

CAMEL MANUAL FOR SERVICE PROVIDERS



INTRODUCTION

Chapter Authors: Ernest N. Mbogo, Christopher R. Field, Kisa Juma Ngeiywa, Khalif A. Abey

Kenya Camel Association
P.O. Box 6067 - 00100
Nairobi Kenya
Tel: +254 20 2731975
Email: kenya.camel@gmail.com

Kenya Agricultural Research Institute (KARI)
Kenya Arid and Semi-Arid Lands Research Programme (KASAL)
KARI Headquarters
P.O. Box 57811 - 00200
Tel: + 254 20 4183302 - 20, + 254 722 206986 - 88
Nairobi Kenya
Website: www.kari.org/kasal

Ministry of Livestock Development
ASAL Based Livestock and Rural Livelihood Support Project
(ALLPRO)
P.O. Box 34188 - 00100
Hill Plaza, Nairobi
Tel: +254 20 6751799
Fax: +254 20 2721001
Email: pc@allpro.go.ke

VSF Suisse
Regional Office - Nairobi
Olekejuado Road
P.O. Box 25656 - 00603 Nairobi - Kenya
Tel: +254 20 4343441
Fax: +254 20 4343442

Editorial Team:

Mario Younan, Ali Zaidi, Patrick Sikuku

Photos: Maurizio Dioli, Simon Kuria, Tura Isako, Chris Field, John Kihumba,
Piers Simpkin, Amos Adongo, Klaus Lorenz



A camel freely grazing on prickly pear (*Opuntia ficus-indica*) an exotic plant infesting large areas in the Horn of Africa.
(Source: Maurizio Dioli)

Why this manual?

In Kenya's arid lands, the majority of people are pastoralists who keep camels for a living. Camels provide them with milk, transport, meat, hides and, for some communities, also blood. From selling camel milk and other products, they get cash for other necessities of life. But while people who keep other livestock have been using modern treatment methods and veterinary drugs for a long time now, camel keeping has lagged behind and pastoralists are getting poorer. Poverty levels in the arid lands are said to be up to 70%.

Camel keepers report that their herds are no longer as healthy and productive as in the past. Somali, Gabbra and Rendille pastoralists say that in the old days, one female camel gave enough milk for four people; today, it only gives enough for two. This is because there is now less forage and what there is, is of poor quality, as repeated droughts dry up the rangelands, which are shrinking as the human population rises.

That means that herds are no longer growing as quickly as they used to, the calves also grow more slowly, take longer to reach physical maturity and have fewer calves in their turn. Due to higher camel population densities and more frequent contact between different herds, camels are also increasingly falling ill with poorly understood diseases like Swollen Glands/Hemorrhagic Septicaemia. They also no longer adapt as well to the harsh environment, perhaps because pastoral lifestyles are changing and becoming more sedentary – that is, they no longer move around as much as they used to.

Pastoralists say in the past camels could stay over 21 days without water but today can last no more than 14 days. These problems, among others, are partly a result of poor management of animal health, breeding and nutrition.

But, as the Hon Mohamed Kuti, Kenya's Minister of Livestock Development, said, the camel can be the animal of the future. It is uniquely adapted to the harsh conditions of the arid and semi-arid lands; its feeding habits mean it does not compete with other livestock, while it remains productive throughout the year. This is why camel keeping has spread to communities like the Maasai, Pokot, Samburu and others who traditionally kept only cattle and smaller livestock. Camel keeping is also spreading to countries like Tanzania, Botswana and recently to Uganda.

In the past, the government, universities, research centres, development organisations and others did not pay much attention to camel keeping; so many pastoralists felt they were being sidelined in development. When the Structural Adjustment Programmes began in the late 1980s, the government stopped employing animal health providers such as veterinarians and animal health assistants, which made the situation even worse. To fill the gap, NGOs and donor agencies began training Community Animal Health Workers (CAHWs) with a focus on cattle, sheep and goats; but there was still little interest in camels. This scenario is now changing fast and development workers in the arid and semi-arid regions of Kenya and beyond are beginning to understand the pivotal

CHAPTER 1

ORIGIN AND USES OF CAMELS

role of the camel. They realise that better management of their camels will greatly improve the livelihoods of pastoralists. But there are still many gaps in knowledge and communication among camel keepers, extension workers and others interested in camel development. This manual tries to bridge these gaps by providing a practical, quick field guide to camel management, health and products. It does not try to present all the existing knowledge and skills about camels; it is instead a simple and easy to read reference manual for hands-on users that can be carried around in the field. After all, in the remote and mobile situations where camels are kept, there are few sources of information and help on camels to turn to. The language used has been kept as simple and non-technical as possible (except when dealing with specific camel diseases, though local names of the diseases where known are included) so that even those with limited knowledge of English will hopefully find it useful. Illustrations and extension messages are included.

The manual is divided into five chapters. Chapter One describes the uses of the camel; Chapters Two, Three and Four look at camel management, camel health and camel products & marketing respectively. Chapter Five explores crosscutting issues affecting camel keepers such as gender, conflict, environment and HIV/AIDS and reflects on the future of camel keeping in Kenya.

For those who want more in-depth information, the manual can be used together with other reference materials, a list of some of which is provided at the end of the manual.

Who can use this manual?

The information contained in this manual includes the natural vegetation, traditional management practices, camel diseases and available treatments that can be found in arid Kenya. Camels in the lowlands of Ethiopia and in the whole of Somalia are kept in very similar environments and under comparable conditions. It is hoped that this manual will be of practical use to all those working with dromedary camels in the Greater Horn of Africa but also outside the region, wherever camels are kept to provide food and transport.

The manual is designed as both a quick hands-on reference and as a training tool to be used by veterinarians, animal health professionals and field trainers – government extension staff, NGOs, CBOs and others – to train Animal Health Assistants (AHAs), Camel Service Providers (CASPROs), Community Animal Health Workers (CAHWs), and others. It is also intended for use by literate, especially younger camel keepers who have limited or no access to camel specific information.

It is hoped the manual will be useful at four levels:

- Trainers of CASPROs, CAHWs and AHAs.
- The CASPROs and CAHWs themselves, who will be community based and conduct hands-on training for camel keepers in the village, camp or at the boma/pen-side.
- The camel keepers – many camel owners and in particular their children are literate and can use the manual to find solutions to their camel problems.
- The manual can also be useful as teaching material for beginners in camel keeping at primary, secondary and tertiary institutions of learning. With more school camel programmes and out of school learning, it is hoped that this manual will also reach educated youth in the pastoralist community.

Role and selection of CASPROs and CAHWs

CASPROs and CAHWs are multipurpose community workers with prior animal health training. Their main role is to:

- Provide a link between trainers, government line ministries, NGOs, CBOs, other stakeholders and the livestock/camel owners, by for example, translating and interpreting during community meetings.
- Deliver extension messages and share basic knowledge with livestock/camel keepers.
- Mobilise livestock/camel keepers in the community when needed.
- Report on livestock/camel diseases and take part in disease surveillance and control activities.
- Be part of the veterinary drug supply chain to livestock/camel keepers.

They should be:

- Preferably trained CAHWs and actively delivering animal health services before being trained in camel issues.
- Living among camel keepers and used to handling camels.
- Literate in English and/or Kiswahili and speak the language of the local community.
- Responsive to community priorities and aspirations.
- Motivated to make an income-generating career as a private service provider.
- Able to provide leadership and have the desire to serve the community and to train successors.
- Willing to share their knowledge with all members of the community without bias.

Undoubtedly, these qualities will not be easy to find in one person and in all communities. Such a person is quite likely to have employment already. However, it is our hope that this manual will reveal the full potential of the camel so that not only will its milk be regarded as the “white gold of the desert” but all its other qualities as well.



Adult females carrying water for the household. This is a very important method to increase herd productivity in marginal areas without destroying the environment. Households that are able to settle in areas far from watering points have access to better and more abundant fodder sources since these areas, being too far from water sources, cannot be utilized by other livestock species and are not overgrazed. (from Schwartz, H.J., Dioli, M., 1992).

1.1 Origin and domestication of camels

- Camel-like animals are thought to have originated from North America about 50-60 million years ago. Over the years, they evolved into two main types: The Bactrian camel, which has two humps and mainly lives in the cold deserts of China and Mongolia, and the dromedary, which is one-humped and is found in the hot deserts of Africa and the Middle East. The dromedary is the subject of this manual. It is thought that the dromedary was first domesticated in southern Arabia about 5,000 years ago. It is used for transport, as a beast of burden, and for meat, milk and hides and, in some communities, for its blood too.
- Camels can live for 40 years, but the productive lifespan is between 20 and 30 years.
- Camels have been used for long distance travel, for trade, exploration, and in the Colonial Police patrols to keep the peace in northern Kenya and

currently between India and Pakistan. As early as 1800 BC, trade routes from Asia and Africa crossed the Arabian Peninsula, with camel caravans carrying spices, incense, gold, ivory, and silk on their way to Europe and the lands of the Fertile Crescent

- In Kenya tour companies and some pastoralists train camels for trekking safaris. The dromedary has also been used for racing in Sudan and the Middle East for many years, and more recently in Kenya. Camels can run at up to 65 km an hour in short bursts and for long distances at speeds of up to 40 km/h.

1.2 Made for the desert: Why the dromedary camel is so suited to arid conditions

The camel, unlike other domestic animals, has no less than 20 specific adaptations of its body that help it survive extreme heat and go without water for long

periods. This means it can travel to remote pastures over a huge area – camels can walk up to 60 kilometres in a day – and go on giving milk during drought when other animals stop lactating or even die. Camels will also eat everything, fresh plants, dried plants, very salty plants, bones, fish, meat, even leather.

The ‘anatomical adaptations’ of the camel – how its body is constructed to help it survive in the desert – include:

- Long legs that lift it well above the hot ground, and sternal pads – very hard skin pads at the back of its front leg joints, and the front of its back leg joints – that keep its body clear of the ground when seated, allowing air to circulate around it and keep it cool (Fig. 1.1).
- Nostrils that can close against dust; large padded feet to support its weight in sand; protruding frontal orbit and long eyelashes that shadow the eye against the sun; a membrane also found in other animals, that moves like a very thin third eyelid across the eye and brushes away sand from the eye; the ears are small and covered in hair, including the inside of the ear, which helps keep out sand and dust.
- A unique fore-stomach (rumen) which has only three chambers (rumen of other ruminants has four chambers) and contains so-called glandular sacs that produce a saliva-like liquid; such glandular sacs are not found in the rumen of any other ruminant.
- The ‘physiological adaptations’ – how its body functions – include:
 - Fat is stored in the hump during times of plenty to be used in times of need. Also, the fact that most of the fat in the camel’s body is found in the hump, helps it stay cool. If a camel’s fat were distributed over its body like a human’s, it would insulate the body and make it harder to cool down. The fat itself also insulates the camel’s back from the heat

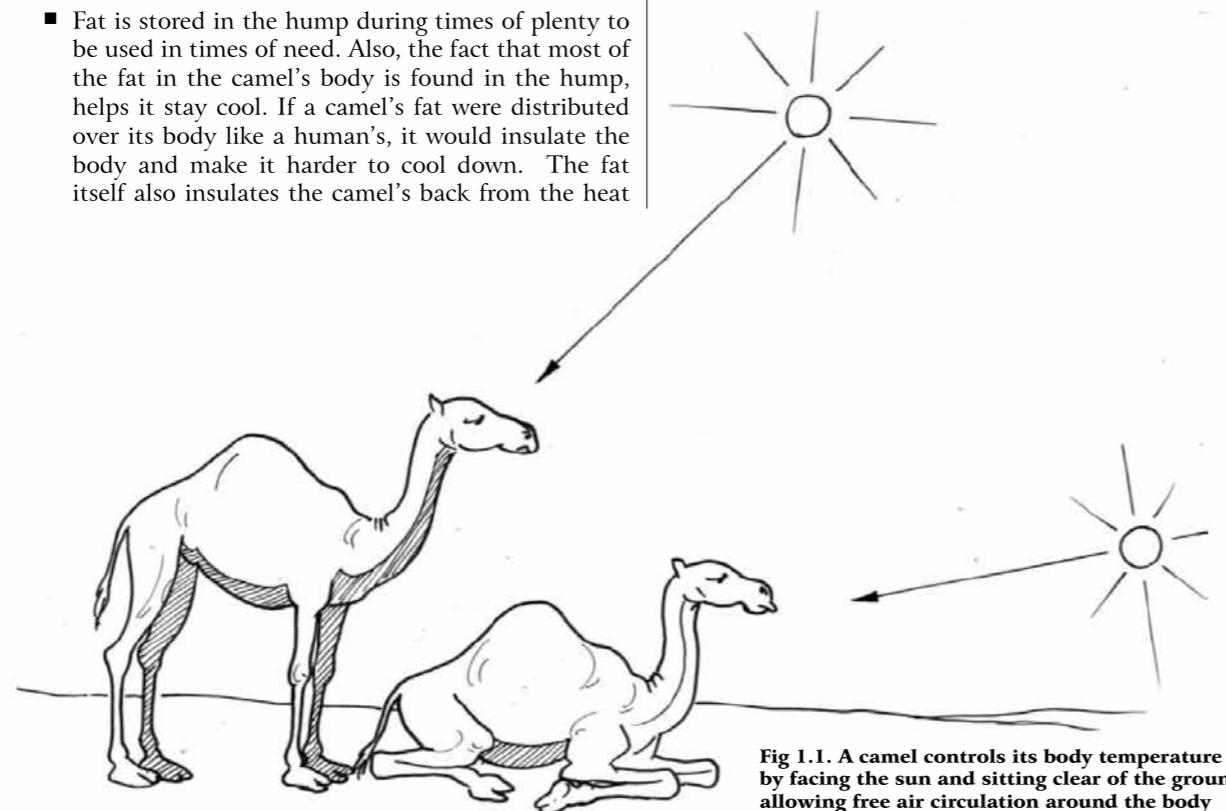


Fig 1.1. A camel controls its body temperature by facing the sun and sitting clear of the ground, allowing free air circulation around the body

- Camels are very efficient at recycling water inside the body. Their kidneys and intestines are very good at retaining water, producing thick concentrated urine and very dry dung that can be used immediately as fuel for cooking.

‘Behavioral adaptations’ include:

Sitting and standing facing the sun so as to expose the minimum surface area to the sun, avoid too much rise in body heat and water loss through sweating.

1.3. Camel distribution in Kenya

Kenya is normally estimated to have about 900,000 camels supporting a population of over 1,583,000 people. Surveys show a 78% increase in camel numbers between 1982 and 2010. Based on the 2009 human population census, the Kenyan government estimates that the national camel population may have reached as many as 3 million animals. In these days of global warming, with all its problems especially in the arid and semiarid lands of Kenya, the camel is likely to become more, not less important for pastoralists and agro-pastoralists in the future.

In Kenya, camels were first kept by the Somali people of North Eastern Province where their much larger breed and herds are found. Camel keeping later spread to the Rendille, Gabra and afterwards to the Turkana of Marsabit and Turkana districts. In recent times, camels have spread farther to the Samburu, Pokot, Massai and beyond the southern rangelands of Kenya into northern Tanzania.

Traditionally, camels in Kenya were classified according to the communities that kept them. However, a study on the physical, production and genetic characteristics of Kenya camels by KARI Marsabit, International Livestock Research Institute (ILRI) and University of Hohenheim confirmed four breeds, namely:

- Somali
- Rendille/Gabra
- Turkana
- Pakistani

Pakistani camels were imported from Pakistan in the early 1990s. More details on camel breeds can be found in Chapter Two.

