

# TUAREG ETHNODIAGNOSTIC SKILL OF CAMEL DISEASES IN AGADEZ AREA (NIGER)

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## ABSTRACT

For generations, nomad herders have been learning to manage herd health, particularly in dromedary because of its high value. They have thus acquired a very comprehensive knowledge of camel's illness signs and have developed their own nomenclature. The present study aims at the description, scientific identification and recognition of this ethnoveterinary knowledge by means of an investigation carried out in Tuareg populations living in the neighbourhoods of Agadez (Niger). The dominant pathologies cited by herders for being the most alarming are gastro-intestinal helminthiasis (*izni*), camel calf diarrhoea (*efay*), tick infestations of camel calves (*igardan*), camel pox (*erk eshik*), sarcoptic mange (*ajud*) and broncho-pneumonia (*toza*). Poorly identified nosologic entities are also reported.

**Key-words:** Agadez, camel disease, diagnostic, ethnoveterinary, Tuareg

In Niger, where climate is of the sahelian type on the major part of the country, one-humped camel breeding populations are mainly Tuaregs, Tubus and Arabs. This activity is primarily turned towards dairy production for family consumption, although meat consumption is not negligible in town populations. In pastoral populations, the dromedary, from its high commercial value, represents a true capital which is advisable to preciously preserve. For generations herders have been learning by themselves how to manage their herds and the poor natural resources they dispose of. Moreover, the veterinary support from public or private sector is very weak, or, in most of the time, completely absent. They thus have been developing a great expertise on camel diseases, diagnosis, consequences, prevention as well as their treatments by traditional pharmacopeia.

Within the framework of projects for livestock development in remote areas, this ethnoveterinary knowledge and its valorisation are of the greatest importance. It is essential that these are taken in consideration by professional veterinary services for mutual comprehension and thus for adaptation and consequently effective integration of the modern veterinary medicine as a development factor.

The present article aims at describing the Tuareg vision of camel diseases by means of a list of vernacular pathological entities, briefly described, which will be compared with the currently known scientific entities.

## Materials and Methods

### Survey

The survey was held from November 2003 to January 2004, corresponding to the beginning of the cold dry season. It was mainly implemented through open discussions with herders taking part in the milk collection circuit organised for the dairy plant *Azla Saveur*, with its manager playing the role of introducer and translator. These discussions were repeated several times during the two and a half months of the stay, thus making it possible to set up the necessary confidence and to let appear some important details needing further thinkings, and if necessary, to confront herders with assumptions from each other. Herders of other zones, passing through Agadez, were also questioned.

The questions asked related to the camel diseases having the greatest importance to them, whether because of their frequency or gravity, were systematically the following: symptoms and their evolution, possible seasonality, preferentially affected age groups, traditional treatments, effectiveness of those, and their personal interpretations for the causes of these diseases. Less important disorders were also indexed or spontaneously cited by inquired herders thus making it possible to have a more comprehensive overview of the subject.

Twenty five Tuareg herders participated to the survey. Those taking part in milk collection lived in

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40 km circle around Agadez, the closest being located at 7 km in the west to the city, in the camp of *Ekirkiwi*. The other camps were named *Urey*, at 9 km in the west, *Kurbubu*, at 25 km in the west, *Tiffayan Inyal*, at 38 km in south-east, and *Tassakh n Talamt*, at 8 km in the east. They practised "micro - nomadism", their displacements during the year being done only within a distance between 5 to 10 km. The herders of *Tiffayan Inyal* camp were however likely to practise greater displacements, going up to 50 km in direction of the South during the dry hot season (from June to the end of July). The other herders originated from more distant zones such as Timia (2 herders), oasis located at 220 km in the north-east of Agadez, or Arlit (*Tamesna* zone), a mining city located at approximately 230 km in the north-north-west of Agadez.

In these populations, there was no traditional animal health's specialist. Thus, each herder had a rather complete knowledge of the question and practised himself ethnoveterinary medicine. However, certain herders were recognised as particularly skilled in some "surgical" interventions.

