

MY JOURNEY TO CAMEL SCIENCE TO BECOME A CAMELOLOGIST?

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My discovery of the camel

Probably, I saw my first camel in a circus in my native town in France, but I really discovered the dromedary in Ethiopia for first time as “tropicalist veterinarian” in Africa in 1975, then in Niger where the camel is an emblematic animal of the Tuareg pastoralists. During my stay in Niger (1977-1979), I worked within the framework of the French cooperation on the “Livestock Reconstruction” programme, a project following the great drought of 1973-1974 which had seen nearly half of the national livestock perish. This programme was based on two main activities: firstly, the establishment of a network of “ranches for livestock multiplication”, aiming to develop a “rational management” of herds in order to obtain a large number of animals quickly, and secondly, to distribute the animals to the affected herders through an advantageous credit system based on deferred repayment in cash or in animals issued from loaned herd. In this issue, Tuareg breeders preferred to get 5 camels rather than 5 cows or even 10 sheep or goats.

But, my first discover of camel as young scientist was during my second stay in Ethiopia (1980-1983). In the Rift Valley, a mythical place in the world’s geology, sheep, goats and sometimes cattle were widely affected by a disease (called “*degamaka*” by Afar pastoralist), characterised by difficult gait, then inability to stand up, and often by the death. After some investigations, I was able to make a diagnosis: a secondary copper deficiency provoking the famous “sway-back”, secondary because linked to the excess of sulphur and molybdenum (two antagonists of copper) in grasses growing in the volcanic soils of the Rift Valley. However, the camel, widely present in the area, seemed to make a mockery of this situation, and in the blood samples I collected on the fourth species (cattle, sheep, goat and camel), plasma copper in camel only was in normal values (Faye *et al*, 1991). To understand, this difference between species, I started my first investigation on

camel feeding behaviour by following a camel herd for a week during the dry season, then again during the rainy season, sleeping in nomadic camp, drinking only camel milk and accompanying the shepherds in the field. At this occasion, I discovered that camel appreciates diversified plants and through its feeding behaviour, takes two or three times more plant species than its herbivorous colleagues, at all levels, from the grass to the top of thorny trees (Faye and Tisserand, 1989). It is well known that diversity is a guarantee of a better balanced diet.

The mineral and water metabolism in camel

After Ethiopia, joining French Research Institute (INRA, then CIRAD), I started a long collaboration in Morocco with my colleague Mohammed Bengoumi at the Agro-Veterinary Institute at Rabat and the physiology lab at Casablanca University, on the mineral and water metabolism in camel. We wanted to understand the physiology of camel resistance to poor nutritive food and to dehydration. With my Moroccan colleagues, we made several discoveries: the camel is able to control deficit situations, to store better in its organs, to manage the metallo-enzymes as glutathione-peroxidase, sodium oxide-dismutase or ceruloplasmin, to save losses, to reduce its metabolism if necessary (Faye and Bengoumi, 1997; Bengoumi *et al*, 1998 and 1999; Essamadi *et al*, 1998; Faye *et al*, 1999). These investigations on mineral metabolism were prolonged later in Emirates, in the frame of a PhD on selenium (Seboussi *et al*, 2008 and 2009) leading to a review on selenium metabolism and the recommendations on selenium supplementation in camel (Faye and Seboussi, 2009). More recently, several investigations were achieved in Saudi Arabia in the frame of FAO project (2010-2015), on mineral supplementation notably using organic selenium (Faye *et al*, 2014a), then in collaboration with King Saud University, on trace mineral status of organ’s camel as liver or kidneys (Abdelrahman *et al*, 2022).

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Clinical and nutritional biochemistry

However, my interest was not limited to minerals. Other blood parameters were investigated since my first investigations in Ethiopia and Djibouti (Faye and Mulato, 1991) or in Morocco (Bengoumi *et al*, 1999) and later in Saudi Arabia, notably the sexual hormones (Al-Saiady *et al*, 2014). Other researches were achieved in collaboration with the university of Casablanca on the blood indicators of stress on camel (El-Khasmi *et al*, 2015), calcium and phosphorus metabolism (El-Khasmi and Faye, 2011), notably the role of vitamin D (El-Khasmi and Faye, 2019). Naturally, my contributions to many studies on haematology and clinical or nutritional parameters in blood, but also in organs (Faye *et al*, 2013) led to the publication of a book by Springer on “Camel haematology and Clinical Biochemistry” (Faye and Bengoumi, 2018).

The mystery of the hump

Camel always bring surprises about his ability to be satisfied with the little that the environment gives him, and especially to manage his fat storage he has on his back. Contrary to a preposterous idea that is lying around in some popular books, the hump is not water storage, but a big amount of adipocytes, and this storage evolves according to the status of the animal (Faye *et al*, 2001a). So, I investigated the hump, to understand its rate of decrease or increase, its links with breeds, nutritional status and the role of leptin hormone in its management (Delavaud *et al*, 2013). My interest for the hump management lead to set up a specific scoring of the camel body condition (Faye *et al*, 2001b) which was used worldwide.