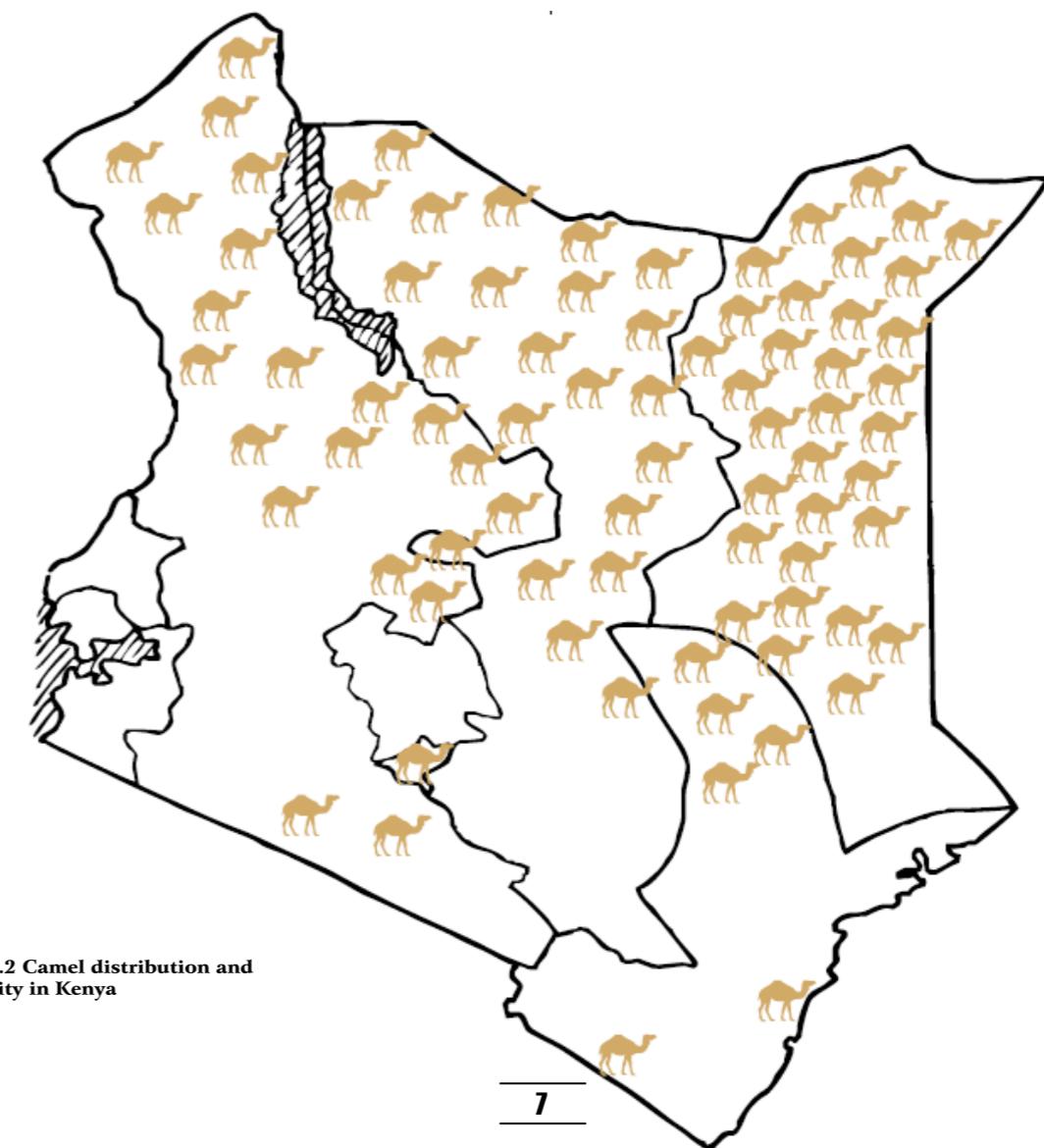
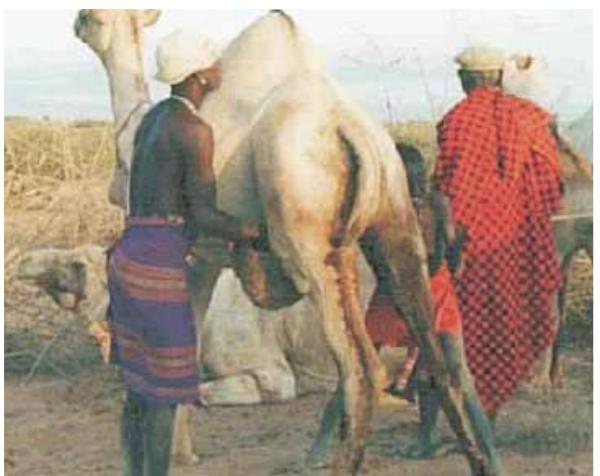


Fig 1.2 Camel distribution and density in Kenya

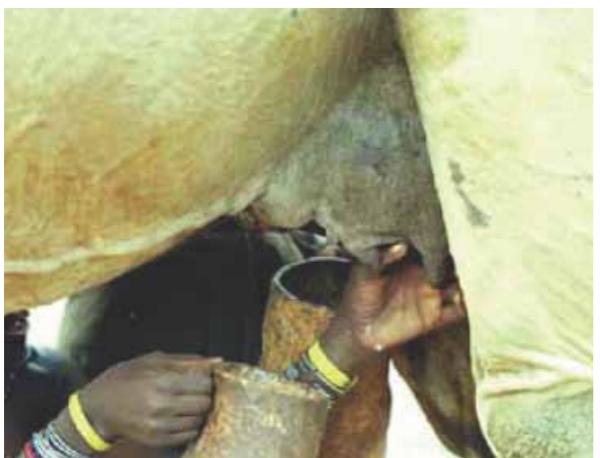
1.4. Use of camels for food and transport

Camels produce milk, meat, hides, and bones, which are used by camel keepers' families for their own needs but are also now being more and more sold in the market on a commercial basis, being professionally packaged and marketed. Untapped potentials are also being explored, such as value addition along the market chain, ecotourism, and draught power – for example, for pulling farm carts and for ploughing.

- A camel can produce 20 litres of milk a day without drinking any water for up to 10 days! Camels are kept mainly for milk, which has been called 'the white gold of the desert'. However, outside the camel keeping communities, few Kenyans consume camel milk despite its nutritional value. Some people look down on the milk because they know so little about camels. The fact is that camel milk has a high vitamin C content, which is very useful to people living in the arid and semi-arid lands (ASAL) who do not have much access to fruits and vegetables.



Rendille elders milking (Source: Simon Kuria)



Rendille Camel being milked. Camel milk is the main food for millions of pastoralists living in arid areas. (Source: Maurizio Dioli)

Depending on the season, camel milk also has more fat, protein, and minerals than cow or goat milk. The milk is also believed to have medicinal value, helping in the management of high blood pressure and diabetes. Due to increased urbanisation and sedentarisation of pastoralists, an informal camel milk trade to supply urban consumers has become an important source of income for camel keepers.

- There are many cultural practices around milking camels. For example, among the Rendille and Gabbra, females and sexually active men are not allowed to milk camels whose calves are below one year of age. This does not apply to Somali and Turkana camel keepers, but, apart from the herders and owners, Somalis do not allow strangers to milk their camels. And enough milk must be left for the calves so the herd can continue to multiply.
- The presence of the calf is very important in milking as it stimulates the milk let-down. If the calf dies, the herder can use a dummy with the skin of the dead calf to encourage milk let-down. A dam can also develop a liking for a particular herder and will let down the milk when she sees him or her.
- Camel meat is very healthy because it has lower cholesterol and less fat than beef, since the fat is mostly stored in the camel's hump
- The Gabbra and Rendille rarely slaughter camels except during severe drought or during major traditional ceremonies like weddings, the death of prominent persons in the family and during peace talks. But castrated, fractured or deformed camels are slaughtered at home.
- The Turkana people regularly slaughter male camels for meat. The Somalis slaughter both males and female camels for meat. Camel meat is preferred to other meat, so camels are slaughtered in large numbers in North Eastern Province. Camel meat consumption is rising with the recent influx of Somali refugees into Kenya.
- Meat from old camels is usually tough and has to be cooked for a longer time. Camels have softer meat when they are less than 5 years of age.
- Camel fat is traditionally used in the treatment of fractures and cooking.
- Some pastoralist communities such as the Turkana, Rendille and Samburu drink camel blood, but since taking blood in any form is forbidden in Islam, the Somalis do not do so.
- Camel hides were traditionally used to make ropes for loading camels, also for making traditional beds, gourd covers, sleeping and prayer mats, cushions, sandals etc. During times of famine, some pastoralists cook camel hides for food.
- Tanned camel hides are used to make high quality leather goods like shoes and bags that are sold in some shops in Nairobi.
- Pastoralists use male camels mainly for drawing water, carrying their tents and other belongings, carrying young children, old people and young

stock and for ferrying surplus milk to the market. A baggage camel easily carries loads of 200 kilograms. But due to increasing demand for slaughter camels, the transport function of camels is now being taken over by donkeys and the males are being sold in larger numbers.

- Camels are also harnessed and used as draught animals, for ploughing and pulling carts.

1.5. Use of camels for tourism and mobile services

- Camel racing and trekking safaris are beginning to earn their owners and trainers a good income from ecotourism. Parts of northern Kenya and the Rift Valley are ideally suited to this as they offer a combination of wildlife and mountain scenery. Camel racing in Kenya is still in its infancy, though.
- Camels can also be used to provide mobile special outreach services such as carrying CASPROs and CAHWS and Village Health Assistants to remote destinations with their equipment; camels are being used for mobile library services by the Garissa branch of the Kenya National Library Services.

1.6. Wealth and respect: Social and cultural uses of the camel

- Camels play an important role in the society, culture and religion of camel keeping communities. A man without camels is like a cripple because he cannot travel with the rest of the community, draw

water from far distances or provide for his family, especially during drought.

- A family without camels is therefore considered poor, even if it possesses other livestock. The camel is a symbol of wealth, status and prestige. For example, among the Somali pastoralists, families or clans with large camel herds are regarded as being wealthy, with a high social status and influence, and often become opinion leaders within the community.
- The culture of most camel keepers revolves around the camel; the Rendille and Gabbra, for example, have regular traditional ceremonies for blessing camels. Camels are required in important ceremonies such as marriage, burial and religious events. Among the Somalis, camels are used to pay Zakat (tithe or offering). In fact, camels are now used as dowry even among communities that have recently adopted camels such as the Samburu and Borana. There are many cultural dances in praise of camels. Camels are also used to settle damages caused by conflicts between individuals, families or clans. For example, among the Somalis, compensation for the death of a man is still 100 camels and for the death of a woman 50 camels, according to the Mogadishu Declaration.

Camels are seen as a store of wealth and security against drought, disease and other natural calamities. In some communities, camels are also loaned to the needy to help them get back on their feet.



Gabbra camels carrying water (Source: Tura Isako)



Desert ambulance about to take children to hospital (Source: Tura Isako)



Camel ploughing on Mt Marsabit (Source: Tura Isako)



Camel de silting a dam (Source: Chris Field)

CHAPTER 2

CAMEL MANAGEMENT

'There are no problems with camels, only with the camel keeper'- Rendille saying

Chapter Authors: Simon G. Kuria, Abdi Y. Guliye, Fredrick O. Aloo, Tura A. Isacko, Christopher R. Field, Mario Younan



A Camel used for ploughing in Ukambani (Source J. Kihumba)



Mating camels (Source: Maurizio Dioli)

A very important part of good camel management is good feeding/grazing and good breeding practices. These includes management of the dam before birth, management of parturition, care of the young calves (timely feeding of colostrum, diarrhoea management, tick control), timing of weaning and time for presenting the dam to the bull for mating after calving.

2.1 Breeding

2.1.1 Different camel breeds in Kenya

There are four camel breeds in Kenya namely Somali, Rendille/Gabbra, Turkana and "Pakistani," which have different physical, productive and genetic characteristics, as shown below.

Somali

- Largest body, weighing 450 - 850 kg.
- Milk yield of 3-5 litres a day; Hoor type camels produce 6-8 litres per day.
- Heavy feeder, needs good pasture.
- Not suited for hilly terrain because of its size and weight.
- Mostly cream coloured coat.



Somali Camel Bull (Source: Maurizio Dioli)

Rendille/Gabbra

Compared with the Somali breed, it is:

- Smaller in size (300-550kg).
- Lower in milk yield (average 1-3 litres a day).
- Does better under poor pasture conditions and on rough hilly terrain.
- Coat colour is mainly creamy or brown.



Rendille/Gabba Camel Breed (Source: Simon Kuria)

- Mainly chocolate in colour and has more fur than Kenyan camel breeds.
- Drooping lower lip

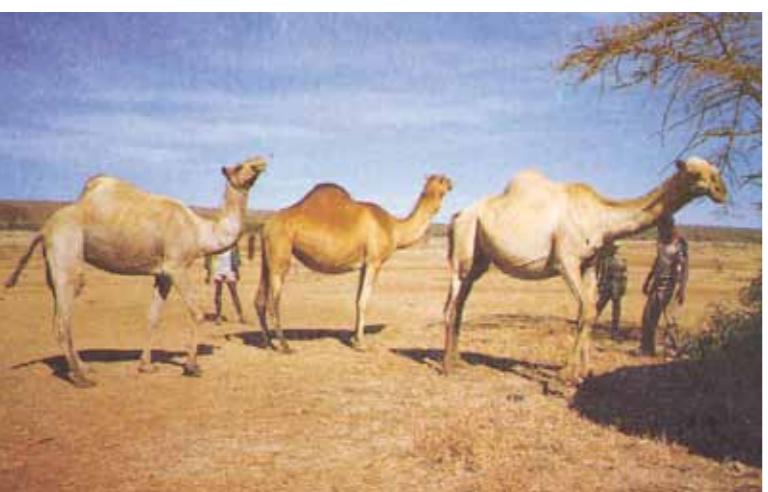


Pakistani Camel Breed (Source: Tura Isako)

Turkana

Compared with other breeds, this is:

- Smallest in size (250-500 kg).
- Lowest in milk yield (1-2.5 litres a day).
- Does well in very poor pasture conditions and on rough terrain.
- Coat colour is mainly grey.



Adult females: Turkana(L), crossbred S x T (C), and Somali (R), (Source: Piers Simpkin)

Pakistani

Very small population in Kenya (currently less than 20 pure bred Pakistani) used for cross-breeding with local camels. Its characteristics:

- Smaller in body size than the Somali camel but larger than the Gabra/Rendille at 400-700 kg, with stocky proportions and shorter legs.
- High milk yield, although in Kenya yields do not exceed 8-9 litres per day.
- Very heavy feeder, needs very good pasture, not suited for arid bush or for running in large herds.

2.1.2 Recommended bull:female ratio

- A camel keeper should have one dominant bull 6 to 12 years of age with one younger bull as his replacement.
- More than one breeding bull may be needed depending on the herd size. A bull:female ratio of 1:50 is best when sufficient forage is available.

2.1.3. Sexual maturity, breeding season, courtship and mating

Sexual maturity depends on nutrition and health as well as the breed of the camel.

Sexual maturity

- Females become active at 4 to 5 years of age and give birth when about 5 to 6 years old.
- A male on the other hand becomes sexually mature at around 5 years of age but begins to serve actively

Table1: Good breeding camels

Good breeding bull	Good breeding female
<ul style="list-style-type: none"> ■ Fast growth rate ■ Good body conformation (tall, large body frame, well built), upright in standing, with good ability to chase and mount females ■ Adapts well to the environment – available feed, terrain etc ■ Mother of the bull is a very good milker 	<ul style="list-style-type: none"> ■ History of producing high milk volumes ■ Adapts well to the environment ■ Good body conformation (slender body and large stomach) ■ Well developed, pronounced milk veins ■ Large and well set udder with four normally shaped and normal size teats ■ Good fertility record and proven good mothering ability
	

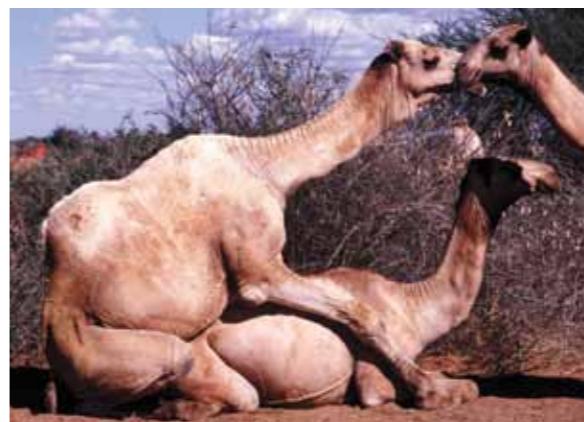
Source: Simon Kuria

Source: Simon Kuria

at around 6, when his canine teeth are sufficiently developed for fighting and he shows signs of "rut" (see next page).

