of the classes: acquisition mode of camels, number of camels (Meharis), drinking source, feed source for animals and vocation for another type of camel farming.

Group 01 (n=14 or 67 % of the sample): These were racing camel farms. The owners were between 40 and 60 years old and considered as multi-actives, involved in other activities apart from camel farming, allowing them to diversify their incomes. Almost all of these owners raised racing camels, either on the periphery of oasis areas or on the periphery of urban areas. These Meharists used experienced trainers (permanent or temporary) of indigenous origins, paid through monthly payments ranging between 10,000 and 20,000 DA. The racing dromedaries were subjected to a daily training rhythm of up to 30 km.

The farming system was intensive with feed, where barley was the main concentrated energy food (subsidised by the State) and distributed in supplement, with carrots and red beets.

The animals were culled at age of less than 15 years. It is a farming essentially with sport vocation (Table 2).

Group 02 (n=7 or 33 % of the sample): This group is more specialised in festivities (Fantasia and parade). The farmers, whose age was under 40 or over 60 years old, were regarded either as multi-actives, or as exclusively farmers, having Meharis bred inside urban areas. The animals were managed by the owner himself and did not involve anyone outside the family. These trained Meharis received an increased feed supplementation based on carrots and by-products: wheat bran and kitchen wastes (dry bread). The Meharis of festivities walked up to 12 km/d, and the culling occurred after 15 years of age. It is camel farming with mainly socio-cultural vocation (Table 2).

Descriptive typology and vocations of Mehari farms in the region of Ouargla

The typological analysis highlighted the presence of two clearly separate types of farming without any overlap between the two main activities of racing and Fantasias/parades. In the latter, farming Mehari plays an important role for nomadic communities of the Ouargla region, where two main vocations – sport and socio-cultural events – are coexisting.

The presence of a single head in some farms shows that the dromedary in the region of Ouargla embodies the tradition in terms of practices in the daily life of the nomadic community, certainly sedentary but moreover faithful to the customs. Between mobilisable capital and diversity in farming, camel vocations emerge, among which the Mehari is reputed to be an animal for racing and parties.

Camel race farming and festivities vocations

It is difficult to find farmers willing to give all the information on their Meharis. The strategies for preparing camels for races in Ouargla region differ from one Meharists to another and are almost a secret. The competition is loyal and tough, and this indicates the importance of getting a place amongst the first, but especially to honour Algeria in various international events. If an owner wins the race, he becomes famous, and his Mehari does also. Moreover, the folkloric activities of Meharis are popular in the study area because they relate the local populations to their traditions. The Meharists are affiliated to specialised associations, where the rivalry between the associations is very intense for choosing the best one. For that, they base themselves on the best selection of an animal, the training, an intensive farming system and a clear health protocol.

Identification of the racing and festivity camels selected

Racing and festivities camels belong to "Targui" population, whose cradle is located in the Central Sahara, in the Hoggar, and in the southernmost part of Algeria (Tamanrasset). They are camels for racing and festivities by excellence (Messaoudi, 1999). The Targui is more slender (lanky) and is an excellent walker, well adapted to long rides. It has more slender and graceful bones (Oulad Belkhir et al., 2013; Guintard and Babelhadj, 2018).

The interviewed racing camel farmers in the areas of Rouissat, Ain Beida and Mekhadma purchased their racing camels in neighbouring countries (Niger and Mali), at prices varying between 500,000 DA and 620,000 DA, but which can reach 1,200,000 DA (7856 Euro). This last price corresponds to animals selected exclusively for racing. Contrary to that of racing, the Fantasia and parade type Meharis in the areas of Mekhadma, Rouissat, Ain Beida and Bamendil are bought from the market of Tamanrasset province, at a price ranging between 200,000 DA and 300,000 DA per head.

Phenotypic characteristics of racing and festivity camels

According to the racing and festivities camels' owners, to select an animal, it is necessary to consider criteria related to the following phenotypic characteristics:

- Male camel, castrated at the age of 3 years old.
- Targui population, known for its speed (on average from 45 to 70 km/h).
- Coat colour clear brown to grey.
- Long neck and small head.
- Small hump.
- Broad chest.
- Distance between the front limbs wider than the distance between the rear limbs
- Long animal with a lanky conformation.
- Long, strong and fine legs.

- Light animal, less than 600 kg for the males with a height at withers of 2 m;
- Rear sides of the rib cage very close to the kidneys.