## Results

Results are presented by a short description of diseases under their Tuareg denominations. The vernacular nosologic entities are gathered into the following groups: generalised, cutaneous, respiratory, digestive, locomotor and nervous disorders, localised lesions and intoxications. Within each group, entities are presented by order of importance reported by the herders.

### General disorders

***Izni***: Two distinct syndromes are gathered under this denomination.

The first, with a chronic course, consists of a marked slimming with anorexia. It is attributed by Tuaregs to malnutrition. Absorption of stagnated water and plants close to water points are another invoked cause for this illness. The herders frequently expressed the idea that this form of *izni* underlies all the other diseases which benefitted from the weakness of the animal. Sometimes, a greenish foul-smelling diarrhoea is said to occur.

The second is an acute exhaustion syndrome. The affected animal stays alone, lies down, snivels and has a rough hair. The suspected cause is overwork of untrained camels.

*Izni* means blood in Tuareg language (tamashek). The herders explain that this disease, whatever its form, is actually due to an "overload in bad blood". Bleeding is thus the usual traditional treatment.

***Tataryat***: This is a lethal affection leading classically to death in 3 days. The cure is however possible. The symptoms are exhaustion, lying down with the neck in extension and whimpering. Some herders mentioned a swelling of the head (throat region) and of the sternal pad.

***Tandar***: This term means brutal death. Cadavers are characterised by rapid swelling and putrefaction and by dark blood oozing from natural body openings. Herders regard it rather as a small ruminant disease which can sometimes affect dromedary, contrary to *tataryat* which is specific to the latter.

***Menchach***: This disorder is characterised by a severe slimming leading to emaciation and death. Appetite is preserved and the disease, sometime lasting for several years, extends over a much longer period of time than in the case of *izni*. These features enable herders to distinguish *menchach* from the latter. Tuaregs report that affected camel hairs are easily detached with the hand. The urine odour is also cited to be characteristic. The disease is apparently better known by herders living in *Tiffayan Inyal* because of their annual migration towards the South where the disease is said to be more frequent. According to all the herders, it does not have a considerable importance in Agadez area.

### Cutaneous disorders and external parasitism

***Ajud***: Herders describe it as a highly contagious condition characterised by irregular depilation with severe pruritus. Lesions usually begin at the head and between hind legs. The general state of the affected animal can remain very good. Deteriorations or even death can however occur, being the consequence of secondary infections. A possible anthrozoönotic feature was not confirmed by herders. Cases are reported as most frequent during the cold dry season, when contagion occurs most easily because of the animal gathering.

***Erk eshik***: *Erk eshik* is described as nodules evolving to crusty lesions on lips and eyelids with a tendency to spread. Secondary infections are not rare. Rapid contagion and high mortality place it among the most important constraints to camel rearing reported by Tuaregs. They suspect an intervention of thorn-bushes (*Acacia spp*) in transmission of this illness. Young animals between 2 and 5 years old are more

frequently affected. Adults can however be affected. During cold dry season, the observed cases are particularly serious. Surprisingly, this disease, cited by Tuaregs from Agadez as one of the most important constraints to camel rearing, is unknown in *Tamesna* region.

***Igardan, Igarmel, Tissulluf***: These are the names given to ticks. It should be noted that all the ticks collected during this survey belonged to the same species: *Hyalomma dromedarii*. Although this can be due to season, it has been here proposed that *igardan* corresponds to the nymph of this species, *igarmel* to the bloodfed adult female and *tissulluf* to the adult male and fasting female. Only massive infestations of camel calves by *igardan* are perceived as pathological by herders, causing nervous symptoms such as weakness, ataxia, wry necks and flaccid paralysis. Herders also describe a bond between ticks infestations and camel calf diarrhoea, these conditions being suspected to act as a predisposing factor of each other.

***Akare***: The described lesions are close to *erkeshik* but in this case they are limited to the lips and the nodules are smaller. There is no reported mortality. *Akare* is thus actually a less violent disease than *erkeshik* but it is still very contagious. Herders also suspected a role of thorn-bushes in transmission. Animals between 6 months and 2 years old are more frequently affected.