Breeding season

- Camels are seasonal breeders; the onset of the breeding season is triggered by availability of fresh green feed.
- The breeding season coincides with the rainy period of the year; a clear sign is bulls coming into rut.



Mating camels. The one-humped camel, including bactrian camel and south American camelids, is the only ungulate that copulates in a crouched position. Young breeding male camels (4-6 years) often require the assistance of the herdsman for a successful copulation. (Source: Maurizio Dioli)

Mating

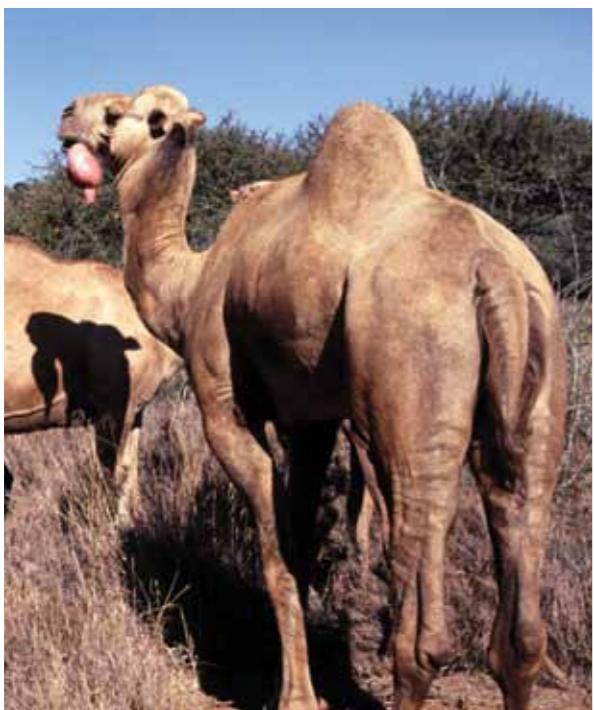
- Mating among camels can be a violent affair and may lead to injury to females.
- A breeding bull in rut should not be allowed to run loose with a small herd of females, since it can injure the females and the calves.
- Sometimes the female will not sit on her own; when this happens, she is often forced to do so by the male who chases her around, biting her neck, the back of her hump, and pressing her down. This may result in severe injuries to the female. So it is a good idea to make the female sit before bringing the male to mate with her.
- Mating can take a very long time and the herder sometimes has to intervene. This has given rise to the belief that male camels need help in mating.
- Release of the egg (ovulation) in females only takes place after mating. To ensure successful conception, it is good practice to allow for repeat mating.
- Rutting males should be herded by strong, mature people since they can be aggressive and easily hurt children.

2.1.4. Signs of rut in male and heat in female camels

Signs of rut in a male camel

- Loss of appetite; its coat becomes dull.
- Unusually aggressive and difficult to handle (chases away all the other males and even humans).
- Urinates frequently and splashes urine on to its back by flicking its tail.

- A tar-like greasy discharge comes out of glands on the neck behind the ears, which the bull then rubs onto plants to mark its territory and warn other males.
- The *dulla*, a soft flap filled with air, sticks out from the mouth, looking like a pink balloon (as shown in the picture).
- Makes noises by grinding its teeth, while saliva flows from its mouth.
- Rutting bulls should be separated from each other as they can fight to the death.



Adult male in rut displaying the “dulaa” an expandable pouch of the soft palate. This balloon-like structure is expelled from the mouth as part of sexual display and as a threatening behaviour towards other males (and humans). The inflation and expulsion of the structure is accompanied by profuse salivation, grinding of teeth and loud vocalization. The “dulaa” is fully developed only in adult males and it is absent in the two-humped camel.
(Source: Maurizio Dioli)



A pregnant camel (Source: Maurizio Dioli)

Signs of heat in a female camel

- May become restless.
- May show swelling of the vulva with a mucous discharge.
- Urinates frequently.
- May yield less milk than normal.
- May sniff urine from other females.
- The heat lasts 3-4 (sometimes up to 6!) days and is repeated after 20-25 days for females that fail to conceive

2.1.5 How to tell if a camel is pregnant

- If a she-camel is pregnant, it will raise its tail when a bull approaches it; sometimes it will both raise its tail and urinate at the same time. The same behaviour is shown by pregnant female camels when the camel keeper comes close.
- This behaviour in pregnant camels can be observed as early as 2-4 weeks after the calf has been conceived.

2.1.6 Bad breeding practices

A study of the traditional breeding practices of camel keeping communities in Kenya found several bad practices that can make camels less productive. **Table 2** gives details of these practices, their harmful effects and the good practices to be introduced instead.

Table 2: Bad breeding practices and how to avoid them

Malpractice	Signs	Correct Practice
Inbreeding	<ul style="list-style-type: none"> Congenital problems like deformities (e.g. overshot or undershot jaws) Slow calf growth High calf mortality 	<ul style="list-style-type: none"> Avoid inbreeding by: <ul style="list-style-type: none"> Replacing the breeding bull at 12 years when its first daughters become sexually mature Exchanging bulls with neighbours (bulls not related to each other) Using two or more breeding bulls who are not related to each other

Using aged males for breeding	<ul style="list-style-type: none"> High return to heat in females served by old bulls Low conception rate Aged bulls have reduced economic value when sold as meat animals 	Use young bulls below 12 years. Such bulls have: <ul style="list-style-type: none"> Good ability to mate females Come to rut faster after the dry season and serve for a longer period in any given breeding season Higher conception rates of females served
Using aged females for breeding (females with more than 6 calves)	<ul style="list-style-type: none"> Females after the 6th calving have lower fertility resulting in more frequent return to heat They also have worn-out teeth and more udder problems leading to poor body condition, low milk yield and increased calf mortality 	Use females who have had no more than 6 calvings. Such younger females normally: <ul style="list-style-type: none"> Have good body condition Produce more milk Their calves show higher survival and growth rates
Selection along female line to breed for better production	<ul style="list-style-type: none"> No substantial improvement in milk yield and other production traits in the camel herd 	Select bulls who are the offspring of very productive females and show superior performance (weight gain, fertility) to spread desired features in camel herds <ul style="list-style-type: none"> For spreading desired traits in the herd, bull selection is faster than selection along the female line because one breeding bull can serve 50 dams every breeding season while one female gives birth to less than one calf per year and to only about 7 calves during her productive life span

2.1.7 Management of pregnant camels, one month before calving

Pregnancy in the camel on average lasts 387 days – or one year and three weeks. A month prior to calving, pregnant camels require special care as described in **Table 3**.

Table 3: Care of pregnant camels one month before birth

What to do	Why
<ul style="list-style-type: none"> Reserve good grazing for pregnant camels nearer to homestead or boma Graze the camels near settlement or boma during last month of pregnancy for close monitoring and to avoid long treks Avoid grazing in areas with potholes, gullies, rocky areas, slippery ground Do not allow the camel to wallow in dust or mud Do not put camels in badly made, weak or dirty bomas 	<ul style="list-style-type: none"> This is the most critical stage of pregnancy Heavily pregnant camels are not fit for long treks and calving must be closely observed and may require some assistance The pregnant camel can fall down and injure itself The pregnant camel cannot easily stand up on sloping or muddy ground Increased risk of infection and predation for the newborn

2.1.8: Signs of giving birth

- The camel's udder becomes enlarged.
- The ligaments at the root of its tail begin sagging.
- It becomes restless, lying down and standing up frequently.
- It loses appetite.
- It makes an unmistakable noise.
- It separates itself from the herd and may wander off into the bush.
- Unlike in cattle, labour in the camel lasts for a short time and takes only between 10 and 30 minutes on average.

2.1.9 Calving management

It is important to only assist the camel during calving if absolutely necessary! Compared with cattle, camels need far less assistance during calving. If the position of the calf inside the mother is normal, it is very important to be patient. In exceptional cases, camels have been known to give birth to a normal calf after as long as 300 minutes of labour. **Table 4** details what the herder or helper should do.

Note: In camels, the normal calf presentation during birth is 'anterior' – it comes out with its head and forelegs first – though occasionally there is 'posterior' presentation – it comes out hind legs first. When the two feet (and the head in the anterior position) are presented, both positions are considered normal.

Table 4: The camel is giving birth

What you should do	Why
<ul style="list-style-type: none"> ■ Before giving birth camels like to separate themselves from the herd and wander off into the bush; when that happens, one herder must stay close to the camel and if possible, keep the camel near the boma ■ Let the mother lie down outside the boma, be very gentle and quiet with the camel; noise makes the mother nervous, interfering with birth ■ Camels calve fast; pushing out the calf takes only 15-30 minutes but may take longer in first calving heifers ■ In case the camel has difficulties delivering the calf and you don't have experience with camels giving birth, call an experienced herder, community based animal health worker or veterinarian to assist; as long as the calf is inside the mother, it will stay alive for hours ■ If you cannot get assistance and the calf is already visible and you can see two front feet and the head of the calf, attach two new clean ropes, one to each leg, and pull very gently. If you can see the two hind feet and the tail, you can also attach a rope to the hind legs and pull gently ■ The camel calf is born inside a membrane (like an envelope). This membrane separates the calf from the fluids; in case it does not rupture, open it immediately after birth with your hand and allow the calf to breathe ■ If the umbilical cord breaks spontaneously, dip the navel in iodine if available ■ Place the calf in front of the mother until the mother makes a low groaning noise ■ Help the calf to stand and suckle; if the mother refuses to let it suckle (common with first calves), make her sniff the calf. If she still proves difficult, isolate her and keep the calf close to her so that 	<ul style="list-style-type: none"> ■ If the camel calves without a human caretaker the birth progress cannot be observed; besides, the newborn calf may suffocate or be taken by hyenas. Also, if the mother calves alone in the bush, she may abandon the calf after giving birth and then it is very difficult to find the calf! ■ Dropping the calf while the mother is standing can injure the calf, also calving inside the boma exposes calf and mother to a lot of dirt and may cause dangerous infections ■ In cases of difficult calving, allow for plenty of time and pull the calf very gently and only when absolutely necessary; this helps avoid very serious injury which can kill both, the mother and the calf. The most common mistake is to interfere with normal birth and try to assist too early - compared to cattle, camels need far less assistance in giving birth! ■ If the membrane/envelope in which the calf is born does not rupture, the calf can suffocate. This strong membrane is not found in the newborn of cattle/sheep/goats ■ Dipping the navel in iodine prevents navel illness. Note: Camel calves do not need licking by the mother or drying after birth ■ The groaning noise made by the mother means that she has accepted the calf and will allow it to suckle ■ Suckling during the first 3 to 6 hours after birth is very important for the calf because the dense milk that the mother produces for the first 2 to 3

she only sees the calf around her. You can also tie the mother's rear legs together to prevent her from kicking the calf during suckling.

- Make sure the placenta has dropped; in camels the placenta normally comes out within 30 minutes after birth

days after birth (called colostrum) protects the calf against infections in the first months of its' life

- If birth takes place far from the boma in the bush, transport the newborn calf back to the boma after it has suckled – the mother will follow its calf, do not leave mother and calf alone in the bush
- If the placenta does not come out, call a vet or CAHW to provide antibiotic treatment, as a retained placenta may start a severe infection in the mother. Suckling of the calf helps the mother pass the placenta.

2.2 Calf management

Poor management practices are among the reasons why so many calves die young – different researchers have reported from 12-60% camel calf mortality in the country's pastoral camel herds. Traditionally, camel keepers believe that whether the calf survives after birth is "amri ya Mungu" or God's will. Still, many causes of calf mortality can be prevented by good management.

Calves are very important for camel keeping communities. Female calves are the future milking camels without which the herd cannot grow or produce milk. Normally, the presence of the calf is necessary to stimulate let down of milk by the mother, although pastoralists have come up with ways of stimulating milk let-down if the calf dies.

If the mother rejects the calf or dies during the first 8 weeks after birth, the calf rarely survives!

Characteristic of a healthy camel calf:

- Birth weight 25 to 35 kg.
- Stands up and suckles within the first 3 hours.
- Walks within 2 to 3 days.
- Passes first faeces within 24 hours.
- Follows mother after a week.
- Forages actively after 2 to 3 months as the rumen is developing.
- Sleeps, suckles, runs, jumps around and plays with other calves.
- Is weaned from suckling within 12 to 18 months. The survival of calves is especially affected by competition for milk between the suckling calf and humans, who depend on camel milk as an important part of their diet. Poor veterinary services, predators, diarrhoea, tick paralysis, internal and external parasites, feed stress during the dry season, water stress especially among mobile herds, all contribute to calf losses. Therefore, special care is needed to improve survival rates of calves, as explained in **Table 5**.

Table 5: Management of the suckling camel calf

Management practice and how it should be done	Why
<p>Colostrum feeding (drinking the first milk after birth)</p> <p>Allow the calf unlimited access to drink colostrum to ensure it gets all the antibodies, vitamins and proteins within the first 3 to 6 hours after birth. If the dam does not allow the calf to suckle, restrain her and try to induce milk let down by palpating the udder and the abdomen. In the absence of milk from the mother, feed the calf on milk from other camels that have just given birth</p> <p>Note: Herders sometimes deny or give very little colostrum to the calves, claiming that excess colostrum causes diarrhoea, especially among second calvers. Research has shown this to be a dangerously wrong practice, based on belief rather than on fact</p>	<ul style="list-style-type: none"> ■ Colostrum is like a vaccination, it gives the calf immunity ■ Colostrum also activates the calf's digestion and helps it to pass its first faeces. ■ Colostrum is very rich in nutrients and is only produced by the udder on the first one or two days after calving; later, the udder starts producing normal milk

<p>Diarrhoea management</p> <p>Rehydration of the calf using a mixture of water, table salt and honey (See chapter 3)</p> <ul style="list-style-type: none"> Take five tablespoonfuls of honey or sugar and one tablespoonfuls of table salt. Mix well with two litres of clean water. Give 500ml of the solution through the mouth every 4 hours until the diarrhoea stops. (see fig. 3.4 - page 36) <p>Treating diarrhoea using eggs from chickens that live near the camels</p> <ul style="list-style-type: none"> Give one egg by mouth daily to a calf with diarrhoea until diarrhoea stops. <p>Use of conventional drugs</p> <ul style="list-style-type: none"> Give sulphonamide tablets according to manufacturer's instructions Separate sick and healthy calves Try to put newborn calves in a clean, separate boma <p>Note: The most important measure is early rehydration, when the calf can still stand and suckle; small calves with diarrhoea lose water rapidly, become dull, stop suckling and can die within 24 hours. To minimise water loss, it is good to keep sick calves in the shade.</p>	<ul style="list-style-type: none"> Diarrhoea contributes significantly to the 12-60% camel calf mortality levels reported among camel herds in Kenya When a calf has diarrhoea, it loses a lot of water and can die from dehydration. The honey-table salt-water solution replaces lost water, energy and minerals, this is called rehydration The eggs of chickens that interact with camels and feed on ticks and other flies from camels have been found to have a protective effect against diarrhoea These drugs help in managing bacterial diarrhoea Older calves are the main source of diarrhoea infection for newborn calves; separation prevents spread of diarrhoea to other calves
<p>Calf management in the first year</p> <ul style="list-style-type: none"> Let the calf run with its mother during the day for the first three months; most pastoralists do not milk the mother during the first 3-4 weeks After the third month, when the calf is able to graze actively, gradually reduce the milk allowance for the calf, depending on the quantity and quality of forage available and its growth performance In case of death of the mother or calf rejection, try to find a foster mother that has calved around the same time; if this is not possible, bottle feeding is advised Ensure that the calf is free of ticks, including nymphs (small white ticks that attach around the hump); often it is sufficient to remove ticks by hand (see chapter 3) Treat abscesses around the joints early (see chapter 3) 	<ul style="list-style-type: none"> This provides enough milk for the newborn calf. For the calf, heavy milking for human consumption delays calf growth and makes calves weak and prone to catch a disease Early separation contributes to calf diarrhoea since the calf stays hungry the whole day and when the mother returns home in the evening, it takes a lot of milk at one suckling. The milk tends to cramp the undeveloped stomach, leading to diarrhoea. Letting the calf accompany its mother during the day also triggers early rumination because of early access to forage and water Young calves can easily die from blood loss if they have too many ticks; ticks can also cause tick paralysis, which kills calves quickly (See chapter 3)
<p>Weaning the calf</p> <ul style="list-style-type: none"> Gradually wean the calf from suckling at the age of 12 to 18 months, depending on the size and strength of the calf and availability of good pasture/browsing Deworm at weaning and treat with Trypanocide (see chapter 3) Provide ample salt regularly Increase watering intervals step wise and slowly Treat weaners for external parasites (mange and ticks) Vaccinate weaners against Clostridia and against Tetanus, especially where camels are kept together with other livestock (use the same vaccine as for sheep and goats) 	<ul style="list-style-type: none"> Camel keepers in Kenya wean calves at an age of one to one and a half years. After weaning, the calves join the main herd, which is normally taken for longer distances for foraging and watering. The abrupt change in management causes stress and it is good to ensure that the weaned calf does not suffer from parasites and has good immunity during that period

