**Dromedaries: no longer welcome in Europe?**

**Comment on the Dutch domestic and hobby animals list**

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**Abstract**

*Introduction:* The Dutch government has recently established a “positive” list of domestic and hobby animals. To avoid unacceptable risks to human and animal welfare, animals that are not on the “positive” list can no longer be kept in the Netherlands as from January 1st, 2024. Because this country is at the forefront of animal welfare legislation, there is a good chance that other European countries will follow.

The dromedary was excluded from the list because this species was considered to be insufficiently domesticated. Other arguments that were put forward are related to its zoonotic potential (Middle East Respiratory Syndrome; MERS), its capacity to inflict physical harm to humans and health risks for the animal itself.

Because these conclusions are counterintuitive and allegedly based on misinterpretation of the scientific literature we performed a thorough evaluation.

*Methods*

Collection and critical examination of relevant scientific literature on this topic including the publications that were referred to in the assessment of the Dutch government.

*Results.*

There are serious flaws in the assessment of the dromedary. Based on the scientific literature it is beyond any doubt that after more than 5000 years the dromedary is in an advanced state of domestication which is confirmed by analysis of its genome.

Dromedaries can indeed transmit MERS, a disease with a high case fatality ratio, but MERS cannot be judged as a “very high-risk zoonosis”, because its spread can be easily controlled. The risk of personal injury corresponds to the socially acceptable risk of other large domestic mammals. Taking into account the specific characteristics of dromedaries, no significant risks for animal health were identified.

*Conclusions.* The assessment of the dromedary as carried out on behalf of the Dutch government lacks scientific rigour. There are insufficient grounds for excluding this species from the “positive" list of domestic and hobby animals and we hope that our analysis will lead to a correction of this error. Other countries should take lessons from the way in which the Dutch positive list was established.

Keywords: Dromedary. Domestication. Animal welfare. Domestic animal. Hobby animal.

**Introduction**

Camels are conquering the world1, with the exception of the Netherlands.

On July 6th 2022, the Dutch Minister of Agriculture, Nature and Food Quality published a “positive” list of mammals that can be kept as domestic or hobby animals2. Keeping animals that are not on the list will not be allowed anymore from January 1st 2024 onwards. It seems likely that similar legislation will soon apply in other EU countries3 as well.

Animals that are not on the positive list may not be used for production purposes either. Therefore dromedary dairies will have to stop their activities. This means the end of a thriving European agricultural industry characterized by very low ammonia emission (only 10% of that of cows4), sustainability5 and innovation6.

The purported objective of the list is “to regulate the keeping of animal species as domestic or hobby animals, by prescribing which animal species can be kept as domestic or hobby animals according to the risk of the various animal species on the impairment of animal welfare or of danger to humans or animals”7.

In order to establish the positive list, an independent committee of experts has formulated an assessment framework. Based on this framework another independent committee (referred to as the “advisory college”), assessed 300 different mammal species, and advised which mammals can be placed on the positive list.. It is foreseen that the same framework will also be used later to assess birds, reptiles and amphibians7.

The advisory college understandably recommended to admit all animal species to the positive list which are at an advanced stage of domestication, even if they are associated with hazards in several risk categories for human or animal health. Non-domesticated animals can only be admitted if they represent hazards for human and animal health in at most three risk categories7.

The dromedary was not admitted to the positive list, because this species was not considered to be (sufficiently) domesticated. It was also argued that the dromedary may spread Middle East Respiratory Syndrome (MERS) via a contamination route that cannot be controlled and because the dromedary may cause severe personal injury. In addition to these risks for human health, also risks were identified in three risk categories for animal health7.

Because the conclusions of the advisory college are rather counterintuitive we suspected that they were based on a misinterpretation of the scientific literature and/or lack of specific expertise. We therefore decided to perform a more thorough evaluation.

**Methods:**

Collection and critical examination of relevant scientific literature on the biology of the dromedary including the publications that were referred to in the assessment by the advisory committee, summarized in table 1.

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| --- | --- |
| Risk | Explanation |
| Domestication | Dromedaries are at an early stage in the domestication process and cannot be considered domesticated yet8,9. |
| Danger to humans (zoonoses) | The very high-risk zoonotic pathogen MERS10,11 has been demonstrated in the dromedary, which puts the dromedary directly under risk class F\*. In addition, the high-risk zoonotic pathogens rabies virus12-14; Rift Valley fever virus15); Brucella abortion, B. meletensis15, Chlamydia abortion16, Leptospira interrogans17 and Mycobacterium bovis18-20are demonstrated |
| Danger to humans (personal injury) | With dromedaries there is a risk of very serious injury to humans, as a result of which the dromedary falls directly under risk class F. The dromedary weighs 400-600 kg21. During the rutting season, males behave more aggressively, and can attack humans by biting, for example. This can lead to fatal injuries21,22. Given the size and behaviour of dromedaries, they can cause very serious injury to humans, placing the dromedary directly under risk class F\*. |
| Food intake | The dromedary has hypsodont molars23,24. Dromedaries forage 8-12 hours a day and spend rest periods to chew the cud24. Dromedaries live in (semi-)arid areas25, where food and water are limited26,27, which means that they cover great distances, up to about 50-70 km per day28.  Dromedaries forage for 8-12 hours a day and spend rest periods ruminating24. Dromedaries live in (semi-)arid areas21, where food and water are limited26,29. as a result of which they travel great distances, up to about 50-70 km per day28. These risk factors therefore applies. |
| Thermoregulation | Dromedaries live in a dry tropical and subtropical climate21,30. In the dry tropical and subtropical climate, with few regional exceptions, the average monthly temperature is above 10 °C throughout the year. In some areas, the average monthly temperature of the coldest month falls to 5 °C. During 5-12 months of the year, the average temperature is above 18 °C. The average annual precipitation varies, but is up to 500 mm. The dromedary is very sensitive to humidity21, which prevents pneumonia29. The dromedary is adapted to a dry tropical and subtropical climate. This risk factor therefore applies. |
| Social behaviour | Dromedaries live in herds of only females, only males, a mixed population or solitary. In the most common structure, herds with one male and several females, the male leads the herd and guards the females against competing males. There is a despotic dominance hierarchy24,31. This risk factor therefore applies. |