***Tafore***: It consists of a multifocal depilation with little or no pruritus, no tendency to generalisation and no epidemic aspect in the herd. These features make it possible to the herders to clearly differentiate it from *ajud*. *Tafore* affects more often young camels. Some herders suspect "retained" milk ingestion to be a triggering factor, i.e. when a calf suckles again after absence of his mother for more than one day.

***Worsadas***: This is a cutaneous, hot and painful swelling localised at any place on the body but more frequently in the neck. These swellings break spontaneously releasing pus creating new lesions on its way. Tuaregs describe that transmission between individuals occurs by direct contact with the pus or by means of inanimate vectors (saddles, trees). Lesions have moreover a tendency to spread out, sometimes resulting in the fall of large shreds of skin. It is thus a potentially serious disease. The period of higher incidence is the end of rainy season.

### **Respiratory disorders**

***Toza***: This term means cough. It indicates a very contagious condition with bilateral nasal discharge

followed by anorexia and weight loss. The affected camel shows fever for an apparently constant period of 7 days at the end of which cure or death occur. Even if cured, the animal remains "tired" for the following months. In addition to this syndrome, another type of cough, less significant than the first, is reported. It consists of a dry cough which is less contagious and of longer evolution.

***Elishlash***: This term means nasal discharge. It sometimes indicates a fatal disease characterised by unilateral or bilateral discharge, at first muco-purulent and later containing blood and necrotised tissues. It is accompanied by anorexia and severe dyspnoea, with the animal holding its neck in extension, followed by emaciation and death. A less dramatic condition is also reported under this name. Herders then just describe a prolonged nasal discharge. Dyspnea can sometimes occur due to obstruction of the nostrils by purulent solidified discharge.

***Anafad***: *Anafad* indicates one or several hard, hot and painful swellings localised on the top of the head. Nasal discharge is classically also described. In some cases, the herders also report a unilateral or bilateral exophthalmos developing gradually until becoming extremely severe and resulting in ocular proptosis. The affected animal is feverish, anorexic, does not ruminate, lies down and "waits for its death". A herder presented exophthalmos as a consequence of *anafad* when no nasal discharge allowed cure. Others ensured that it could occur without swellings on the head but with nasal discharge.

***Tamne***: This is the name given by Tuaregs to the insect believed to be responsible for the laying of larvae in the nostrils of camels. This insect is actually a yellow and green striped hymenoptera presenting a tendency to approach human and animal eyes. Herders did not recognize the specimens of *Cephalopina titillator* which were presented to them (specimens were obtained by culture of larvae collected at the slaughter-house).

### **Digestive disorders**

***Efay* (or *touffite*)**: *Efay* means diarrhoea, the most important being camel calf diarrhoea. It is frequently quoted as the first, or the second cause of camel calf mortality after *igardan*.

***Tadanan***: In this disease, the animal rolls on ground, struggles with obvious pain. These colics can cease rather quickly in benign cases or lead to death. Another name for this is *anannarha*.

## Locomotor and nervous disorders

**Lajuad**: This consists of rear limb paraparesis or brutal paraplegia. It occurs in old overweight camels and is potentially lethal. This name is also attributed to a brutal paraplegia reported in kids which is however not lethal. The affected kids recover their motricity but remain weak for the rest of their lives. A herder quotes a similar affection in 6 to 12 months old camel calves whose growth had been faster.

**Taras**: This is a paresis or paralysis affecting one limb. Muscle wasting occurs over less than 1 month and leads to the "death of the leg". Old overweight camels are particularly affected. Herders unanimously accuse the feeding behaviour of some dromedaries which stretch themselves exaggeratedly to reach the highest leaves of trees and thus carry all their weight on their rear quarter.

**Irziman**: This is a slow S-shaped deformation of the neck or simple stiffness without deformation. The associated pain is intense and the affected animal, which cannot lower its neck anymore, is obliged to lie down to crop. In absence of treatment, the camel usually dies. Herders also suspect the above described feeding behaviour to be the main cause.