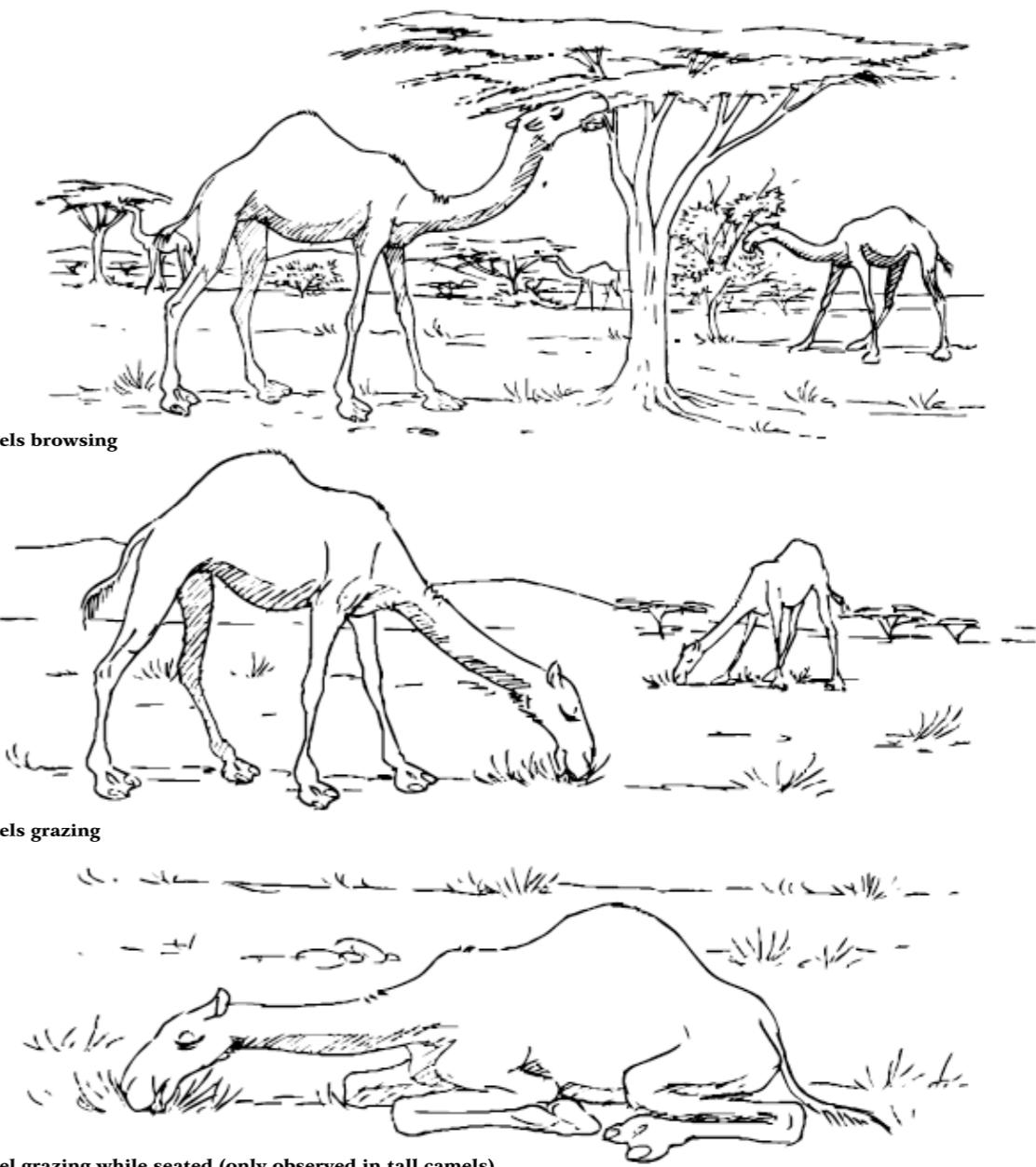


Fig 2.1 Camel feeding habits

2.3 Camel nutrition and feeding

Good nutrition is essential for the camel to grow well, to reproduce and to produce milk, because it affects health, fertility, growth, birth weight of the calf and milk yield. As with humans, good nutrition means the camel must get enough protein, energy, roughage, vitamins, minerals and water.

2.3.1 Feeding habits

Foraging camels spread over a large area, thus putting less pressure on the vegetation in any one

area. This feeding behaviour also makes camel herding more challenging.

- Camels are browsers. Their long legs and neck allow them to browse up to 3 metres above the ground, so they can eat foliage that other livestock cannot reach.
- Because of the kind of forage they prefer and the fact that they feed at higher levels, camels rarely come into direct competition for grazing with other animals like cattle and sheep. This means that keeping a combination of different livestock species allows the fullest use of the available pasture land.

Table 6: Some important range forage species for camels

Scientific name	Growth form	Somali	Rendille	Turkana	Samburu	Gabba
Acacia tortilis	Tree	Abuk Abak	Dahar	Etir Ewoi	Ltepes	Dadacha
Acacia nilotica	Tree	Bili Madow	Gillorit	Ekalapelimet	Ikkiloriti	Burque
Indigofera spinosa	Dwarf shrub	Rufile Maratet	Khoro	Emakwi	Lkitagesi	Korategala Kiltipe
Salsola dendroides	Dwarf shrub	Darran-ad	Hadum	-	Aduung	Hadum
Boscia coriacea	Shrub	Ghalangal Dakkiyah	Yoror	Erdung	Sericho	Galgacha
Balanites	Tree	Kullen Kidthi	Kulum	Eroronyit	Sarai Ilbulei	Badhan Baddana
Salvadora persica	Shrub	Adde Athei	Hayei	Esekon	Sokotei	Aadhe
Euphorbia tirucalli	Shrub	-	-	Elila	Loile	Anno
Cordia sinensis	Shrub	Mared Maeer	Gaer	Edome	Ilgoita	Madeera
Barleria Spp	Herb	Gamaadiis Odarol	Geidow Sucha	-	Lkurumbule Sucha	Maadeek Shiisha
Blepharis linearifolia	Herb	Quarda Yumarook	Lemaruk Harja	-	Emarak	Kutumbule Baraata
Sueda Monoica	Shrub					Duurte

2.3.2 Suitable camel feeds

Given the opportunity, camels prefer to feed on shrubs and trees. However, in their absence, they can live comfortably on herbs and annual grasses.

- Camels are highly selective feeders and require 8-10 hours of grazing daily to be satisfied. This depends on breed, body size and seasonal feed availability. During drought, camels require a daily grazing time of up to 12 hours.
- Under normal rangeland conditions, camels select a diverse high-quality diet that provides all the nutrients required by the body.
- Camels are also able to survive on low quality fibrous roughage. They adapt well to different diets and dietary conditions.
- During the dry season, when other forage is scarce, camels can browse on the green tips of trees (for example acacia) that are out of reach for other livestock, or feed on Euphorbia, which is toxic for other livestock species, so they are better able to survive droughts.
- However, there are some plants that are poisonous to camels – for example, the Capparis tomentosa – so areas where such plants are concentrated should be avoided (See Chapter 3). Ingestion of toxic plants is often linked to periods of extreme feed scarcity and/or to animals being introduced into a completely new area.

2.3.3 Mineral requirements

Camels like salt and prefer grazing and browsing on salty plants (i.e *Indigofera spinosa*). They need much more salt than other livestock species.

Pastoralists, knowing that camels need extra salt, try to take their camels to naturally occurring salt sources (saltlicks, salty springs).

A camel's salt needs under normal dry land conditions range between 30 and 60 grammes a day. A camel working hard in the hot season may need as much as 140 grammes of salt daily. It is good to provide salt to camels daily in the boma.

Still, research shows that camels suffer deficiencies of certain minerals that are either not found in natural sources, or are not present in sufficient quantities. This means camels need properly formulated and balanced minerals for good all-round nutrition. One option is to buy industrial chemicals that supply key deficient elements and mix them with natural saltlicks or other low quality livestock salts sold in the market.

2.3.4: Water requirements

- Compared with other livestock, the camel's body is very good at using water, as it can reabsorb most of the water in the kidney and intestines and also loses very little water through sweating.

■ How much water camels need depends on the water content of their forage; so, during wet periods, camels get enough water from their feed and from shallow puddles and may not need direct watering for up to eight weeks.

■ During dry seasons and drought, camels need regular watering, ideally every 5 to 8 days. Watering intervals longer than this lead to dehydration, which interferes with the functioning of their body systems and reduces productivity. Watering intervals during drought of more than 14 days have however been reported, even in lactating camels.

■ Lactating camels should be watered at least every six days, and should have plenty of forage.

■ Camels can drink up to 25% of their body weight within a few minutes; still, time should be given to the camel to drink several times with rests in between to help it meet its body's needs. It is also good practice to rest camels for a while after watering.

■ Checking skin elasticity is a good test to assess dehydration in camels. This is done by grabbing and pulling out the loose skin around the neck or lower abdomen and then releasing it. If the raised skin fold disappears quickly, the animal is not in acute need of water. But if the skin fold remains standing for a long time, the animal is dehydrated and should be watered soon. Dehydrated camels must not be injected with veterinary drugs! (**This skin test is also very useful to assess severity of dehydration in suckling calves with diarrhoea.**) see chapter 3

2.3.5 Supplementary feeding of camels

- Under normal circumstances, camels can get enough good quality nourishment from natural vegetation. However, during periods of scarcity, supplementary feeding is good for them, especially for pregnant and lactating camels and their calves.
- Because of this, it is a good idea to harvest and store feed material like acacia pods, especially for settled households.
- The nutritional quality of natural vegetation is highest when it is beginning to dry up, so this would be a good harvesting time.
- Hay, minerals supplements and concentrates like dairy cubes can also be bought from the market and fed to camels. However, this can be expensive and is usually only affordable for high yielding female camels.

2.4 Camel body weight and age

2.4.1 Weighing your camel

To the camel keeper, knowing the animal's weight is important for the following reasons:

- How much medicine (dosage) to give to a camel depends on its weight.

■ Weight helps to decide when the animal is ready for breeding or slaughter and also affects its price if it is being sold in the market.

■ If necessary, in times of shortage, its weight will help decide how much feed to give the animal.

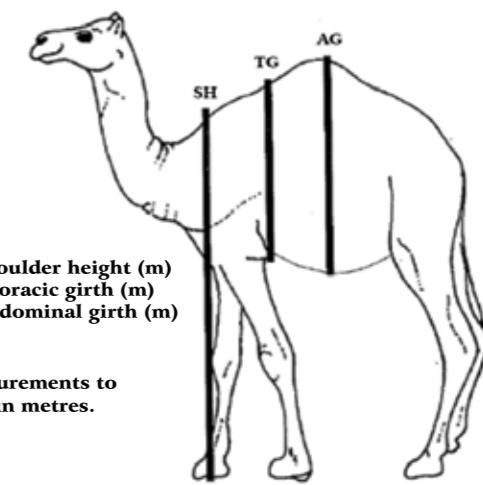
■ New born calves weigh 25-35kg.

■ Mature camels weigh 350-800 kg, depending on the breed.

■ Camels reach their mature weights between 4 and 6 years of age depending on their management and breed; camels kept on very good pastures mature and grow faster than camels kept in very arid areas.

If there is no scale to weigh the animal, you can use a tape measure to estimate the body weight from three measurements using the following formula:

Shoulder height x Abdominal girth x Hump girth x 50 = Body Weight in kg



All measurements to be done in metres.

Fig 2.2 Source: J O Evans, S P Simpkin and D J Atkins (1995)

Example: Camel with Shoulder height = 2.0m; Abdominal girth = 2.05m; Hump girth = 2.25m . Therefore the body weight of this camel is $2.0 \times 2.05 \times 2.25 \times 50 = 461.25\text{kg}$. This method is not 100% accurate, it is more accurate in mature than in young camels and should ideally be done before watering.

2.4.1 Calculating the age of a camel from its teeth

It is useful to know the age of camels for four reasons:

- It helps the camel keeper decide whether to breed the camel.
- Age is important when buying or selling camels.
- Age is important when selling camels for slaughter – the older the camel, the tougher the meat.
- Age is important in monitoring how well a camel is growing.

CHAPTER 3

CAMEL HEALTH MANAGEMENT

"Healthy camels mean sustainable livelihoods"

Chapter Authors: Mario Younan, Ilona V. Gluecks, George C. Gitao, George J. Njoroge-Wamwere, Njihia G. Kinyanjui, Kisa Juma Ngeiywa, Raymond Mdachi, Maurizio Dioli



Aging camels using permanent front teeth – incisors ('jembe')

- 1st pair erupts at 4.5 to 5 years.
- 2nd pair erupts at around 6 years.
- 3rd pair erupts at 7-8 years.
- The amount of wear of the teeth determines the age thereafter.

Number of milk teeth in young camels and permanent teeth in mature camels

Young camels have 22 temporary teeth:

- 1 incisor, 1 canine and 3 premolars on each side of the upper jaw.
- 3 incisors, 1 canine and 2 premolars on each side in the lower jaw.
- The incisors and canines of the upper jaw are rudimentary and have very little function.

Mature camels have 34 permanent teeth:

- 1 incisor, 1 canine, 3 premolars and 3 molars on each side of the upper jaw.
- 3 incisors, 1 canine, 2 premolars and 3 molars on each side of the lower jaw.

Teeth wear is in relation to the type of food eaten. Camel that prevalently browse (coastal Somalia) have much more pronounced teeth wear than camels who graze. Adult females upper incisors are often very small or absent. For aging purposes the lower incisors are the main teeth used. Also to mention that male have large canines (tusks) that are fully developed at around 9 years.



A 9-year old male camel with three pairs of fully developed incisors, and partially developed first pair of canines. (Source Chris Field)

2.5 Record keeping

2.5.1 Why keep records?

- By keeping records, a camel keeper can monitor what is happening in the herd over time. This is important for planning.
- Records can be used to make decisions on future management of the herd: When to breed, which camels to keep and which to sell, when to take them to market and the quantities of milk and income that they are likely to produce.
- Records help the camel keeper to assess the profitability of the whole camel rearing enterprise.

