Camel genetic resources in North Africa

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Introduction

The dromedary (*Camelus dromedaries*) has demonstrated its high adaptability to the most rigorous environments in North Africa. Its ability to grow on feed that is not regarded as sustenance for most other domestic animals made the dromedary a special component for marginal, arid and semi-arid ecosystems. The dromedary, or Arabian Camel, is one of the six species in the camelidae family, along with the bactrian camel (*Camelus Bactrianus*), Llama, Alpaca, Guanaco and Vicuna. The dromedary populates the semi-arid and arid tropical and subtropical regions of Africa and Asia and other regions like Australia. The Bactrian is found in regions of Asia with a colder climate and is well suited to high mountainous regions. Both types of animals have provided man with animal protein and energy and given nomads immense mobility (Knoess, 1979). The Arabian Camel has one hump and it is adapted to the desert conditions. The term 'dromedary' is derived from the word *dromos* (Greek for "road"). Even though considerable research work has been done on health, nutrition, anatomy, physiology and reproduction, dromedary productivity is still low and new innovative management practices are mostly needed. The association of camels, in general, with harsh environments and the lack of appropriate genetic management strategies did not help camels reach a better economic status when compared with their counterparts, such as cows, sheep and goats. The objectives of this article were: 1) to describe the dromedary population in North Africa, and 2) to propose a plan of action for dromedary improvement in the region.

North Africa population trends

North Africa has a population of about 78 million inhabitants which represents 28% of that of the Arab countries and 15% of all the Mediterranean basin. This population has been multiplied by 2.4 times since 1965 with an average annual growth varying from 2.26 in Tunisia to 3.76 in Libya (Table 1). The urban population growth rate has been increasing during the period 1965-2000 by 3.76, 2.96, 2.82, 2.56, and 2.26 per year in Libya, Algeria, Morocco, Mauritania and Tunisia respectively. The ratio (Agricultural Gross Domestic Product : Gross Domestic Product (AGDP/GDP)) was between 12-13% in Algeria,

Table 1. North Africa total population.

Country	1965	1995	2000	2000 (%)	Increase 1965-2000
Algeria	11 923	27 655	30 291	0.39	2.96
Mauritania	1 096	2 275	2 665	0.03	2.82
Morocco	13 323	27 213	29 878	0.39	2.56
Libya	1 623	4 755	5 290	0.07	3.76
Tunisia	4 630	8 943	9 459	0.12	2.26
Total	32 595	70 841	77 583	1	

Morocco and Tunisia. The GDP per inhabitant was $5 349, $2 238, $1 580, and $1 193 in Libya, Tunisia, Algeria and Morocco respectively (MED AGRI, 2002).
Improvement of standards of living in the region, combined with a high population growth rate and a high rate of urbanization has caused a massive increase in demand of livestock products that native breeds could not satisfy. This situation resulted in the importation of exotic specialized breeds and intensification of livestock production systems, especially in dairy cattle and poultry. Little is invested in camel production development.

North Africa farm animal resources

North Africa is home of a very rich animal resources biodiversity of small ruminants, cattle, equines and camels that have been adapted for centuries to a variety of environments encountered in the region (Table 2). Approximately 2 millions of camels are raised in the region. It is quite difficult to have exact camel numbers within each country because of the movement of camels among countries. This is why it may be more interesting to see the total camel population size within the region and not within a given country per se.
Farm animal resources play many agricultural roles in the region (food production, social, employment, traction, fuel, fertilizer, bank, culture, tourism). The livestock sector contributes around 30-35% to the GDP.

Livestock food production

Total camel milk and meat production in the region are reported in table 3. Mauritania has the highest camel population size and it is the highest producer of milk and meat (FAOSTAT, 2003).
Total production of meat and milk by country and by species in the region are mainly coming from other species (Figures 1 and 2). Poultry, sheep and cattle contribute approximately by 45%. 30% and 24% respectively to the total meat produced. Milk production is mainly coming from dairy

Table 2. Livestock numbers in North Africa (in 1 000 heads) and percentages.

Country	Sheep	Goats	Camels	Cattle	Horses	Asses
Algeria	0.34	0.20	13	0.25	0.17	0.13
Mauritania	0.12	0.25	70	0.21	0.06	0.10
Morocco	0.30	0.34	2	0.40	0.46	0.61
Libya	0.12	0.13	2.5	0.02	0.14	0.02
Tunisia	0.12	0.08	12.5	0.12	0.17	0.14
Total	53 750	16 783	1 851	6 718	327	1 595

Source: FAOSTAT, 2003.