**Madness**: The affected camel turns in circles and falls down or suddenly starts running straight on. Some herders believe this is attributable to the ingestion of toxic plants. Others accuse *izni*.

**Dendimi**: This condition is noticed at night when affected camels bump into trees. This vision disorder is typical for hot dry season.

## Local lesions

**Akurzukul (tafasas and zlitey)**: *Akurzukul* means swelling. Two types of swellings are described. The first is named *tafasas* and is located under the ear, behind the jaw. The second type is named *zlitey* and is located at the base of the neck, in front of the shoulder. The herders do assimilate these two diseases as a same phenomenon which can occur in two different parts of the body. Swelling is hard, hot and painful and it contains pus. It is accompanied by a light feverish state but does not present either contagion or mortality.

**Amanos**: It affects old or weakened camels and is characterised by two lesions. The first, located under the tongue, consist of a fusiform mass approximately 5 cm long which gradually hardens to become "similar to bone". The affected camel refuses to eat, first refusing complementation salt and then the other food. It then dies by starvation. The second lesion, at the sternal pad,

starts with an oozing crack and then degenerates into purulent wound with a nauseous odour.

**Awras**: This is a hard, hot swelling of the foot caused by traumatism by spines from *Acacia spp* or *Prosopis africana*. It is extremely painful and shows no tendency to cure. Subsequent weight loss can be serious. While *awras* lesions consist of hard tissues, cases with abscess formation are called *egges*.

**Goiter (no specific Tuareg name)**: A soft congenital (but evolutive) mass located at the top of the neck (10 cm under the jaw) was found on camel calves of two camps (*Ekirkiwi* and *Urey*). A clear viscous liquid was collected by puncture. Necropsy of an affected camel calf which died soon after birth revealed the swelling of the thyroid gland that had caused the total collapse of the trachea.

**Tadenak**: This word indicates an eye disease. Conjunctivae are red and swollen and the associated exophthalmos can be very serious. The lens becomes opacous, white or blue, causing blindness. The presence of a body resembling a nail is reported in the eyelids spacing by the herders. The withdrawal with a razor blade of this body constitutes one of the possible treatments of this affection. Herders explain that several cases often occur at the same time but that this is not due to real contagion.

**Tafadi**: This is a saddle sore. Possible complications of the wound by myiases (emitting a very strong odour) and secondary infections can lead to death. Birds are also reported to worsen saddle sores.

**Tarkaa**: Tuareg herders use to say: "*Tarkaa* damages milk and kills the udder". The described gangrenous mastitis leads to black drying of the whole udder. Inguinal lymph node abscess and purulent discharges on the affected udder are common features.

**Tasrawin**: This is the name given to an excessive development of the jugal papilla. This is a painful disorder and the affected camel presents mastication difficulties. The papilla is approximately 4 cm long and it bleeds abundantly if lacerated during mastication. Recurrences after excision are possible.

## Intoxications

**Asolof**: *Asolof* is a stinging caterpillar found on acacias (*A. raddiana*) during the rainy season. Its ingestion is believed by herders to be responsible for abortions in camels. The expulsion of the foetus is often followed by a uterine prolapse. The herders accuse a reaction of "irritation" of the uterus, "similar to that felt by skin contact with the caterpillar's hairs".

**Salt intoxication:** The described symptoms are sternal recumbency, arumination, a hanging lower lip, sialorrhoea and greenish diarrhoea. No convulsion was reported. This type of intoxication occurs when an animal has free access to the complementation salt.

## Discussion

### Identified vernacular disorders

The following traditionally described disorders are clearly comparable to scientific nosologic entities, the etiology of these being known or not.

*Ajud* most probably corresponds to sarcoptic mange (*Sarcoptes scabiei* var. *cameli*).