The camel meat and milk

From the hump to the other parts of the camel body, I was naturally interested by camel meat and notably its composition by comparing Bactrian and dromedary meat in the frame of another PhD in collaboration with Prof. Kadim from Qaboos University in Oman (Raiymbek *et al*, 2015 and 2019). Additionally, I published several papers on the camel meat market, leading to the participation to the book “Camel Meat and Meat Products” (CAB publ.) proposed by Kadim *et al* (2013).

I had already tasted camel milk in Ethiopia in the Afar camps. The first time, I drank it from a calabash coated with fat with impurities floating around that I didn't want to know the origin! Then I drank it from the milking bucket in the farms in Turkmenistan, then later in pasteurised plastic bottles in the Emirates or Saudi Arabia. Finally, it was even

accessible in milk cartons at the Nouakchott dairy in Mauritania or in glass bottle in the north of France! Thus began for me, the long saga of camel milk, the discovery of its virtues, its tonic functions, the particularities of its proteins (Ryskalieva *et al*, 2018), fatty acids (Konuspayeva *et al*, 2007 and 2008) and the richness of its vitamins (Faye *et al*, 2009). To listen to colleagues in Asian or African countries, camel milk proved the miracle product. Some of them claimed that it cures tuberculosis patients. Another claims that it has anti-diabetic and anti-cancer properties. There is always a little truth in it, but as scientific truths mix with legends, it is better to understand the secrets of its composition. So, I began to describe the complex chemistry of this white liquid notably by comparing the “one-hump” to the “two-humps” in a place where the two species coexist and interbreed, in Kazakhstan (Faye *et al*, 2008) and I contributed to another book regarding the health benefits of the camel products (Al-Haj *et al*, 2020). Finally, I tried to understand the links between milk composition and health effects (Faye and Konuspayeva, 2024), but also the risks linked to its potential contaminations by pesticides or heavy metals (Konuspayeva *et al*, 2011a and b) and the conditions to get organic milk (Konuspayeva *et al*, 2023a).

My adventure regarding camel cheese making began for me in Saudi Arabia in collaboration with Prof. Konuspayeva from Al-Farabi University in Kazakhstan (Konuspayeva *et al*, 2017) and continued by practical training of farmers and dairy technicians in Kazakhstan, Mongolia, Algeria, Morocco, Chad, Mauritania, Turkey and also in Spain and France. But another camel milk product retained our attention, the fermented camel milk which has strong probiotic effects. Thus, I contributed to research on this processed milk in Sudan (Ahmed *et al*, 2015) and in central Asia (Konuspayeva *et al*, 2023b), especially by the investigation of its microbiological flora (Baubekova *et al*, 2015).

The camel economy and demography

Being interested by the production, an additional question was “What is the economy of camel products?”. This question led to many investigations on the different camel farming systems in many countries from Africa (Biya *et al*, 2021), Middle-East (Abdallah and Faye, 2013) or India (Laval *et al*, 1998). The camel milk market is experiencing an important recent development (Ait-El-Alia *et al*, 2025), especially thanks to the progressive integration of camel milk producers into market (Faye and Corniaux, 2024), including the international market of milk powder (Konuspayeva *et al*, 2022). The camel



Fig 1. Practical demonstration at the Algerian Veterinary Conference at El-Oued, Algeria (2016).



Fig 2. Camel calving at the Camel Research Centre, Al-Jouf, Saudi Arabia (2011).

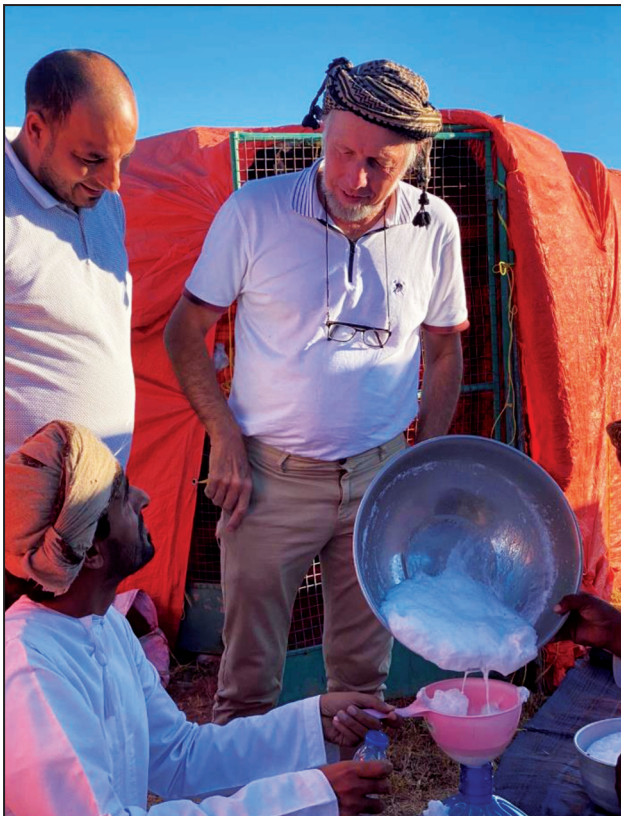


Fig 3. Training on milk hygiene of the camel farmers in Dhofar, Oman (2022)-FAO project on camel cheese.