Table 3. Camel milk, meat and leather production (Mt).

Country	Number (1 000 heads)	Milk	Meat
Algeria	245	8 000	3 400
Mauritania	1 292	22 000	20 000
Morocco	36	3 800	2 000
Libya	47	2 000	3 500
Tunisia	231	1 000	1 400

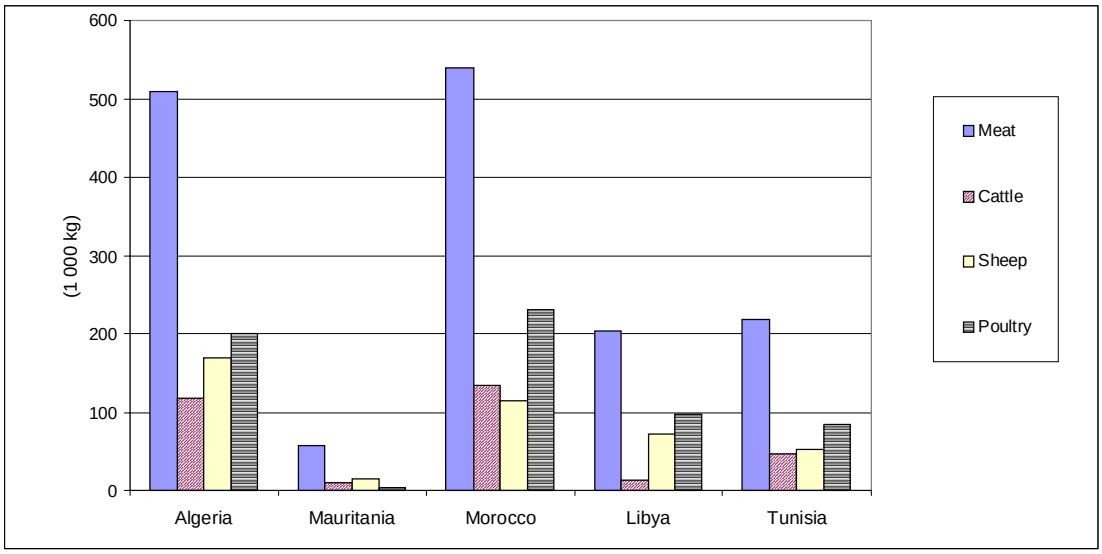

Figure 1. Meat production in North Africa by species.

cattle in all North African countries, exception made for Mauritania, where the three species (cattle, sheep and goats) contribute almost equally to the total milk produced.

In the case of camels, it should be understood that the lack of a complete evaluation of its potential led to an underestimation of its real capacity to produce meat and milk. As reported by Kamoun in 1995, the daily

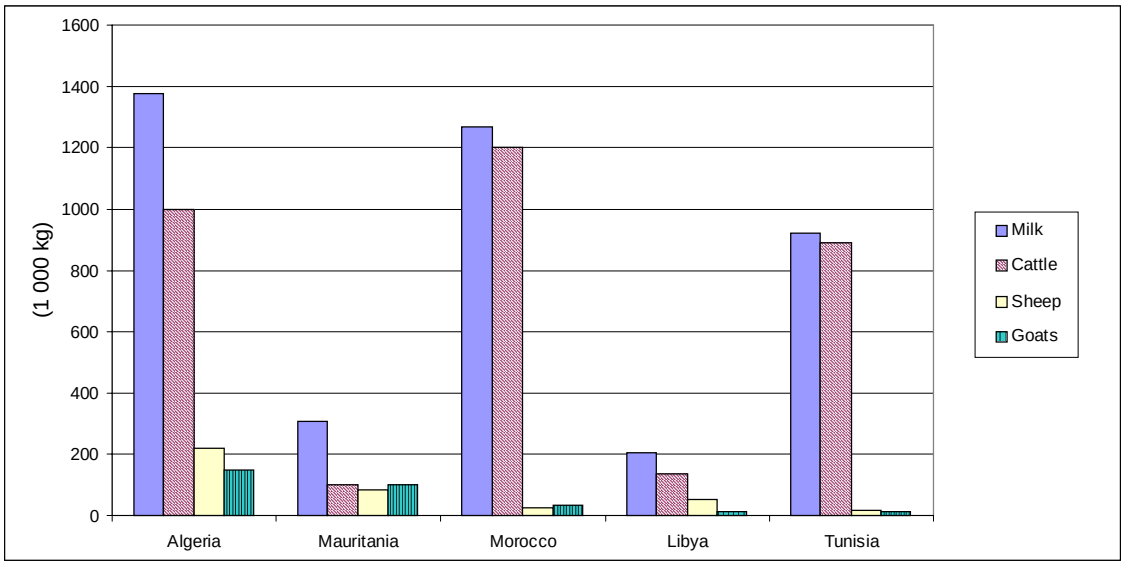

Figure 2. Milk production in North Africa by species.