*Erk eshik* corresponds to camelpox (*Orthopoxvirus* var. *cameli*), in the transmission of which herders suspect the implication of the thorn-bushes such as it is also reported in the literature (Wernery and Kaaden, 2002). However, a particularly severe form of this one is said by Tuaregs to occur during cold dry season, which is opposed to literature which reports an attenuation of the clinical expression in dry season (Faye, 1997; Wernery and Kaaden, 2002, Al-Ani, 2004). It is worth noting that *akare*, reported as a similar but less serious condition could gather under this name some cases of contagious ecthyma (*Parapoxvirus*), papillomatosis and more benign forms of camelpox.

In the same way, *tafore* seems to designate dermatophytosis, which is thus well identified by herders. However, the generalised form could be misclassified under the denomination of *ajud* (sarcoptic mange), this classification being done according to the extension of the lesions.

*Anafad* is a sinusitis, which confirms the results of a previous study done by Ag Arya (1998) in Tchintabaraden (Niger). However, in another similar study, Mahaman (1979) described under a similar name (*nafed*) a superficial abscess localised at the poll.

*Tadenak* is a keratoconjunctivitis. The reported epidemiologic image, i.e. the simultaneous appearance of several cases without real contagion, seems to implicate flies in the transmission of this condition, on the same way this is observed in bovine with *Moraxella bovis*. The presence of *Thelasia leesei* is not to draw aside despite none was actually found nor reported by Tuaregs in lachrymal glands.

*Tandar* is probably the name given to anthrax (*Bacillus anthracis*). Though Mustafa (1987) claims that

anthrax is of major importance in camel disease, comparable with that of haemonchosis or mange, Tuareg herders seem to affirm that the dromedary is relatively resistant to this disease, being small ruminants its usual victim.

*Tafadi* is a saddle wound prone to myiasis (possibly *Chrysomya bezziana* in accordance with the described nauseous odour of the wound).

*Tafasas* and *zlitey* seem to be a lymphadenitis (*Corynebacterium pseudotuberculosis*) with its two principal localisations (mandibular and lower cervical lymph nodes). However, Tuareg herders describe a hot and painful swelling whereas cold and painless abscesses are reported to be pathognomonic in the literature (Domenech *et al*, 1977).

*Efay* (diarrhoea) and *igardan* (tick infestation) are the two major camel neonatal diseases. On this subject, it should be noted that the questioned herders do distribute the colostrum to camel calves, whatever the birth season, being conscious of the importance of this practice.

By establishing a link between these two conditions, one predisposing the animal to suffer from the other, Tuaregs show the great accuracy of their observations. It is also worth noting the reported importance of tick paralysis.

*Worsadas* corresponds to contagious skin necrosis. Its etiology is variable: dermatophilosis, corynebacteriosis, staphylococcosis (Domenech *et al*, 1977; Faye, 1997; Wernery and Kaaden, 2002).

*Dendimi* is a nyctalopia (night blindness) probably due to vitamin A deficiency (Pacholek *et al*, 1999). This assumption is supported by the increased morbidity observed during the end of the hot dry season when food becomes scarce.

*Menchach* is trypanosomosis (*Trypanosoma evansi*). The illness signs quoted by the herders in this investigation, namely the urine odour and the easy pulling up of the hairs, are the same as those classically used by herders from the Horn of Africa (Ouhelli and Dakkak, 1987; Kölher-Rollefson *et al*, 2001; Dirie and Abdurahman, 2003). The low frequency of this disease in the area established by a serologic study (Pacholek *et al*, 2000) confirms the Tuareg herders' allegations.

### Poorly identified vernacular disorders

These traditionally described conditions do not correspond to precise scientific entities, leaving, in the absence of further investigations, their interpretation at the stage of differential diagnosis.

## Symptomatologic denominations

Some reported denomination just indicates the dominating symptom, thus potentially gathering under the same vernacular noun many different diseases. So is the case for *toza* (cough), for *elishlash* (nasal discharge) for *tadanan* (colics), for *irziman* (wry neck), and for "madness".