Table 1. Summary of risks that the dromedary poses for human and animal safety and health, according to the advisory college for the pets and hobby animal list32. \*Keeping specimens of animal species in risk class F poses a high risk to people's health.

**Results:**

*Domestication.*

The wild ancestor of the dromedary became extinct 4-5 millennia ago33 and thus the dromedary is by definition domesticated34. However, according to the advisory college the dromedary cannot be considered to be sufficiently domesticated yet. This decision was based on the publications of Fitak et al.8 and Alaskar et al.9

It appears that these publications were not interpreted correctly:

In the study of Fitak et al.8 the following sentence in the introduction may have led to a misunderstanding: “ *In essence, domestic Old World camels represent features of the “initial stages” of the domestication process, which were primarily focused on the selection for tameness and docility*”. However, this sentence merely reflects the fact that dromedaries (and camels) have maintained a rather high genetic variability, because the selection pressure to which they were submitted was mainly limited to tameness and docility35, whereas many other domesticated animal species were also selected for additional positive traits such as milk or meat production, which led to a secondary bottleneck with concomitant reduced genetic variability. Another element that contributed to the relatively high genetic variability is the fact that dromedaries were used for transport purposes which facilitated genetic exchange between different populations. Obviously, this does not occur to a large extent with animals that are confined to a much more restricted habitat such as cows, pigs, dogs, etc. From a safety perspective, however, there is no reason to assume that such domesticated animals with a limited gene pool would pose a smaller risk to their environment. What matters is whether traits like tameness and docility are strongly embedded in the genome, which is certainly also the case for the dromedary (as shown in the same publication by Fitak et al.8).

The advisory college also referred to a publication of Alaskar et al.9, but the scientific relevance in this context is not obvious except perhaps for a remark that the domestication process of the dromedary is a recent event. It is true that it started somewhat later than that of the camel and horse for instance, but 4000-5000 years should still be regarded as quite a large time span (and more than sufficient to allow for thorough selection of animals with suitable behaviour).

Subsequently there is no doubt that the dromedary should be regarded as a domesticated animal. After more than 4000 years its state of domestication is advanced and is similar to that of, for instance, the Bactrian camel, a species that was not excluded from the list.

*Risks for human and animal health.*

Middle East Respiratory Syndrome virus (MERS) is a serious zoonosis that can be transmitted from dromedaries to humans. Transmission from person to person hardly takes place, making it fairly easy to prevent the spread of the disease (for example, by the controlled culling of infected herds and the introduction of transport bans). As a result, the number of cases worldwide has been decreasing for years36. In the European Union, MERS does not occur and there is a ban on importing dromedaries from outside the EU, which means that the chance that MERS will be found in Europe is virtually nil. Consequently MERS is not a “very” high-risk zoonotic pathogen, as considered by the advisory college, but just a high-risk pathogen, like the other zoonotic pathogens identified in dromedaries (table 1).

The risk of dromedaries causing personal injury to humans25 is comparable to that of other large, domesticated animals such as horses and cows. The advisory college considered this rightly to be socially acceptable in domesticated animals.

*Risks for animal health.*

Contrary to the advisory college (table 1) we did not find substantial risks in the categories for animal health.

In the *food intake* risk category, the identified risk factor "hypsodontic molars", does not play a role, because the characteristic lifelong growth of teeth and molars, as for example in rabbits, is absent in dromedaries, because they sand and grind their teeth for 8-12 hours a day24. The other risk factor "long-term foraging" is not applicable either for the dromedary in Europe. Although dromedaries forage for 8-12 hours a day, they do not have to travel long distances for water and food in Europe.

The risk category *thermoregulation* is not relevant for dromedaries as they are known for their very strong adaptation ability and remarkably good thermoregulation37. Although dromedaries were considered to be sensitive to humidity, predisposing to pneumonia24, pneumonia in dromedaries is no more common than in other large farming animals such as horses and cows, according to consulted veterinarians (Peter Klaver and Roland van Riel; personal communication)

Within the risk category *of social behaviour*, the despotic dominance hierarchy present in dromedaries24 plays a favorable role, except when several male dromedaries are in the vicinity of adult female dromedaries during the rutting period (which is prevented by appropriate herd management). Therefore this risk category is not applicable either.

**Conclusion.**

The scientific literature that was used to assess the dromedary with respect to its domestication status and the risk of MERS spread were not interpreted correctly. It also appears that the specific properties of the dromedary were not taken into account to adequately evaluate the risk categories for animal health. Consequently the dromedary deserves a place on the pets and hobby animals list. It is advisable that other countries3 take lessons from the way in which the Dutch list was established.

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