Extension Messages:

It is important for camel keepers to ensure the following:

- Regularly monitor the physical condition of the camel.
- Ensure that the camel has enough forage for optimal performance.
- Discuss the importance of proper selection of a good breeding animal in a herd.
- Discuss the importance of avoiding teat tying in order to prevent mastitis and loss of udder quarters.
- Discuss the importance of rehydration in camel calves with diarrhoea using a rehydration solution.
- Pregnant camels should be put on good nutrition in the last three months of pregnancy as this normally translates into fast foetal growth, high birth weight and increased milk yield after birth. Further, higher birth weight of calves enhances survival, growth and production during later stages of life.
- Camels should get mineral supplements that are rich in essential elements and in the required quantity.
- Lactating camels should be watered after every 6 days to avoid dehydration, which reduces milk yield (a 29% reduction in milk yield after 8 days has been reported in Kenya).

Failure to observe these guidelines may lead to loss of production, especially of milk, which is very important for the pastoralist.

TRAINING TIPS:

- Ask the camel keepers to collect good and bad forage plants and discuss.
- Discuss the importance of proper nutrition in camels.
- Demonstrate how to take body measurements and estimate the weight of a camel. Ask the participants to guess the weight before and give a small reward to the one whose guess is nearest to the measured weight.
- Discuss the importance of correct age determination.
- Demonstrate the dentition of a live camel and how it can be used for ageing. This is best done using a camel of between 5 and 7 years of age to show the eruption sequence of incisors.
- Discuss the advantages of record keeping.
- Demonstrate how to measure milk in a plastic jug and how to record the measurements.

For pastoralists, keeping their camels healthy makes the difference between poverty and prosperity, between hunger and full stomachs. But the camel, despite being a hardy animal, is prone to a variety of disease. So camel health management has been seen as a major challenge for decades.

However, in recent years, great strides have been made in both curative and preventive camel disease management. But the full benefits of these achievements are yet to trickle down to the community-based camel service providers and the camel keepers, because the available information on camel diseases and management is often too technical. Also, since most camel populations are found in very remote areas, camel extension messages do not always reach the camel owner through conventional extension

channels. The biggest challenge therefore is to make the information available to CASPROs, CAHWs and pastoralists in a practical and easy to understand format.

It is important to remember that five major livestock diseases do not affect camels. These are Foot and Mouth Disease, East Coast Fever, Rinderpest, Contagious Bovine Pleuro Pneumonia and Lumpy Skin Disease.

Many camel diseases have been reported in various parts of the world. In Kenya, pastoralist camel keepers describe diseases mainly as symptoms and/or syndromes and name them using varying criteria and dialect names – a major challenge for the camel service provider. The tables in this chapter describes the most

common symptoms, syndromes and diseases as referred to by the traditionally camel keeping communities (e.g. Somali, Gabbra, Rendille and Turkana). The English names are used in all cases, but the names commonly used in the various local languages are also

given where possible. But even local names used by the same community can vary from place to place. The drug cards in this chapter describes drugs available in the local markets and how they should be used to treat camel diseases.

3.1 General disease control

An overview of general livestock disease control measures is provided in **Table 1**.

Table 1: General disease control measures

Type of Control Measure	Why	How	When	Remarks
Vaccination e.g. against Rift Valley Fever (RVF), Camel Pox, Brucellosis, Anthrax, Rabies	To help susceptible animals survive infectious diseases and / or to prevent them from becoming infected To prevent losses through deaths, abortions and lost production To protect humans against dangerous infections from livestock	Injection of killed or mild form of the disease-causing agent into the animal so it can develop immunity to the disease Sometimes undertaken on a large scale to achieve herd immunity for the purposes of eradicating a particular disease	Done to protect healthy but susceptible animals either at a specific age, before seasonal occurrence of the disease and in the face of disease outbreaks	Vaccination is particularly important against deadly infections for which there is no cure or treatment CASPROs should understand the importance of vaccination so that they can encourage their community to present their camels for vaccination when it is announced
Quarantine and/or livestock movement control, e.g. against RVF	To minimise losses through deaths, abortions, lost production and disruption of trade To contain disease outbreaks locally and prevent the spread of infection to non affected clean herds and areas	Total ban on movement of the affected and susceptible livestock species by the district veterinary authorities Closure of livestock markets	In case of disease outbreak (Export Quarantine is a controlled observation period used to prepare animals for export)	Quarantine is disliked by producers and traders, who are always looking for ways of dodging it. CASPROs should understand that if quarantine rules are followed, the veterinary authority can contain the disease outbreak quickly and hence lift the quarantine faster

Safe disposal of the remains of dead animals	Proper disposal of carcasses prevents environmental contamination	Done through burying or burning as recommended by public health or veterinary authorities	Best done immediately after death	For a disease like anthrax, the contaminated area remains a source of anthrax infection for many years Inappropriate handling of brucellosis-infected aborted foetuses and / or anthrax carcasses can lead to infection to humans and other animals
Disease surveillance and sampling	To determine the prevalence of a specific disease in a particular area	Involves regular collection of data through questionnaires and samples Also as a disease status assessment tool	Usually done in cases of disease outbreaks	CASPROs should understand the importance of surveillance so they can educate their communities on the importance of offering their animals to be sampled when requested They should also encourage camel owners to take part in participatory disease search (PDS) activities Can also be a requirement before export
Public education and awareness creation	To enlighten all stakeholders, thus assisting in disease control	Creation of village disease control committees Public fora (<i>barazas</i> , workshops, seminars, “under elders’ trees” meetings) Through the media, e.g. FM radio stations	Should be a continuous activity	No one cadre or institution can manage a disease control programme alone, hence the importance of involving all the stakeholders CASPROs will be very important in public awareness creation

3.1.1 Diseases of the skin and eye

Table 2: Wounds

Names	Madaa (Gabbra); Ngoldonyot (Samburu); Boog (Somali); Ngajemei (Turkana).
Definition	Injuries that cause breaks in the skin that may be shallow or deep.
Causative agent	Bites, physical injuries from thorns, fighting between bulls, beatings, predator attacks, castration and branding. Often get worse through infection with bacteria. Sometimes fly maggots can infect open wounds.
Mode of transmission	Pus and secretions from wounds are full of dangerous bacteria and can cause infection in animals that come into contact with them; pus and wound liquids contaminate Boma and can lead to other infections (e.g. mastitis). Bacteria are also spread by flies feeding on open wounds; flies can also lay their eggs into wounds – larvae ("maggots") grow inside the wound, leading to very serious, sometimes deadly infections. This is also called 'blowfly stroke'
Affected age group	All.
Major clinical signs	Open wounds, broken skin, lameness, pus and other secretion, bad smell, may develop into abscesses.
Disease with similar clinical signs	Camel Pox, Orf, Contagious Skin Necrosis
Seasonality	Thorns may penetrate the foot more easily during the wet season. Flies are much more common and active in the wet season. Fighting between bulls is also common in the wet season/breeding season. Bites by predators are common during prolonged dry spell and drought periods.
Treatment	<p>Clean with antiseptic (hydrogen-peroxide 2%), apply iodine once daily. For superficial fresh wounds, aerosol spray (gentian-violet) is sufficient. Always make sure that pus and wound secretion can flow from the wound and/or are removed from the wound. NEVER stitch up or close infected wounds; air contains oxygen that helps in wound healing, if air cannot get into the infected wound bacteria grow much faster and the animal can die. An open wound, cleaned daily and treated with iodine, heals much faster than a closed wound that cannot be cleaned. Injecting antibiotics alone is not sufficient, every wound needs local treatment.</p> <p>Large infected wounds need supportive injection of antibiotics (Penicillin-Streptomycin or Oxytetracycline 20% LA). For large wounds of the foot, a protective leather boot may be necessary. (see photograph)</p> <p>Maggot infested wound can be treated locally with acaricide or insecticide</p>  <p>Protective boot made of leather to protect wound on pad (Source: Chris Field)</p>

Prevention/Control	The earlier you treat a wound the less it becomes infected. Don't wait until it swells up and develops pus, treat immediately after injury or bite have occurred. Treat wounds early before they become infected, remove thorns and treat small wounds (especially in the sole of the foot). Prevent bull fights. Chronic festering wounds attract flies and lead to blow fly stroke, treating wounds early avoids such problems.
Can it affect humans	Contact with wound secretion and pus is also harmful for humans.
Notifiable disease	No
Economic and social impact	Low quality hides; if wound is severe it may affect the condition and finally the production of the camel, large infected wounds and wounds infected by fly maggots (blow fly stroke) can kill even adult camels!

Table 3: Abscesses

Names	Kharfat (Rendille); maala (Gabbra,); mala, mall, arno (Somali); ngubuthien, abus, adjumei, lobus (Turkana); ntubui, (Samburu).
Definition	Accumulation of pus under the skin or inside the body, surrounded by a hard tissue called a capsule.
Causative agent	Bacteria
Mode of transmission	External (very common): Bacteria invading the body through small and deep skin injuries from bites, Acacia thorns, skin abrasion, unclean injection, unclean castration, contact with infectious pus. Internal (rare): Caused through bacteria that have managed to get inside the organs of the body.
Affected age group	All.
Major clinical signs	Swelling of parts of the body (mainly skin and lymph nodes, but also udder and parts of internal organs) with pus accumulation. The affected area is first warm, swollen and painful; later the hard swelling becomes softer and there is no heat or pain; after 3-4 weeks, abscesses can burst and discharge pus. Suckling calves quite often develop external abscesses around the joints where the skin is rubbing on the soil when they are lying down because they have not yet developed hard skin pads like adult camels. These abscesses around the joints become chronic and affect the joint, tendons and muscle. Internal abscesses cause chronic progressive loss of condition. A specific form of hard dry internal abscesses, mostly located in the lungs, is caused by Tuberculosis.
Diseases with similar clinical signs	Haematoma (accumulation of blood due to injury). Tumours caused by cancer. Worms or Tryps can also cause chronic loss of condition.
Seasonality	None
Treatment	External abscess: When the abscess capsule becomes soft, make a cross-shaped cut with a clean knife at a low point to allow the pus to drain out. Flush it with Hydrogen Peroxide (3%), Iodine or Gentian Violet and repeat flushing for several days. In severe cases, especially in calves with several abscesses around joints, inject Penicillin – Streptomycin (PenStrep) daily for 5 days. Internal abscess: No effective treatment; antibiotics cannot penetrate the abscess capsule. Internal abscesses are only seen after death or at slaughter.

Prevention/ Control	Early treatment of wounds (see under Wounds). Use sterile needles when injecting camels and always inject where the skin is clean. Use clean knives (sterilised in boiling water) for castration. Prevent pus from contaminating the boma; do not open and drain abscesses inside the boma.
Can it affect humans	Tuberculosis is transmitted from animals to humans. Contact with pus is harmful for humans.
Notifiable disease	If Tuberculosis is suspected, it should be reported to the meat inspector and veterinary officer.
Economic and social impact	Lowers the quality of hides. Calves do not develop well and some may become crippled. Abscesses on the udder and on the teats are a source of bacteria that cause chronic mastitis, which leads to complete loss of the quarter (dead milk gland tissue) Internal abscesses are incurable and lead to chronic wasting, severe loss of production and loss of the animal.

Fig 3.2 When and how to flush an abcess

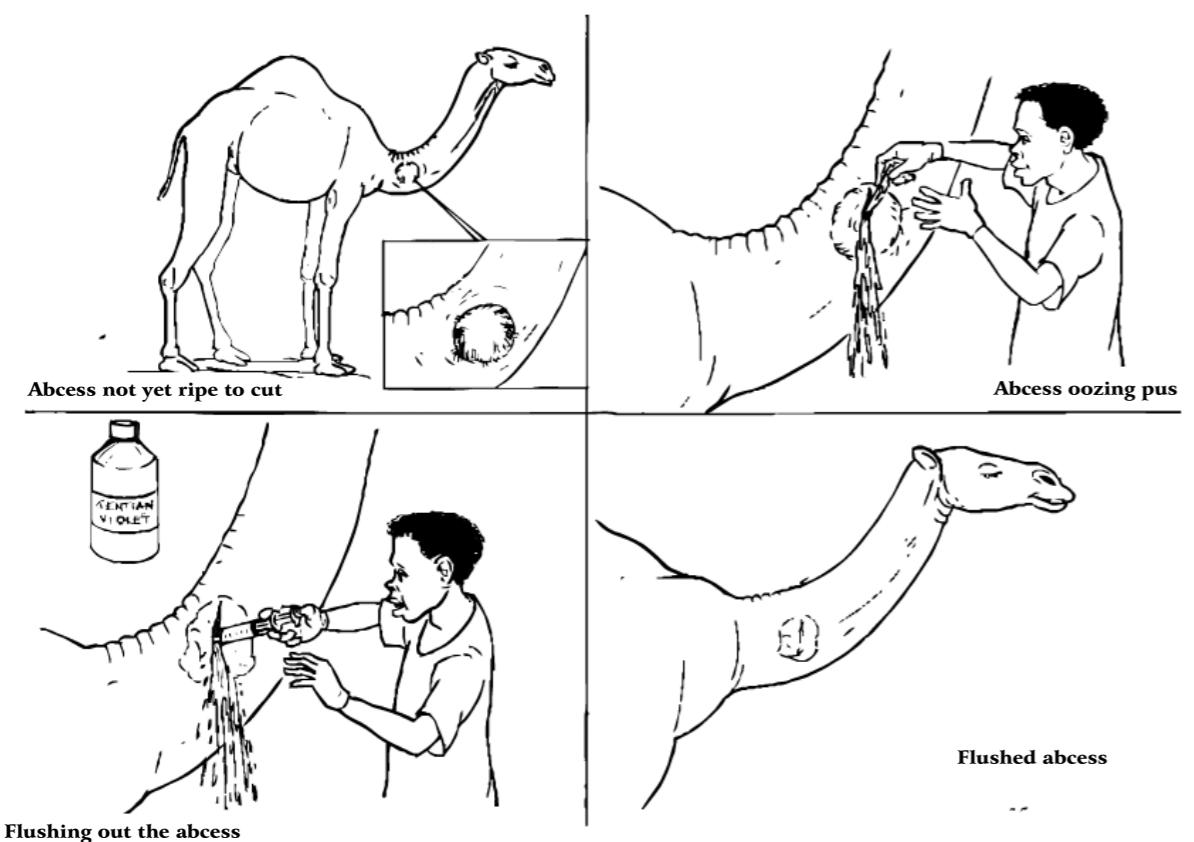


Table 4: Camel pox

Names	Furuk, (Somali); Chito (Gabbra); Afturo (Rendille); Abturo (Samburu); Ekolimeri (Turkana)
Definition	Highly infectious skin disease causing typical pox lesions.
Causative agent	Camel Pox virus (<i>Orthopoxvirus camelii</i>) Camel Pox only affects camels.
Mode of transmission	Main factor is contact with affected herds; short distance transmission mainly through inhaling, but virus also enters body through skin injuries or through insect bites, also transmitted via contaminated Boma. Outbreaks occur at intervals of several years, sometimes related to stress and poor nutrition.
Affected age group	Mainly young camels up to 3 years (non-immune animals born after the last pox outbreak). If adults are affected, the disease is usually more severe.
Major clinical signs	Lesions start as small red patches; they swell and become liquid filled pustules with a depressed centre (= the pox), these then rupture and turn into blisters (it is at this ruptured stage that most lesions are seen on the skin). If a lot of flies feed on the blisters, the blisters become infected by bacteria and start producing pus. Healing can take 4-6 weeks and over that period the camel can become very weak. Mild form: Pox found only around nose, mouth, eyes and under the tail, recovery without problems. Severe form: Fever, the animal is very dull, no appetite, swelling of the head before pox appears. Pox distributed all over the body. Often the pox get infected with bacteria and develop pus (camels covered in pus lesions all over the body become very weak and may die). Pox on the teats make milking difficult which regularly leads to mastitis. Swollen lymph nodes. Especially in young camels, the same pox lesions which are visible on the skin also develop inside the nose and the lung and can lead to severe secondary pneumonia and death if not treated early. In severe pox outbreaks, 3 out of 10 infected young camels can die, most pregnant females abort and milk production is disrupted! Peracute form (only in adults): Severe swelling of the head and throat, leads to rapid death (shock-like death with foam in the mouth in less than 24 hours) before any skin lesions occur. After recovering from Pox, camels are immune for life; normally, they get the disease when they are young.
Diseases with similar clinical signs	Orf; Mange; Contagious Skin Necrosis. Mild Pox and Orf look exactly the same!
Seasonality	Cases are more severe during rainy seasons (lot of flies) and less severe in dry seasons; outbreaks are separated by several Pox-free years.
Treatment	No treatment for virus, but in severe cases especially when young camels start showing signs of pneumonia(!) or when lesions produce pus and camel becomes very weak, use Pen-Strep (daily injection for 5 days) or Oxytetracycline 20% LA injection (repeat injection on day 4). If available, also inject Vitamin A (often sold as Vitamin ADE combination), which helps with the recovery.