About the latter, various neurologic causes are possible, such as meningitis or meningoencephalitis, caused by perforation of the ethmoid bone by the larvae of *Cephalopina titillator* or by propagation of a secondary infection by tissue continuity and/or contiguity, vitamin B1 deficiency or rabies. Herders report indeed cases of madness to occur after a mad dog bite. Similarly, wry neck is certainly a consequence of nervous or musculoskeletal disorders of different natures such as tetanus, ticks paralysis, meningitis, vitamin B1 deficiency or myositis (Dioli and Stimmelmayer, 1992; Faye, 1997; Dirie and Abdurahman, 2003; Al-Ani, 2004).

In terms of respiratory diseases, *toza* and *elishlash* are currently used to express cough and nasal discharge, respectively. However, syndromes of great importance are often clearly indicated under these general denominations.

*Toza* is described as a strongly invalidating and potentially lethal condition affecting adult camels. It seems to be an infectious bronchopneumonia. This disease comes thus out from this investigation as being a major constraint of pastoral herding in Niger. The concept of an acute evolution in 7 days is also present in the study of Mahaman (1979). This author along with others has incriminated *Pasteurella multocida* as the etiologic agent in such severe cases (Mahaman, 1979; Tesfaye, 1996; Faye, 1997; Yigezu *et al*, 1997). These affections are however to regard as multifactorial.

In the case of *elishlash*, a particular necrotising and lethal form is reported by Tuaregs. The isolation of *Streptococcus equi zooepidemicus serotype 2* in a similar case of necrotising rhinitis is reported in the literature (Ibrahim *et al*, 1998). The possibility of an intervention of *Cephalopina titillator* larvae in the development of such affections remains open.

## Poorly identified syndromes

Some syndromes are identified by herders as a single and independent entity and are clearly differentiated from other disorders with identical dominant symptoms. These conditions could thus potentially correspond to precise diseases, but their

scientific interpretation remains unclear. It is the case of *izni*, *tataryat*, *taras* and *lajuad*.

*Izni* constitutes a particular case since this denomination gathers two types of syndromes, one of acute type and the other of chronic evolution, with the suspected cause, an overload in bad blood, being the same in both cases. This denomination is thus given according to the supposed etiology, like in the case of *tamne* (camel nasal botfly) and *asolof* (abortions by intoxication by a caterpillar living in acacias). It should be noted that if in the case of *asolof* the etiology has not been scientifically checked, in the case of *tamne* it has been shown during this investigation that the insect accused by the herders was not *Cephalopina titillator*.

Concerning the chronic form of *izni*, in a general way, the differential diagnosis of cachexy can safely be reduced to gastro-intestinal helminthiasis and trypanosomosis. The latter is however a well-identified disease (referred as *menchach*), clearly distinguished from *izni*. Moreover, the success of ivermectin treatments supports the idea that most *izni* cases are gastro-intestinal helminthiasis, which is in complete agreement with the causes invoked here. Pacholek *et al* (2000) also translated the word *izni* by gastro-intestinal helminthiasis. This *izni* chronic form can thus rather be classified among scientifically well-identified syndromes.

The stagnated water hypothesis could nevertheless indicate some cases of *Salmonella* spp infections such as reported by Cheyne *et al* (1977). It could thus correspond to the reported cases of *izni* with acute enteritis and severe foul-smelling diarrhea (Cheyne *et al*, 1977; Pegram and Tareke, 1981; Faye, 1997; Wernery and Kaaden, 2002). The herders' classification of this acute ailment under *izni* chronic form could be explained by the prolonged duration of diarrhea in absence of antibiotic treatments leading to emaciation or by the absence of obvious exhaustion syndrome which is actually the Tuareg basic definition of *izni* acute form.

*Izni* acute form is the only form identified under the name of *izni (ezzini)* by Mahaman (1979). This last author evoked, besides the symptoms described here, congestive mucous membranes and a phase of excitation followed by coma. He proposed within sight of these last signs a heat stroke syndrome and possible anthrax cases. These clinical data, as well as the association of the beginning of the disease with stress (brutal effort, malnutrition, helminthiasis), incites to consider salmonellosis and pasteurellosis in the differential diagnosis.