milk increase can reach 28.5% when the number of milking changes from 2 to 3 per day. The part taken by the young camel should also be measured accurately in order to assess the total milk produced on average by lactation. There is no doubt that variability in production potential does exist among and within camel breeds (Ismail and Al Mutairi, 1998). This variability can be very useful for screening productive animals under harsh conditions. In Tunisia, Kamoun *et al.* (1990) reported milk yield averages varying from 1 000 to 2 700 kg.

Importance of camels in the region

Data on the actual amount of milk produced from camels in the region by lactation are not known very accurately for judging their milk-producing capacities. However, they are valuable animal genetic resources and constitute an indispensable natural resource that must be properly managed due to their unique characteristics especially under the most stressful conditions. As awareness of the importance of animal resources and food safety has increased in the region as well as worldwide, agricultural development and food security are becoming the main components in most countries' agricultural policies. It is becoming clear that the food security argument is putting additional value on local agricultural products, irrespective of their opportunity costs. The strategic idea is to minimize the country's dependence on external food supply sources and produce a product that can be traced back regarding its origin. This choice should allow camels in the future to regain economic importance. If a sharply rising population in the developing countries is to achieve higher real incomes and a better quality of life, agricultural output must rise more rapidly than population growth. In order for the

rise in agricultural output to be maintained over time, natural resources, including camels, which provide the basis for such output must be preserved and new technologies offering higher productivity must be developed.

Genetic considerations

The adult Arabian camel weighs between 450 to 650 kg and its height varies from 190 to 230 cm. Various types are encountered. In Tunisia, the most common name of the breed is "Maghrebi". The adult live weight of males is 450 kg on average while for females it is 400 kg. Algeria has 9 camel varieties in total (Chaambi, Chameau de l'Aftout, Chameau de la Steppe, L'ait Khebbach, L'ajjer, Ouled Sidi Cheikh, Reguibi, Sahraoui and Targui). Their adult live weights vary from 600 to 700 kg on average. Their milk yield is 1100 kg on average and days in milk are 345 days on average (DAD-IS, 2004). In Mauritania, there are 2 varieties: Chameau de l'Aftout and Chameau du Sahel. In Morocco, four varieties are encountered: Jebli (central atlas and anti atlas) Khaouri, Marmouri and Sahraoui. Milk yield of these types varies from 500 kg in 180 days to 2 500 kg in 720 days (DAD-IS, 2004)

Almost no research has been done on a multidisciplinary way including genetic improvement aspects as to the capacity of the camel to produce milk and meat under drought conditions or under conditions where human nutrition is so precarious. No thought is given concerning the genetic ability improvement of this animal to produce food in severe drought periods.

Looking at camels from a genetic point of view will soon clarify why camels did not progress the way cattle, sheep and goats did in developed countries. While developing countries are trying to follow the steps of developed countries in breeding strategies for cattle, sheep and goats, the situation is completely different for the camel case because the camel is mainly encountered in developing countries. This situation did not stimulate developing countries to investigate more the breeding component in camels. The latter (Genetic improvement component) with all its organizational aspects (Breed Associations, legislature, etc) is still not considered as a priority for animal improvement when compared to health, nutrition and feed resources. The common view is expressed that there is no need to worry about genetics until management is sufficiently improved to allow full expression of the existing available genetic potential. This view, however, fails to recognize that an animal population is dynamic in nature (culling and replacements) and that genetic variability does exist in any given environment. Therefore, the notion that there is a genetic potential for each level of management is conceptually and practically more accurate (Falconer, 1996). The absence of national recording systems and the lack of reliable breeding strategies have been for long time major limitations to improvement. This explains the absence of specialized breeds in camels. The main traditional typology classifies camels into riding and pack types. A further typology allows camels to be classified as lowland or mountain types (Lease, 1927). These

classifications assign little importance to the main products (milk and meat). Recent attempts have categorized camels into types comparable to those applied to cattle (beef, dairy, dual purpose and racing) (Wardeh, 1991). This could build a new way of orienting research work in camels and allows the development of breeds based on main products rather than tribe names.