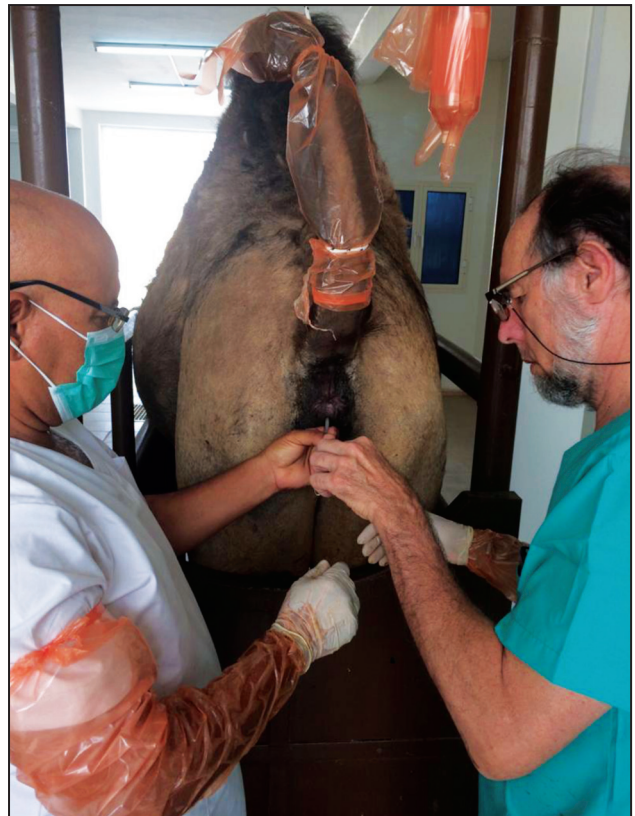


Fig 4. Trials on camel embryo-transfer in Mauritanian Centre of Camel breeding development (CMDEC) supported by FAO, Nouakchott, Mauritania (2019).

milk value chain was also investigated in Saudi Arabia (Faye *et al*, 2014b) and in the frame of different development projects, in Chad, Mauritania, Mali, Niger. The question of the camel economy also refers to its demographic developments. For that, I tried to achieve a critical analysis of the current available data in FAO database (Faye, 2020) and to understand the impact of climatic changes on the camel farming systems and their geographical

distribution worldwide (Faye *et al*, 2012). However, the camel economy is not limited to its national or international contribution, but it is important also to the household economy (Tardif *et al*, 2014).

Other contributions

The camel breeding requires to investigate several dimensions of the animal and its farming



Fig 5. With The Saudi delegation at the 4th Conference ISOCARD at Almaty, Kazakhstan (2015).



Fig 7. Restrained camel prepared for hump biopsy, Cholak-Korgan, Kazakhstan (2013).

practices. Thus, I was implied in many other studies including genetics (Al-Abri *et al*, 2019; Burger *et al*, 2019), welfare (Menchetti *et al*, 2021) leading notably to the scientific edition of the book “Dromedary Camel Behaviour and Welfare” (Padalino and Faye, 2024), feeding (Laameche *et al*, 2019), milking (Ayadi *et al*, 2016), veterinary sciences (El-Wathig and Faye, 2016; Gossner *et al*, 2016; Dially *et al*, 2022), ecology (Trabelsi *et al*, 2023) and even camel history (Faye *et al*, 2024) for citing few papers only.

Conclusion

There are few camels in my country, France. It is why I followed this animal and the people living with him in many other countries. Finally, I was seduced by the camel for three main reasons: he is an interesting biological model, he is a remarkable producers of milk and meat in harsh conditions and he is a fundamental element of the desert ecosystems. Globally, the camel is a quest for survival first, happiness perhaps, knowledge certainly. This is why, tirelessly weaving a network of passionate



Fig 6. Training on camel cheese making with farmers from Atyrau, Kazakhstan (2016).

researchers, I founded in 2006 with a few others, the International Society for Camel Research and Development (ISOCARD) in order to regularly bring together these researchers who are anxious to better understand this very special animal. And for a good cause, I invented a new discipline: “camelology” (Faye and Gahlot, 2024). By giving a definition of this new discipline in the website that I supervise in my former research Institute CIRAD (<https://camelides.cirad.fr>), I was even challenged by the French Academy who asked me the origin of this neologism of which I have claimed the authorship as now indicated by the online encyclopedia Wikipedia (<https://fr.wikipedia.org/wiki/Camelologie>)! And that’s how I became a bit like the father of world camelology!

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