Ag Arya (1998) also reported a disorder called *azni*. In his study, even though the syndrome itself is not described, different etiologies are discussed. About the overwork Tuaregs' hypothesis, he proposed an energy metabolism disorder occurring in muscle fibres. This proposal is interesting since a condition similar to equine exertional myopathy was reported in camel (Higgins, 1986; Kölher-Rollefson *et al*, 2001; Wernery and Kaaden, 2002). For the stagnated water hypothesis, he suggested parasite infestations and quoted the argument given by the efficacy of treatment by plants known for their anti-parasite virtues.

Another acute exhaustion syndrome was referred by the Tuaregs by the name of *tataryat*. This syndrome, which is close to *izni* acute form, is however differentiated from it by the swelling of the throat region and the in-three-days death pattern. The differential diagnosis of *tataryat* is thus the same as for *izni* acute form, i.e. pasteurellosis, acute haemonchosis, salmonellosis, anthrax, blackleg and enterotoxemia. However, the described particular signs point preferentially to acute haemonchosis and hemorrhagic septicaemia (pasteurellosis) (Chauhan *et al*, 1986; Higgins, 1986; Momin *et al*, 1987; Dioli and Stimmelmayer, 1992).

The existence in the dromedary of septicemic pasteurellosis, similar to that present in the bovine, is however controversial (Wernery and Kaaden, 2002). The various hemorrhagic lesions, severe pneumonia, a normal aspect of the spleen and the absence of blood oozing from natural body openings observed at necropsies of the supposed cases carried out by official veterinary services could nevertheless corroborate this assumption. The last argument used by official services to attest presence of pasteurellosis in the area is the observed effectiveness of the vaccination campaigns led in Tchén-Tabaraden. This argument of vaccine effectiveness is also reported in the literature (Hassan and Mustafa, 1985; Momin *et al*, 1987). In conclusion, although nothing can be ascertained on simple basis of testimonies, lack of clear data and the possible confusion between pasteurellosis and anthrax (Wernery and Kaaden, 2002), it could be possible that pasteurellosis has in this zone a certain importance as Wernery and Kaaden (2002) reported it for zones with similar climatic conditions (Chad, Sudan, Mauritania and Sahara). Bacteriological studies could allow a confirmation.

About *taras* (one limb paresis/paralysis), the extreme legs' extension and unusual positions of the dromedaries while eating, as reported by herders,

could indeed provoke losses of balance or wrong movements with elongation of muscles and sciatic or femoral nerves. Such peripheral nerve injuries are indeed plausible given the fast muscular waste quoted. The usual differential diagnosis has however to be considered (Mayhew, 1989a).

For brutal paraplegia as observed in *lajuad*, among the general differential diagnosis proposed by Mayhew (1989b), the most probable causes are nutritional deficiencies and plant poisoning, although parasites are interesting to consider since those are known to cause myositis, myelitis or thrombosis.

Among nutritional causes, cases of myopathy caused by a vit E/Se deficiency were already reported in camel in Morocco, United Arab Emirates and Oman (Faye, 1997; Al-Ani, 2004). It is however worth mentioning that young stocks are classically affected. Magnesium deficiency induced paralysis, reversible by magnesia salt supplementation, are also reported in India by Faye (1997). Kraff disease, which seems associated with phosphorus deficiency, is characterised by disorders of the bone tissue metabolism such as exostosis, spontaneous fractures and paralysis (Curasson, 1947; Faye, 1997).

Plant poisoning was suspected by some herders. At this subject, *Tribulus terrestris*, which is present in this area, is reported to cause various locomotor symptoms (ataxia, paresis) in other species than camel (Mayhew, 1989b). *Capparis tomentosa*'s liability in hind quarter stiffness and paresis in camel is also reported in the literature (Dioli and Stimmelmayer, 1992; Kölher-Rollefson *et al*, 2001; Al-Ani, 2004).