Prevention/ Control	Vaccination is possible, but the vaccine is only available in UAE, still too difficult to get in East Africa. When camel herd is in a Pox outbreak, ensure good nutrition and avoid stress. During outbreaks avoid all contact with other camel herds.
Can it affect humans	Normally not, exceptional cases reported
Notifiable disease	No
Economic and social impact	One of the economically most devastating camel diseases! Camel Pox disrupts the whole reproduction and production cycle of the camel herd through abortions, loss of young camels and loss of milk. Loss of young camels and abortions lead to severely reduced herd growth, which is still felt one year later. Recovered young animals may grow slower. Milk production is lower and may even stop in many females. There is also the increased risk of contracting mastitis. Because almost all animals in a herd can become infected at the same time and many of them need treatment, this is a very costly disease.

Table 5: Orf

Names	<i>Mburur, Humbururu</i> (Borana & Gabbra); <i>Lopedo, Non-kutukie</i> (Samburu); <i>Ambarrur, Mburur</i> (Somali); <i>Ngiborwok, Mburuwok</i> (Turkana). Other names: Pustular Dermatitis, Contagious Ecthyma, Sore Mouth.
Definition	Pox-like swellings on the skin around the mouth, lips and nose. May initially appear in the form of a swollen head.
Causative agent	Virus (<i>Parapoxvirus</i>).
Mode of transmission	Contact and suckling; virus enters through lesions on lips.
Affected age group	Calves and weaners below three years; disease is usually more severe in weaners and older calves than in young calves
Major clinical signs	Nodules or swellings which turn into blisters (that look exactly the same as pox lesions), then form scabs that can become confluent on the head; the same lesions that are visible on the skin also appear inside the mouth and nose, in severe cases they can even spread to the stomach. Other common signs are watery eyes, dullness, stinking breath and swollen lymph nodes. Calves have serious difficulties in suckling and feeding. Swelling of the head can occur before skin lesions become visible. In mild form, only a few blisters/scabs occur around the mouth and heal quickly.
Diseases with similar clinical signs	Camel Pox, Contagious Skin Necrosis, Ringworm, Mange
Seasonality	Related to calving season i.e. during wet season but may also occur during the following dry season
Treatment	Treat severe cases with Penicillin-Streptomycin daily until recovery and wash mouth with antiseptic solution (e.g. iodine). Apply Vaseline petroleum jelly on the affected areas to soften the skin and assist sick calves to suckle if necessary, bottle feed extreme cases. Injecting Vitamin A D E helps with the recovery.
Prevention/Control	There is no vaccine. Calves and weaners in good condition recover faster; good management of lactating mothers, allowing calves to suckle enough milk and deworming of calves/weaners are important.
Can it affect humans	Yes
Notifiable disease	No
Economic and social impact	Impaired suckling and feeding ability can lead to stunted growth and sometimes even death of calves

Table 6: Mange

Names	<i>Lpepedo</i> , (Samburu); <i>Emitina</i> , (Turkana); <i>Adho, Chitto, Addha</i> (Somali); <i>Haddo</i> (Rendille); <i>Simpirion</i> (Pokot). <i>Chitto</i> (Gabbra, Borana)
Definition	Parasitic skin disease.
Causative agent	Parasite: Mite (<i>Sarcoptes scabiei var. camelii</i>).
Mode of transmission	Through direct contact with infected animals, with contaminated objects (including trees stems on which camels like to rub) and via a contaminated Boma; the mite penetrates and stays under the skin but can also survive for some time in dead skin scabs shed by affected camels.
Affected age group	All, including young calves.
Seasonality	More common during rainy seasons.
Major clinical signs	Severe itching, especially in the morning, and hair loss, mostly starting on the head and spreading from there to other parts of body. Hair loss is later followed by formation of dead skin scabs and thickening of the skin (skin develops folds, looks like elephant skin). Animals with such chronic mange are very difficult to treat. Typical sign is the almost permanent itching, not seen in other skin diseases. Some animals may show almost normal skin, but there is always severe itching, much more intensive than grooming behaviour.
Diseases with similar clinical signs	Ringworm, Contagious Skin Necrosis, Camel Pox, Orf
Treatment	Preferred treatment: Ivermectin 1% injection; 2 doses 8 days apart (note that this treatment interval is specific for camels and is shorter than the interval recommended by the manufacturer for cattle); sometimes three treatments at 8 days' interval may be necessary (very costly!). In between the two Ivermectin injections, it is important to first wash animals with a detergent and in particular rub off all dead skin scabs (with a brush); then an acaricide must be applied on the skin, best done by spraying manually with a knapsack. After washing and acaricide treatment, move camels to a clean fresh boma In cases where Ivermectin is too costly for the camel owner, the following treatment protocol is also efficient if carried out correctly: FIRST washing with detergent (+ brushing of dead skin); SECOND spraying twice (better three times) with acaricide at eight days' interval and moving camels to new clean boma after first spraying. Spraying must be done thoroughly such that the whole skin surface is reached by the acaricide, including the head and insides of the ears. Calves born in between two treatments must also be injected twice and treated with acaricide, the same as the adult camels. CAUTION: One single untreated calf can act as a source of slow re-infection for the whole herd; despite spending a lot of money on treatments, mange then comes back spreading throughout the herd Caution: A single treatment does not eradicate disease from the herd because this only kills the adult mites, while mite eggs left behind in the skin hatch within a week. Hence the need for at least one more treatment, otherwise Mange will slowly come back in the herd. Also Ivermectin does not penetrate into dead skin scabs, hence need for washing and removing all dead skin in between the injections Note: Because of very long drug withdrawal period, Ivermectin should not be used in lactating camels! If you have to treat lactating camels for Mange, use washing + 3x acaricide spraying (observe milk withdrawal period for acaricide). See drug card 2

Prevention/Control	Once in the herd, Mange is very difficult and very costly to eradicate, because the entire herd has to be treated twice at the same time. A major problem is sharing of grazing and water points with other Mange-infected camel herds and also introduction of Mange by clean looking infected camels from other herds. When introducing new camels into a clean herd, inject them twice with Ivermectin at 8 days' interval, before allowing them to mix with the clean camels Early treatment is advisable. Good feed and good mineral supplementation reduces severity.
Can it affect humans	Yes, has been observed occasionally.
Notifiable disease	Yes, report to veterinary authority.
Economic and social impact	Severe Mange shortens the time that camels feed each day, reduces their body condition and productivity, lowers milk yield, causes stunted growth in calves, low quality hides. This disease does not kill camels but costs the owner a lot of money.

Can it affect humans	No
Notifiable disease	No
Economic and social impact	Affected camels cannot be used for carrying loads, low quality of hides. In severe cases, it can affect production and condition of the animal.



Fig 3.7 Cutaneous Skin Necrosis in camels
Source: Maurizio Dioli

Table 7: Contagious Skin Necrosis

Names	<i>Dulla</i> (Borana); <i>Dula</i> (Gabbra), <i>Kharfat</i> , <i>Garfat</i> , <i>Hilaliit</i> (Rendille); <i>Garfat</i> , <i>Dalleham</i> , <i>Dhaleeco</i> , <i>Ma'ah</i> , <i>Maha</i> (Somali); <i>Lomgoi</i> , <i>Ngamanyeni</i> (Samburu); <i>Lelebunai</i> (Turkana).
Definition	Skin disease that causes localised drying and breaking up of the skin, multiple spontaneous skin wounds and sometimes abscesses.
Causative agent	Caused by insufficient salt in the diet (mineral deficiency). Bacteria infect the skin wounds (pus and abscesses).
Mode of transmission	Skin disease starts when camels suffer from long-term mineral deficiency and the skin breaks up. ("Contagious" means "infectious," because the disease was thought to be caused by an infection)
Affected age group	Especially in adults, but also in older weaners.
Major clinical signs	Lesions can be located anywhere on the body, but more common on neck, shoulders, flanks and hind quarters. Begins as painful swellings of the skin; starting from the centre of the swelling, the hair falls out, then the skin becomes hard and dry scabs appear, which fall off after 1 to 2 weeks causing a wound with sharp irregular edges (like an ulcer). At the beginning, a clear discharge comes out. Later, it often gets infected with bacteria, leading to discharge of pus. This can continue for months. After healing, a star shaped scar remains.
Diseases with similar signs	Wounds, Abscesses, Ringworm and Mange.
Seasonality	None
Treatment	Feed plenty of salt/minerals to camels or take camels to salty pastures/salty springs. Clean affected area and apply iodine. In severe cases, inject Penicillin-Streptomycin daily for 5 days.
Prevention/Control	Ensure camels have regular access to salt (mineral supplementation, salty pasture, salty water sources). Provide quality salt and/or move to new pasture when first cases occur.

Table 8: Tick infestation/paralysis

Names	<i>Shilmi</i> , <i>Chilim</i> , <i>Yagar</i> , <i>Yakhal</i> (Gabbra); <i>Shilim</i> , <i>Chillim</i> , <i>Turdach</i> (Rendille); <i>Shilin</i> , <i>Yakhal</i> (Somali); <i>Ilmangeri</i> , <i>Lmanjeri</i> , <i>Imansher</i> , <i>Itunturi</i> (Samburu), <i>Ngimadang</i> , <i>Emadang</i> (Turkana), <i>Shini</i> , <i>Shelem</i> (Borana)
Definition	Ticks attached to skin causing harm and nuisance to the animal.
Causative agent	Different tick species.
Mode of transmission	Ticks attach themselves to animals to feed on their blood.
Affected age group	All age groups but particularly important among calves and weak camels.
Major clinical signs	Specific sites where ticks attach to camels: nostrils; under the tail; inside of the thigh and inside of the armpit; on the teats; on the scrotum of the male. Presence of a large number of ticks causes general weakness, loss of blood (anaemia), loss of weight, skin wounds and stunted growth in calves. <i>Hyalomma</i> nymphs ("white ticks" attached mainly in the long hair of the hump) can inject a toxin into the blood, which causes tick-paralysis and fast death in young suckling calves (older camels are normally immune against the toxin). Ticks on the teats cause wounds that can lead to mastitis (see Mastitis). Sometimes there is difficulty in breathing when large numbers of ticks are attached inside the nostrils, causing blockage.
Diseases with similar clinical signs	None.
Seasonality	Ticks more active about 2-3 weeks after rains.
Treatment	Manual removal followed by burning of the ticks, traditional remedies like <i>Commiphora africana</i> resin mixed with water and milk applied in the nostrils. Use commercial pour-on acaricides that are licensed for use in camels. When signs of paralysis appear in suckling calves, <i>Hyalomma</i> nymphs must be removed very quickly (manually) to prevent fast death of the calf from rapid increase of tick toxins in the blood.
Prevention/Control	If an area has too many ticks, shift Boma to new location. Avoid known tick-infested areas, especially during rains. Keep tick numbers low using commercially available acaricides applied to the specific sites where ticks attach to camels (save on acaricide costs: there is no need to spray the whole camel).

	Traditional shaving of calves along the hump and back has been reported to be beneficial. Unlike cattle, camels do not suffer from tick-born diseases like ECF/Babesia/ Anaplasma, so small numbers of ticks are not a problem
Can it affect humans	Ticks can transmit diseases to humans.
Notifiable disease	No
Economic and social impact	Loss of production and poor weight gain, loss of calves, low quality of hides, increase in mastitis.

Table 9: Eye infection

Names	Dhaasi (Gabbra); Moyian Yonkouyek (Samburu); Kolumay (Pokot) Itwaren (Somali); Edeke Ankonyen (Turkana). Also called Pink Eye
Definition	Disease of the eye.
Causative agent	Different bacteria (common); Eye worm (<i>Thelazia leisci</i> -Rare).
Mode of transmission	Bacteria are spread by flies or enter eye via injuries (mainly from thorns). Sand/dust entering and irritating the eye; dust can also carry bacteria. Eye worm transmitted by flies from infected eyes to clean eyes. Irritation due to tick bites in the eye lid.
Affected age group	All.
Major clinical signs	Swollen red eye, painful, eyelids closed, discharge from eye (either clear or with pus), temporary blindness flies clustering around the eye. Can affect one or both eyes. (Eye worm is very thin, 1-2cm long, and can sometimes be seen in the eye.) If untreated for a long time, loss of the eye can occur.
Diseases with similar clinical signs	None
Seasonality	Windy, dry and dusty conditions.
Treatment	Wash the eye with salt water and apply antibiotic ointment (e.g. a few drops from mastitis tubes) at least twice a day for 5 days. If possible, carefully remove any foreign body or eye worm from the eye. If worm infection is suspected, instil a few drops of ivermectin into the eye.
Prevention/Control	Check eyes of camels that are lacrimating (shedding tears) for foreign bodies and eye worms. Treat early to avoid eye secretions/pus attracting flies, which can transmit infection to other camels.
Can it affect humans	No
Notifiable disease	No
Economic and social impact	In severe infections involving both eyes, general condition of the camel becomes poor, leading to reduced production and sometimes blindness. In very severe cases eye ball can rapture leading to permanent loss of an eye.

3.1.2 Diseases affecting stomach and intestines

Table 1: Diarrhoea in suckling camel calves (up to 3 months of age)

Names	Halbathi (Gabbra); Ngiriat (Samburu); Adeya, Har, Hardik (Somali); Eremoru, Colera, Loleo (Turkana); Haar (Rendille).
Definitions	Frequent passing of loose faeces in suckling calves.
Causative agent	Bacteria (<i>Salmonella sp.</i>); Parasites (<i>Coccidia</i> : especially <i>Isospora orlovi</i> , sometimes also worms/Helminths); Viruses (<i>Rota-</i> and <i>Coronavirus</i>).
Mode of transmission	From contaminated environment and through direct contact from one scouring calf to the next; the more calves have diarrhoea the higher the contamination of the Boma and the higher the risk of new infections. other sources of infection are contaminated water and contaminated feed.
Affected age group	Mainly from birth up to 3 months of age.
Major clinical signs	Frequent passage of loose (watery, bloody, pasty, with pieces of mucosa, at times also smelly) faeces at the beginning. Very little if any passage of faeces after some time but constant pressing; soiled hind legs; sunken eyes (dehydration = no fluid/water in the body, drying up of the body); dullness, weakness; no appetite; death due to dehydration/ too little fluid left in the body!!! Dehydration signs are: Eyes sunk deep into the socket; skin fold when raised does not slide back; calf very dull and feels cold on the nose, calf cannot stand up (diarrhoea calves that cannot stand are about to die!).
Diseases with similar signs	None
Seasonality	Especially common when a lot of calves are born over a short period. Coincides with dirty Bomas during wet period.
Treatment	The most important treatment measure regardless of the cause of diarrhoea is replacing the lost fluid (rehydration) . Don't wait until calf is dull and cannot stand up; start treatment when diarrhoea calf can still stand and suckle! Instruction how to give oral rehydration fluid: Mix 5 tablespoons of sugar and 1 tablespoon of salt with 2 litres of clean water (boil water and let it cool down before mixing). Instead of 5 tablespoons sugar, it is also very good to use 5 tablespoons of honey. A calf of 30kg needs a minimum of 3 litres per day (minimum 1 litre for 10 kg of body weight per day). Feed the rehydration fluid in small portions at the rate of one and a half cups' full at a time (equal to about 0.5litre). <ul style="list-style-type: none">▪ In addition, finely crushed charcoal (like powder) can be added to the rehydration fluid (2 handfuls of charcoal powder per litre, then passed through a sieve before giving it to the calf).▪ Rehydration fluid should be given for 5 days.▪ Milk may be withheld for first 24 hours but not for longer than 36 hours. So from the second day on you can start giving small amounts of milk while still feeding rehydration fluid. (See illustration on next page) Antibiotics are not required to treat diarrhoea but Sulphonamides given orally can be used. Calves that cannot stand up any more need both oral and intravenous rehydration therapy; for this, the services of a veterinarian will be required.
Prevention/Control	Give calf colostrum (the dense first milk produced by the mother after birth) during first 3-6 hours after birth. Move Boma frequently and do not put too many animals in one Boma (don't overcrowd). Separate sick calves from healthy ones. Start rehydration early so that calf does not get weak.
Can it affect humans	No
Notifiable disease	No
Economic and social impact	Most important disease in suckling camel calves; 3 out of 10 affected camel calves die from diarrhoea resulting in limited herd growth; most dams stop giving milk without their calf, resulting in loss of one whole lactation, and reduced availability of milk for household consumption and sale.