Generally, the camel farmers in Ouargla region consider the external aspects of the animal (phenotypic characteristics) to proceed to the selection of the camels. This, in the absence of genotypic characteristics, is contrary to the Gulf countries where both phenotypic and physiological criteria are used and considered during the sorting of the best racing dromedaries (Haydn-Evans and Wernery, 1995; Gasmi, 2002). On the contrary, the Meharists in our study area preferred to exploit male dromedaries for racing, as females are oriented towards reproduction amongst the Tuareg. On the other hand, Gasmi (2002) and Cabalion (2019) reported that racing camel owners in the Gulf countries, particularly in the United Arab Emirates and Qatar, prefer female camels for racing because they have proved to be faster than males.

Preparation for races and folkloric festivities

Preparation for races

In the perspective of taking part to races, a training protocol named Tchhabe is adopted one month before the competition in Ouargla region. This protocol consists of a daily walk through, the owner starting by walk on a distance of 30 km daily, before ending with short strides. The aim behind this step is to improve the animal's performance, avoiding gaining weight and giving it a morphology similar to that of greyhound.

Racing camels in our sample were intensively reared in open-air pens throughout the year. This practice has been noticed also in racing camels from the Gulf countries (Gasmi, 2002) and Morocco (Mjidou, 2018). The intensive aspect of farming concerns not only training, but also feeding. Indeed, because of its specific sporting function, the Mehari requires very particular attention concerning its diet, which impacts the biological functions of the animal. Thus, the food composition of racing camels diet before the competitions is changing both quantitatively and qualitatively, although it was not based necessarily on their nutritional requirements, but rather on the empirical experience of the owner. Before competitions, an owner distributes the feed for racing camels as follows:

One month before competition, the morning meal was composed a basal ration: 12 kg fresh alfalfa (*Medicago sativa*) and the evening meal 7-8 kg barley. Fifteen days before the competition, the diet is changed: 8 kg fresh alfalfa (morning) + 4 kg barley enriched with carrot, turnip, beet and goat milk (evening meal). One week before, alfalfa was decreased in the morning (2 kg) as well as the barley (3 kg complemented with a mixture of carrots, olive oil and goat milk) in the evening. Finally, the last day, only one kg Alfalfa was distributed in the morning while in the evening, each camel received a complement composed of 3kg barley + mixture of beet, turnip and orange (a complementary ration).

These practices were also noted by Gasmi (2002), who reported that the efforts before and during racing require energy, high quality proteins, minerals and vitamins. For example, the feed distributed for a winner in the United Arab Emirates consists of i) a basal foodstuff composed of alfalfa, barley, corn, sorghum, ii) a complementary ration composed of rapid energetic foods (dates, honey), and protein-lipid foods (cow's milk, butter, egg), in addition to the mineral and vitamin complement. In Morocco, food rations are divided into two types: i) a basal ration (alfalfa, barley, corn and crushed wheat), and ii) a complementary ration (dates and honey). The latter is distributed one week before the race (Mjidou 2018). Regarding watering, in winter, water is provided every 3 to 4 days, but in summer, the camels are drinking ad libitum. However, for short distance races, trainers do

not provide water to animals in order to avoid a decrease of their performance. During long distance races, marathons (dromathon), a small quantity not exceeding 5 litres is given to the animal to avoid dehydration.

Preparation for folkloric festivities

The owners of Fantasia and parade camels adopt an intensive farming system, and, throughout the year, the animals are bred either in groups inside enclosures located near the towns where the owners reside or alone in the courtyard of the houses. During folkloric events, the owners start animal preparation by walking for 4-5 days, covering 7-8 km/d, before increasing the distance to 10-12 km/d, for improving the animals' performance.

The feeding management of Fantasia camels can change from one farmer to another, but feed is always composed of basal and supplementary feeds. An example of diet distributed by a Mehari owner of festivities is as follows: basal feeds in the morning, including 10 kg or 5 bundles of alfalfa; in the evening, 8 kg of barley. Complementary ration: dry bread, wheat bran, vitamin and olive oil administered to strengthen the immune system and provide energy for more sustained efforts.

By the way, for both racing and folkloric festivities, the amount of barley distributed to animals is reduced after the sporting season and in the absence of festivals, to avoid weight gain of camels. The camels used for festivities are watered at will all over the year.

Race organisation

In Ouargla region, two types of races are organised systematically: short races and marathons, but in the Gulf countries, long races (dromathon) that exceed 12 km are scheduled exclusively in Kuwait and Saudi Arabia (Abou Chaneb, 1992). In the study region, the sporting season usually extends from September to June. Generally, the "short races" (Dawra) are organised in the evening on tracks or Camelodromes, while the marathons (Raly), known for their long distances, take place in the morning. The most important races are organised on national celebrations (November 1st and July 5th) or cultural festivities. Moreover, the Directorate of Youth and Sports of the province of Ouargla and local companies, in addition to clubs and associations of camel farmers, financially support the organised races. Bedda (2014) and Haili (2015) noted that, every year in Algeria, Mehari races are organised during the periods of "Ouaada" (religious celebrations) in the regions of Ouargla, Metlili des Châambas, Brezina and Ain Safra, and occasionally in most Sahelian countries (Faye et al., 1997).