### Lesions of unspecified etiology

The disorders belonging to this class are *amanos* (sublingual fibrous cord hyperplasia and crack of the sternal pad), *tasrawin* (jugal papilla development/congestion) and the congenital goiter of *Ekirkiwi*.

The histopathologic analysis of a sample of hyperplasiated sublingual fibrous cord (*amanos*) taken at the time of a traditional surgical operation revealed a non-inflammatory hyperplasty of the mucous membrane which seemed otherwise healthy. Macroscopically, the sample presented indeed a fibrous aspect without other alteration. The assumptions in agreement with these microscopic and macroscopic images are those of a benign tumoral phenomenon or of a hyperplasty related to chronic irritation. With regard to the first assumption, a calcifying fibromatous process could make it possible to explain the osseous aspect unanimously reported

by the herders. The description reported by Ag Arya (1998) does not provide more precision since a simple crack of the sternal pad and a sublingual "wound" are described. The name by which this one indicated the disease was *awininak*. *Amanos* term was also quoted by this author to indicate a different disease (foot wound), also named *adyal*.

Concerning the goitre etiology, it is probably a multifactorial disease having for basis a genetic predisposition related to the consanguinity which could be suspected by some aspects of herd management, the two involved camps using the same reproductive males. This condition had been present in these camps for 4 years and incidence had increased through years. Considering iodine deficiency, a particular poverty of the grounds in the study area is possible. The salt used for animal complementation is on the other hand the same as in the unaffected camps. The particular abundance on these camps of *Showwia thebaïca* (*alwad*), a *Brassicaceae*, has to be mentioned because of the known anti-thyroid factor content of this plant family. Al-Ani (2004) also reported cases in Niger which he attributes to ingestion of *Brassica spp.* Another case report in adult camels was made in Darfur in Sudan and is attributed to iodine deficiency (Tageldin *et al*, 1985). A report of neonatal cases was made in North America (Decker *et al*, 1979).

## Conclusion

This investigation shows, by the accuracy of the reported observations and the correspondence between many vernacular and scientific nosologic entities, the great expertise in animal health disorders developed by the pastoral herders. They indeed achieve to incorporate epidemiologic data, species specificity and supposed etiology together with symptoms in their diagnostic approach. However, the recognition of the diseases done on the basis of symptoms causes that a scientific nosologic entity with a polymorphic clinical expression can be classified under various traditional denominations. As a precaution, the field veterinary surgeons should always take these vernacular denominations as differential diagnosis and not a precise scientific entity. However, since many veterinary diagnosis are essentially clinical or anamnestic, the opinion of a well-trained herder is thus of great value. Notwithstanding these possible divergences between veterinary medicine and ethnoveterinary knowledge, the latter remains an interesting basis for discussion between pastoral herders and animal health agents. It is thus imperative for these health agents to have a good knowledge of ethnoveterinary medicine so that mutual

comprehension can be achieved allowing an effective collaboration. Implementing this type of investigation is also interesting as it gives a general picture of the animal health status in a given breeding system as well as it highlights some disorders that are little or not reported in the literature such as *amanos*, goiter, *tasrawin*, abortions by caterpillars intoxications (*asolof*), kerato-conjunctivitis (*tadenak*) and sinusitis (*anafad*) and their spectacular evolutions (eyeball expulsion), tick paralysis (*igardan*) as well as the paresis and paralysis of the rear limbs (*lajuad* and *taras*). All these diseases should be further investigated.

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### Some endotoxin induced clinical and biochemical changes in plasma of camels (*Camelus dromedarius*)

Intravenous administration of endotoxin prepared from *E.coli* serotype 055:B5, at a dose of 0.1 mg/kg body weight to calves and adult camels induced fever and increased haematocrit, triiodothyronine and cortisol values. The endotoxin treated animals showed significantly decreased ( $p < 0.05$ ) total protein, urea, glucose and creatinine. A significant increase was seen in the activity of aspartate aminotransaminase and creatine kinase. These results demonstrate high sensitivity of camels to endotoxin.

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