A plan of action

Breeding programs have been successful in developed countries because they serve real needs and they were designed on solid bases, i.e. identification of economic objectives, recording, genetic evaluation, dissemination of favorable genes and breed or farmers' associations backed up by reliable research institutions. Well-trained people and caring breeders, working together in harmony, have made breeding programs successful and essential for their breed improvement in a sustainable way. These considerations should be taken into account for camels in the future. In order to improve their productivity, a complete strategy, including technical and organizational components, should be implemented according to the prevailing production systems or society use as follows:

Technical component

1. Identify types of breeds (meat, milk or dual purpose, racing) based on:
   - Number.
   - Production system.
   - Community preference.
2. Develop a breeding strategy for each important breed that includes:
   - Breeding goals.
   - A simplified reliable recording system.
   - Reliable genetic evaluation methods.
   - A plan for dissemination of results and wanted genes.
   - An evaluation of management progress and genetic trends in the recorded herds on a yearly basis.
3. Implement a sound management program (nutrition, health, etc) specific to each proposed breeding strategy.

Organizational components

In order for the technical components of the strategy to be maintained on a continuous basis, the following organizational steps should be followed:

1. Create a national/regional association for the chosen breed with the recorded herds taken as the breed nucleus.
2. Educate and design training programs for nationals who will have the responsibility of implementing the breeding strategy and advising the breed or farmers' association.

3. Increase the awareness of administrators in Ministries of Agriculture about the importance and potential of the genetic management of the breed and the role of the associations in promoting the breed. This could be achieved through special short courses (Cunnigham, 1987)
4. Build working links between the association and specialized national research institutions.
5. Use the association as a framework for extension programs to enhance the multidisciplinary involvement (nutrition, genetics, socio-economics, environment and marketing) and to develop services and technology transfer to farmers. National legislatures could help enhance this type of organization. International organizations like ILRI, ICARDA, ACSAD and the FAO have a lot to offer in the field of education and training in animal breeding, management and breed associations organization. They can play a facilitating role in bringing key people and national institutions together to implement and manage the proposed strategy. It is important to stress again that the proposed plan of action considers the breeding component as a leading issue due to its dynamic nature in a sustainable way and the amount of information that it generates. The breed/farmer association is taken as a framework through which any program (nutrition, health, range improvement...) aimed at improving the breed can be implemented. It is also essential to note that all the mentioned actions should be taken into account together in order for the strategy to be successful (Djemali & Wrigley, 2002). Resource requirements for the implementation of the strategy could be partially fulfilled by farmers' participation.

Organizational aspects

During the past three decades, most developing countries have established an institutional infrastructure for livestock development research: extension, veterinary laboratories, disease control services and educational institutions at various levels. The technical performance of this infrastructure varies from country to country and from institution to institution. The development concern these days is not so much about the capacities, in terms of physical infrastructures or size of trained manpower, but about the usefulness of this capacity in improving farm output. One of the alternatives to enhance this capacity resides in the establishment of coordinating mechanisms among different active forces working in agriculture within countries as well as at regional and international level. The future of local livestock breeds in general and camels in particular depends on the steps taken today toward their improvement. Van Vleck (1987) reported that the true model in studying livestock traits should be defined as y = f (genotype, environment, people). It is the organization of people for the benefit of their animal resources (breed or scientific associations) that generates progress at the productivity level and ensures its sustainability. Successful examples are seen in the developed world (European Association for Animal Production, American Dairy Science Association). This is why it is very important

that national livestock scientists in countries with arid and semiarid climatic characteristics should join their efforts in order to create mechanisms that allow them to meet regularly to present, discuss and exchange information on topics relevant to the conservation and improvement local breeds.

Conclusions

The potential of camels as a food producer in the region should be studied, utilized and improved. The absence of reliable genetic strategies is a real handicap for camel development. A plan of action is proposed considering the breeding component as a leading issue and a generator of useful information with the breed/farmer association taken as a framework for extension programs and a larger multidisciplinary involvement. In order for the camel industry to benefit from science, dynamic mechanisms should be established to bring together livestock scientists working in arid and semi arid areas to facilitate exchanges of findings, avoid redundancy and set up research priorities relevant to local animal breeds in general and camels in particular.

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