Mix 5 tablespoons of sugar and 1 tablespoon of salt in 2 litres of clean water (ideally boiled)



Fig 3.4 How to rehydrate a camel calf

Note that a 30kg calf actually needs 3 litres of rehydration mixture per 24 hours. So you need to prepare a second 2 litre bottle of rehydration mixture when the first one is finished

Table 2: Gastro-Intestinal Worm Infections

Names	<i>Ntumai</i> (Samburu); <i>Goryan, Bahala</i> (Somali); <i>Ngirtan, Nyiritan</i> (Turkana); Deyah (Rendille), <i>Mini</i> (Gabbra); <i>Chepturu</i> (Pokot); <i>Mnyoo</i> (Swahili).
Definition	Presence of parasitic worms (mainly round worms) in stomach and intestines that interfere with digestion and lead to chronic inflammation of the stomach and intestines.
Causative agent	Parasite: Many different species of parasitic worms (also called Helminths, Nematodes or round worms): Worm eggs and larvae found on pasture (microscopic in size). There are stomach worms, living in the stomach and intestinal worms, living in the intestine; stomach worms are mostly minute and difficult to see with the eyes, but they cause much more damage than the larger intestinal worms. Occasionally, camels also excrete tapeworms, which are the biggest worms but only cause harm in camel calves.
Mode of transmission	Via pasture. Worm eggs and larvae are found on pasture. When it is wet, larvae hatch from the eggs and are swallowed during grazing. When it is dry, larvae on the pasture are inactive and the risk of infection is very low.
Affected age group	All, except young suckling calves less than two months old that do not graze yet.
Major clinical signs	Different worms have different pathogenicity. Many of the species cause similar clinical signs in the animal. When in large enough numbers, many cause general weakness and reduced productivity. Often, when the numbers of the worms are not very high, the animals are alert and feed well (no fever!) but may lose condition. Some dangerous worms are almost too small to be seen with the naked eye. The signs of worm infection are especially severe in young camels and in animals on poor nutrition. For practical purposes one can look at two groups of Round Worms: Non-bloodsucking worms causing mainly diarrhoea, rough hair coat, bloated stomach, chronic weight loss and stunted growth in young camels because of poor absorption of nutrients; the ones living in the stomach (<i>Trichstrongylus</i> and <i>Ostertagia</i>) are very common and cause severe problems. Bloodsucking worms that attach to the wall of the stomach and suck a lot of blood and cause mainly anaemia (visible as paleness of mucous membranes of the eye); often, there is also diarrhoea. Bloodsucking worms like <i>Haemonchus</i> cause rapid weakening of the camel and can even kill young animals. Camels can also be infected by tapeworms (<i>Monieza</i>) that live in the intestine and may cause obstruction and colic in the young.
Diseases with similar clinical signs	Trypanosomosis (anaemia, oedema); diarrhoea caused by viruses and bacteria (viruses and bacteria infections normally cause fever); diarrhoea caused by Coccidia; chronic malnutrition; internal abscesses; tuberculosis.
Seasonality	Especially common after onset of rains and under wet conditions.
Treatment	Worms cannot be eradicated but should be treated early to avoid a too high worm burden, which can seriously harm the animal. Oral de wormers: Drench or bolus (e.g. Albendazole, see drug card 1); Levamisole is not recommended for camels because it has late and inconsistent action in camels. Injectable dewormer (subcutaneous injection) e.g. Ivermectin 1%, dosage 1ml/50kg (See drug card 2)

	<p>Timing of de worming is determined by the rainfall, because worm larvae on the pasture are active when it is wet and that is the time when camels become infected. High worm burden in camels can occur about 3-4 weeks after the start of the rains.</p> <p>Resistance of the worms to the drugs used in de worming is becoming more common and is caused mainly by underestimation of body weight and underdosing of the drug. This is a major problem. It is very important to correctly estimate the weight (see chapter 2) of the animal before giving the "dawa"!</p>
Prevention/Control	<p>Avoid overstocking and your camels staying on the same pasture for very long, because this leads to high contamination of the pasture with worm eggs and larva. Camels can also be infected by worms that come from sheep and goats. When too many animals (camels, sheep, goat) are grazed in the same area, the contamination of pastures with worm eggs and larvae can reach dangerous levels and worms become a big problem. Moving away from overcrowded pastures onto fresh pastures, especially during the rains, avoids such problems.</p> <p>Shift the Boma regularly, not only in the dry season but also during the rains. Inspect your camels regularly and deworm when first signs of worms appear in an animal (diarrhoea without fever, weight loss but good appetite, rough coat, pale membranes). If you see any roundworms (they look like spaghetti) in the faeces, is a clear sign that many smaller "invisible" worms are present and that it is time to deworm the animal.</p>
Can it affect humans	No
Notifiable disease	No
Economic and social impact	<p>Worm infection leads to weight loss, loss of milk and meat production, reduced fertility, stunted growth and late maturity. Experts estimate that the combined economic damage caused by worms in camels is second only to that caused by chronic Trypanosoma infection. Many animals are infected with low numbers of worms and do not show any signs of disease. It is important to treat camels early when signs show that infection levels are going up and before camels start really suffering from worms and productivity starts going down.</p>

3.1.3 Diseases affecting internal organs, blood and brain

Table 1: Anthrax

Names	Kud, Khut (Somali); Lochum (Samburu); Chilmate (Gabbra); Renwihara (Rendille).
Definition	Infectious disease affecting both human and animals. It can kill camels and humans very quickly! Anthrax spores are very resistant and cannot be destroyed by boiling or by normal disinfectant.
Causative agent	Bacteria (<i>Bacillus anthracis</i>)
Mode of transmission	When an animal dies from Anthrax and the dead body is not buried deep or burnt completely, the pasture becomes contaminated with Anthrax. Camels can become infected through grazing on such infected pastures, drinking contaminated water and through consumption of contaminated soil or bones or inhaling dust with Anthrax spores. Anthrax contaminated pastures/soils remain dangerous for camels for many years! Such areas are usually known to the camel owners (often these are flood zones only grazed in dry season).
Affected age group	All except young calves that are only suckling. (affects all livestock species)
Major clinical signs	<p>Peracute (very rapid) form: Sudden death without symptoms</p> <p>Acute form: Fever, bloat, diarrhoea, irregular and fast breathing convulsions, leading to death within 1-2 days. Unclotted dark tar-like blood coming out of all body openings. The blood remains liquid. The dead body does not become stiff and decomposes very fast.</p> <p>Sub-acute form: Painful swelling of head and neck, swelling (edema) of the tongue, foamy blood coming from the mouth. This form can go on for several days before the animal dies.</p>
Diseases with similar clinical signs	Camel Sudden Death; Swollen Gland / Hemorrhagic septicaemia; Tse-Tse transmitted Trypanosomiasis (<i>T. vivax</i> and <i>T. congolense</i>)
Seasonality	Common during the dry season, when flood plains have to be used for grazing because no other pasture is available. Flooding can contaminate previously safe pastures with Anthrax. Can occur throughout the year.
Treatment	In early cases use PenStrep (doubled dose) for at least 5 days; in many cases this is not possible as the disease runs a very short course and death comes extremely fast.
Prevention/Control	WHEN ANTHRAX IS SUSPECTED, DO NOT OPEN THE CARCASS! Dispose of carcasses through burning or burying. In cases where this is not possible, guard the carcass against being opened by scavengers (dogs or hyenas) Unopened carcasses decontaminate themselves over time (2 days). Never dissect or open the carcass; the moment the dead body is opened millions of Anthrax spores are released and contaminate the environment! Avoid affected grazing areas. If you have to graze your camels in an Anthrax area, vaccinate animals with recommended Anthrax vaccine on a yearly basis. (Same vaccine as in cattle)
Can it affect humans	Yes! Caution: Humans can get infected through contact with carcasses and through consumption of infested meat even if meat is boiled! Inhalation of contaminated air can also lead to infection as when handling hides and skins. If a human gets sick after contact with an Anthrax infected animal, he has to be treated with high doses of Penicillin within hours, otherwise he will die!
Notifiable disease	Yes, report to veterinary authority.
Economic and social impact	Loss of animals, reduced use of pasture, loss of production. Danger of human infection!

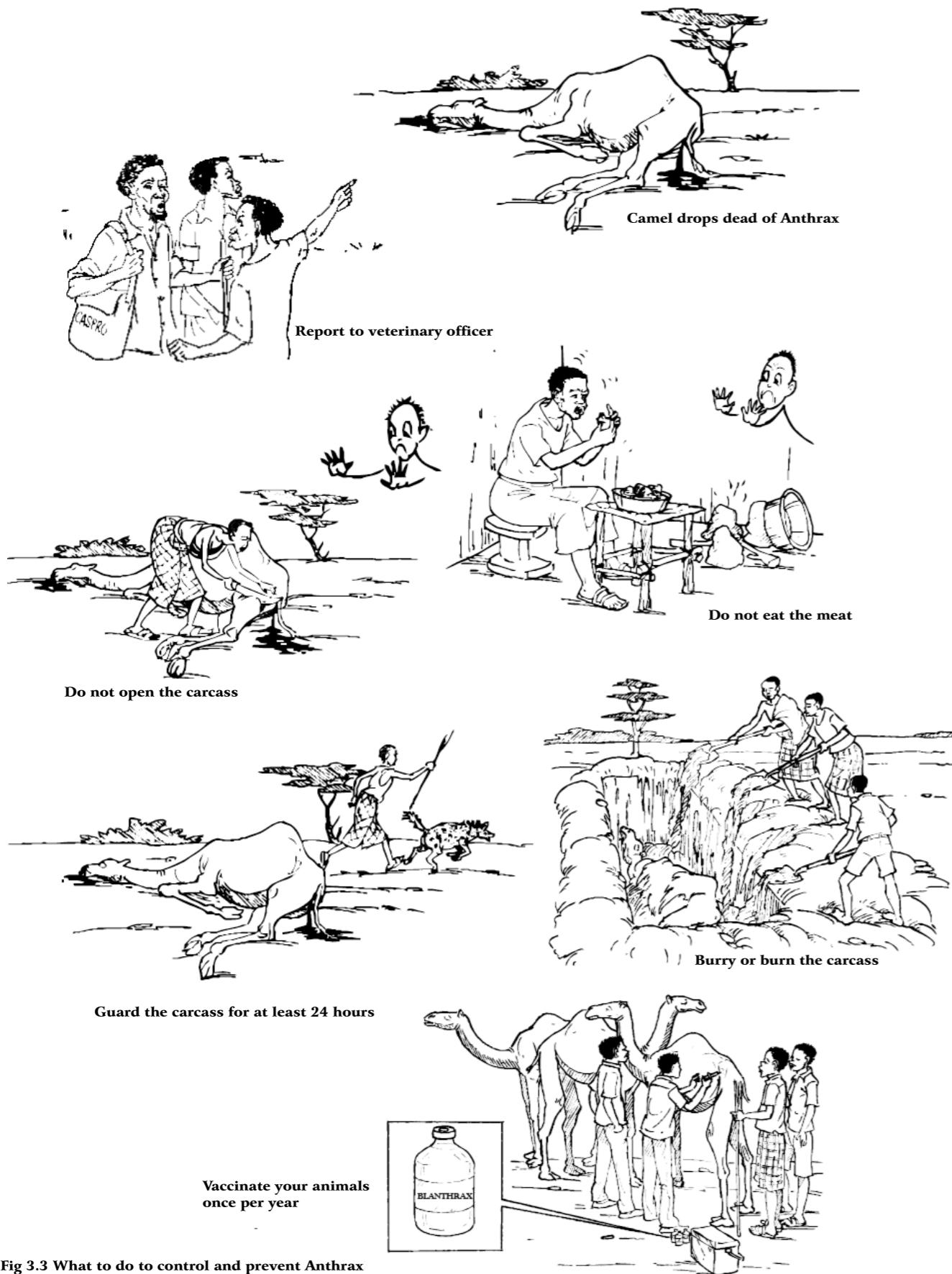


Fig 3.3 What to do to control and prevent Anthrax

Table 2: Hydatidosis

Names	<i>Mholimboli</i> (Samburu); <i>Labusiyon</i> (Turkana)
Definition	Infectious parasitic disease causing round swellings (cysts) mainly in the liver and lungs.
Causative agent	Parasite: Tapeworm (<i>Echinococcus granulosus</i>) of dogs and other carnivores.
Mode of transmission	Camel grazes in pasture contaminated with eggs shed in the faeces of dogs and other carnivores (eggs are microscopic = invisible).
Affected age group	All
Major clinical signs	Cysts in liver, lungs and other organs seen when camel is slaughtered. Affected camels can show chronic weight loss. If cyst is located in the brain camel shows central nervous signs (e.g. circling movement).
Diseases with similar signs	Internal abscesses, tuberculosis
Treatment	None
Seasonality	None
Prevention/Control	Inspect carcass, organs and offal carefully for cysts. Some cysts may be very small and difficult to detect. Do not consume organs that have cysts. Do not consume raw meat! Do not feed dogs with organs or any slaughter offal, unless the meat inspector has confirmed that the camel is free of cysts! At slaughter, bury or burn organs with cysts so that dogs and other carnivores cannot eat them. When slaughtering, all offal must be buried or burned to prevent dogs and other carnivores from eating it. Deworm your own dogs regularly against tapeworms, read instructions to confirm that the de wormer you use is effective against tapeworms (some de wormers only cover roundworms).
Can it affect humans	Yes, through transmission from dog faeces. In humans, this is a serious chronic disease with cysts growing in the organs and causing death; it is also difficult to treat.
Notifiable disease	No
Economic and social impact	Loss of food and revenue through condemned organs. Serious human health and public health hazard!