Folkloric activities

Owners of Fantasia camels ride their camels and parade on the track after the races. They also represent folkloric activities in case of visits of eminent personalities in the province of Ouargla. The Mehari of Fantasia is also encountered in regional wedding celebrations; indeed, in the practices of local populations, since antiquity, the bride rides a palanquin (Bassoure) wrapped in a coloured cloth, installed on the back of the camel to transport her to her husband's house.

Reference and price distribution for racing and folkloric activities

In Ouargla region, the organisers of camel races award certificates of distinction, money and prices to winners. As an incentive, a cash price of 200,000 DA (2000 €) is dedicated to the dromathon (marathon) champion, and smaller amounts of money are offered to subsequent winners. For the short races, cash prices or household appliance gifts are given to the first five classified. On the other hand, a sum of money estimated towards 200,000 DA is offered yearly to the best folklore associations.

In the Gulf countries, camel racing is a vocation encouraged by Sheiks, Emirs, Kings and camel racing club who award the winners

luxury cars, gold trophies, prestigious watches, ornaments, daggers, swords and sums of money (Faye et al., 1997; Gasmi, 2002). In Morocco, prices for the first ten places are distributed in the monthly Tan-Tan race (Moussem race); cars and sums of money can go up to 30,000 Dirhams, accorded by the Emirati princes who assist (Mjidou, 2018). Moreover, in the same country, the farming of racing camels and camels for folkloric activities has become very important in the last decade (Mjidou, 2018). The animal is even part of "beauty contests" that function a bit like canine or feline exhibitions during which, based on strict criteria, the most beautiful subjects are determined and can therefore receive fabulous prices (Faye, 2016). Such contests are also emerging in Turkey, where the camel is used for wrestling in yearly festivities (Yilmaz and Ertugrul 2014; Yilmaz 2017).

Health of racing and festival camels

Regarding health problems, the main risk for racing camels is lameness and bone fractures while mange, trypanosomosis and influenza are common to the both types of animals (racing and festival) although influenza is rarer among the last ones.

The treatments applied by the owners are often traditional (medicinal plants, cade oil, olive oil, goat milk) and sometimes “modern” medicine (antibiotics, antiparasitic). Regarding preventive measures for racing camel, the target is the strengthening of bones with chicken bones powder distribution, and of immune system with vitamins. For festival camels, the owners wash the animals with warm soapy water every two days, and provide regularly vitamins and olive oil to strengthen the immune systems.

For racing camels, Gasmi (2002) reported that, in periods of high competition, stress induces an immune deficiency that results in epidemics of influenza types. When camels are presenting signs of diseases, they are usually treated with antibiotics. Lameness, joint disorders, broken bones and dietary diseases (acidosis, mineral and vitamin deficiencies) have a negative impact on the performance of the racing camels (Al-Juboori, 2013). Parasitic diseases (trypanosomosis and mange) are also very common in the Gulf countries (El-Wathig et al., 2016; AL-Afaleq et al., 2018).

Conclusion and recommendations

The present study, carried out in the region of Ouargla (Algerian Northern Sahara), has allowed the identification and characterisation of two main types of Mehari farming: (i) a peri-urban and peri-oasis type Mehari farming system with racing purpose, and (ii) an intra-urban type farming system with socio-cultural events purpose. These systems are practised by resident Meharists of nomadic origin. The prestige associated with this Mehari farming, within nomadic societies through racing and folkloric representations, shows a real development of camel farming beyond the aspects related only to production. Therefore, the programming and organisation of various cultural and sport events are opportunities to encourage young people to maintain such practices related to the local and cultural heritage to be preserved. However, this farming remains proportionally a limited activity, with the number of involved farmers remaining modest, despite the measures, related to the promotion of the camel sector, taken by the authorities since September 2019.

For the future, research centres interested in camel farming (such as the Saharan Bio-Resources Laboratory) must be able to carry out detailed specialised studies of "Mehari". These studies could be related to nutrition, health, physiology, sporting performance and genetics. Such a centre could help Meharists to select the best candidates for races and festivities, in order to develop this farming in Algeria.

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Conflict of interest

The authors have no conflicts of interest to declare for this study.

Authors' contributions

Aïcha Abazi performed all field surveys, statistical analyses and wrote the first draft of the manuscript. Abdelhakim Senoussi supervised the work and participated in the writing. Bernard Faye helped to interpret the statistical analyses and contributed to the critical revision of this manuscript and to the final writing of the article. All authors authorise the submission of the final version for publication.

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