Table 3: Respiratory Infection and Pneumonia

Names	Qufa, Kufa', Furri (Gabbra); Dahassi, Yaharr (Rendille); Laxawgal, Ah, Dhugato, Dugub, Erghib, Kharid Dugub, Oof (Somali); Loukoi, Lotai (Turkana); Nkorroget, Loroget, Lchama, Ibus bus (Samburu).
Definition	Infection & inflammation of upper respiratory tract (nose, windpipe). Pneumonia: Infection & inflammation of the lungs.
Causative agents	Bacteria, viruses. Camel bot fly (<i>Cephalopina titillator</i>), also called nasal bot fly*. Accidental introduction of fluid into the lungs (incorrect drenching with de-wormer or rehydration fluid) can cause severe inflammation ("Aspiration Pneumonia"). [Camels can be infected by lungworms, but only in cold wet climates (Kazakhstan, Russia, Mongolia)]
Mode of transmission	Inhalation – close contact with sick camels. Fly lays eggs in the nose of the camel.
Affected age group	All.
Major clinical signs	Upper respiratory tract infection: Nasal discharge, light coughing, camels a bit dull but still feeding (infection has not reached the lungs, if camels are in good condition the majority will recover), especially in weak animals the infection can spread to the lungs. Pneumonia stage: deep and painful coughing, complete loss of appetite, very dull, fever, fast and difficult breathing; leads to long lasting severe sickness and even death if not treated The Camel bot fly is very common in Kenyan camels; the larva live inside the nose and sometimes cause clinical signs like restlessness, off feed, sneezing, particularly when mature larvae (maggots) emerge from the nostrils; occasionally bot fly larvae can reach the brain, causing infection of the brain and central nervous system; there is one report where bot fly larvae have also been found inside the lung. Aspiration Pneumonia: Sudden onset of acute breathing problems.
Seasonality	Common in the rainy season; chilly weather (wet and windy) can trigger outbreaks.
Treatment	Upper respiratory tract infection is caused mostly by viruses and does not need treatment, but camels must not be stressed or driven over large distances. Pneumonia stage: Caused by bacteria and must be treated; inject Penicillin Streptomycin (daily), or Amoxycillin LA (every 48 hours) or Oxytetracycline 20% LA (every 4th day). Pen-Strep usually most effective. Camel bot fly larvae respond very well to Ivermectin injections; if the brain is affected by migrating larvae, a combination of Ivermectin plus antibiotic treatment can be attempted. Treatment for Aspiration Pneumonia is often unsuccessful because of lung damage.
Prevention/Control	Reduce stress, isolate sick animals, provide shelter; protection from wind is especially important for calves. Avoid contact with affected herds. Inject Ivermectin to avoid camels carrying too many bot fly larvae in their nose.
Can it affect humans	No
Notifiable disease	No
Economic and social impact	Loss of production. If untreated or treated too late, Pneumonia may cause death; animals recovering after long lasting Pneumonia remain stunted

* The nasal bot fly is well known to camel pastoralists; mature larvae (maggots) drop from the nostrils and can be seen on the ground before they pupate in the soil. The fly has the following names in the vernacular: *Rhamu* (Gabbra), *Senghelel* (Rendille), *Sangaale* (Somali), *Marsomwa* (Samburu).

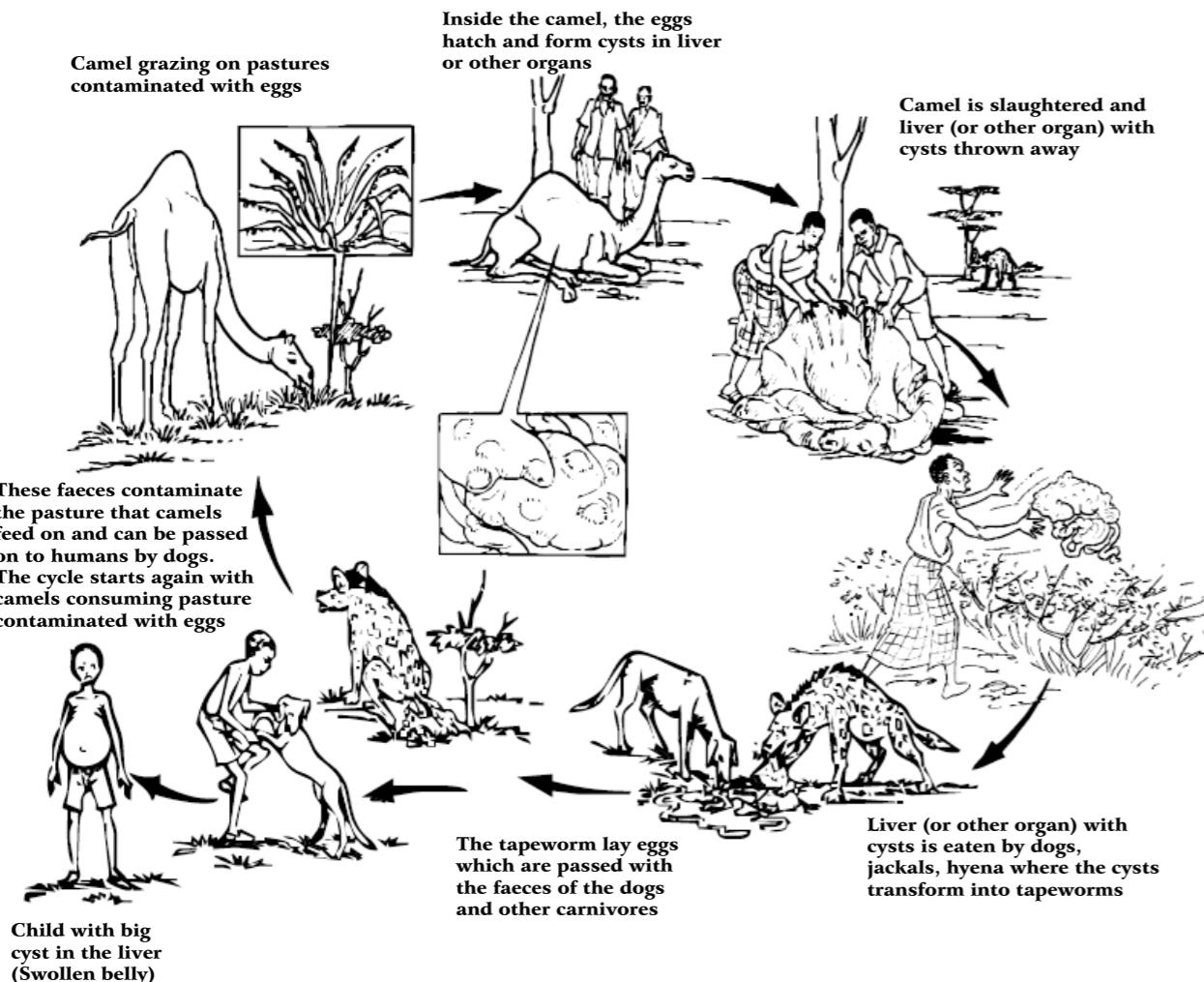


Fig 3.5 The vicious cycle of hydatidosis infection

Table 4: Trypanosomiasis

Names	Gandi (Gabbra); Dukan (Somali); Omar (Rendille); Saar (Samburu); Ltorobwo, lokipi (Turkana).
Definition	A parasitic disease in the blood caused by different <i>Trypanosoma</i> species.
Causative agent	Protozoan parasites called Trypanosomes that live in blood. <i>Trypanosoma (T.) evansi</i> is very common in all camel keeping regions. <i>T. congolense</i> and <i>T. vivax</i> occur only in and near tse-tse fly infested areas.
Mode of transmission	<i>T. evansi</i> is transmitted mechanically by all bloodsucking flies (Tabanids), including the camel fly – a large shiny reddish coloured fly that sucks blood specifically from camels (<i>Hippobosca camelina</i>). <i>T. congolense</i> and <i>T. vivax</i> are transmitted by tse-tse flies.
Affected age group	All, but uncommon in camels below one year of age.
Major clinical signs	Abortion and premature birth of weak calves; development of edema on abdomen, on base of neck, sometimes also on scrotum and on the legs up to the knees and the hocks, edema very common with <i>T. congolense</i> infections <u>Very common:</u> The chronic form caused by <i>T. evansi</i> . Abortion soon after infection before camel appears sick; sudden drop in milk production; chronic weight loss progressing over a long period; pale mucous membranes; flow of tears from the eyes; camels appear “sleepy” – they sit down and rest while other camels are feeding; dull coat; long hair at the tail coming off easily. Weak camels become susceptible to many other diseases (e.g. pneumonia). Their urine has a characteristic smell. In majority of cases, death occurs after many months of illness. At post-mortem, camel often has a lot of water inside the abdomen. Spontaneous self-cure occurs, but is very rare. <u>Less common:</u> The acute central nervous form caused by <i>T. evansi</i> . Brain affected, leading to dullness, blindness (typical sign!) and abnormal behaviour like crying and running around like a rabid animal. Death occurs after few weeks. <u>The acute haemorrhagic form:</u> Only in and near tse-tse areas, caused by <i>T. congolense</i> and <i>T. vivax</i> . Acute form causing rapid death within a few days (esp. <i>T. vivax</i>). Dead camel shows internal bleeding and blood under the skin. NOTE: Because camels migrate over long distances, infection with trypanosomes may take place in one location, but clinical signs may become visible in a different location.
Diseases with similar clinical signs	Acute forms: Rift Valley Fever (abortion), Haemorrhagic Septicaemia (internal bleeding), Rabies (abnormal behaviour). Chronic form: Heavy worm infestation, internal abscesses, tuberculosis, malnutrition.
Seasonality	Any time of the year, but more common during the wet season when the fly population is high and transmission occurs more frequently.
Treatment	Quinapyramine-salt and pro-salt (Triquin®) preparation is available in a vial containing 2.5 g pale yellow/whitish powder. The drug is dissolved in 18ml of sterile water (provided) or boiled water that has cooled. The preparation is administered through subcutaneous (under the skin) injection at a dose of 0.03ml per kg live body weight (see Triquin dosage table). Treat sick camels as early as possible for high success rates. The drug is highly irritating and should not be used intravenously. It is very important to observe clean injection practices by using new disposable needles to avoid contamination that can lead to abscesses. A total dose of 18ml should not be exceeded for one camel. The drug may be used for prophylaxis (protection) against <i>T. evansi</i> infections (especially in pregnant females) and protects camels against <i>T. evansi</i> infections for 6 to 12 weeks. Isomethamidium chloride (Samorin, Trypamidium)- Make a 1% solution, ie dissolve the contents of the 1g sachet in 100mls of sterile water or boiled water that has cooled. Administer the solution intravenously. If you don't know how to do this you can also use deep intramuscular injection at 0.5 mg/kg live body weight (equal to 1ml/20kg - See Isomethamidium dosage table). The drug is irritating and toxic and should only be used intravenously under supervision of competent veterinary personnel. Most camel with Triquin resistant <i>T. evansi</i> infection when treated with Isomethamidium do not respond to the treatment and may suffer from toxic effects.

Melarsamine hydrochloride (Cymelarsan) It is prepared as a 0.5% solution in sterile water and administered at 0.25mg/kg live body weight by deep intramuscular (im) injection into the neck muscles. The drug cannot be used for prophylaxis (protection) but only for curative treatment. <u>Causes for treatment failure:</u> Some of the causes of treatment failure include: using poor quality (fake) drugs, using a wrong drug (e.g. Oxytetracycline has no effect against Tryps), administering a lower dose than recommended (very common!), using the wrong route of drug administration and resistance of the disease to the recommended dose of the drug. <u>Caution:</u> Never use Products that contain diminazene aceturate (Berenil, Veriben, Diminasan, Dimaze, Diminatryp etc) because it is very toxic for camels and kills them! Don't inject highly dehydrated camels with trypanocides, they can collapse and die. Water and rest such animals before injecting the drug. Never mix trypanocide with any other drug because it loses its effect completely
Prevention/Control
Can it affect humans
Notifiable disease
Economic and social impact

Triquin Dosage Table

Body wt (kg)	Volume (ml)	Body wt (kg)	Volume (ml)	Body wt (kg)	Volume (ml)
10	0.3	150	4.5	400	12.0
20	0.6	200	6.0	450	13.5
40	1.2	250	7.5	500	15.0
60	1.8	300	9.0	550	16.5
100	3.0	350	10.5	600	18.0

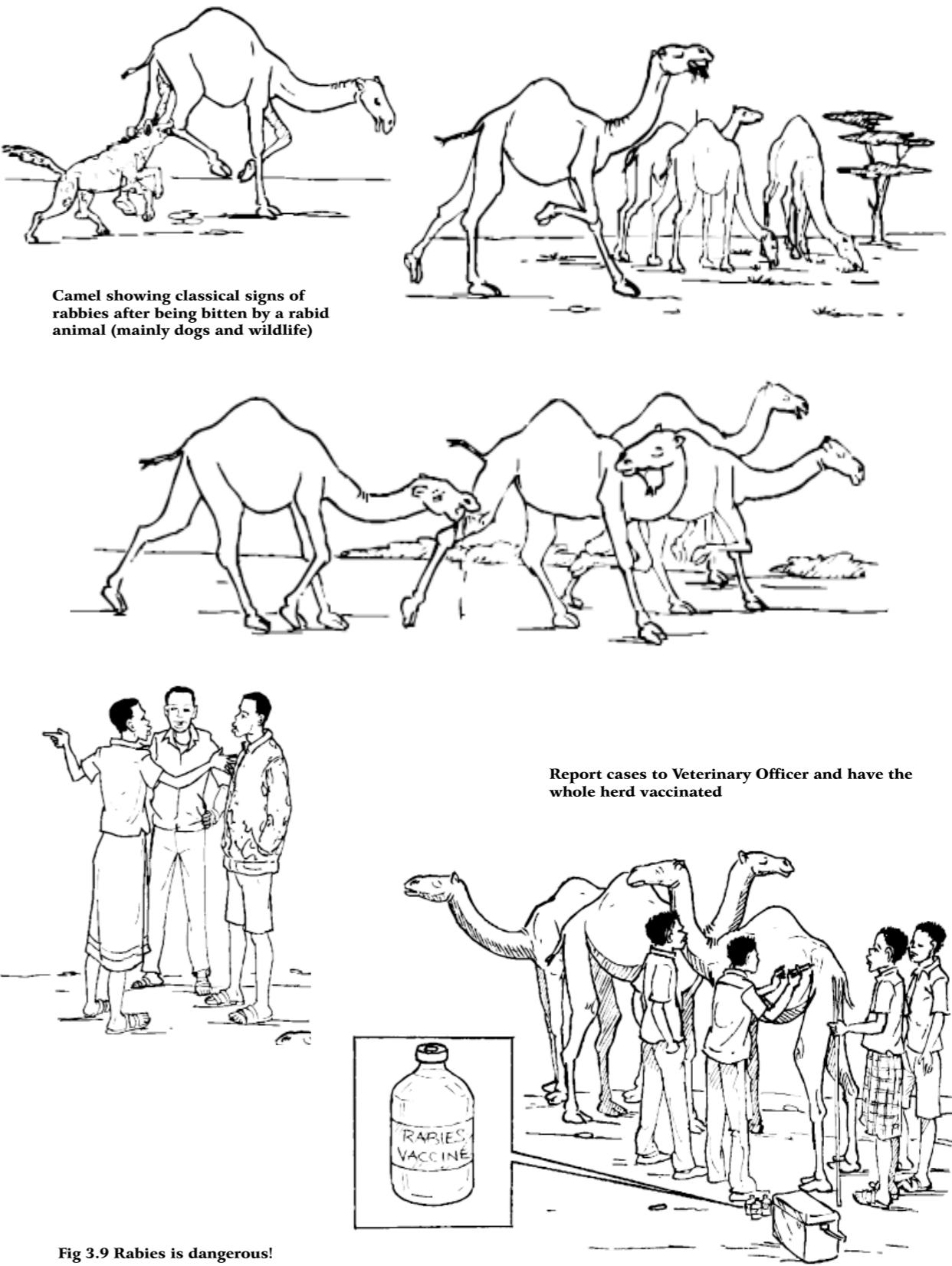
Isomethamidium (1% solution) Dosage Table

Body wt (kg)	Volume (ml)	Body wt (kg)	Volume (ml)	Body wt (kg)	Volume (ml)
100	5.0	300	15.0	500	25.0
150	7.5	350	17.5	550	27.5
200	10.0	400	20.0	600	30.0
250	12.5	450	22.5		

Carry out correct weight estimate (see Chapter 2) and dose carefully – Trypanocide drugs are more toxic than other veterinary drugs that are used in camels.

Table 5: Rabies

Name	Nyanye (Gabbra, Borana), Sugere Kaar (Rendille), Nkwang (Samburu), Ruqus (Somali), Ingerep, Arthim (Turkana).
Definition	A viral disease characterised by nervous signs and abnormal behaviour.
Causative agent	Rabies virus.
Mode of transmission	Bites and saliva of sick animals; most rabies cases are caused by dog bites; if a camel with rabies bites other camels or people they also get infected by rabies.
Affected group	All
Major clinical signs	Camels become aggressive and attack others. They salivate a lot and are not able to drink or swallow. Bulls show hypersexual behaviour. After some days, they become weak and unable to stand. All affected animals die. There is no recovery from Rabies!
Diseases with similar clinical signs	Trypanosomiasis, the cerebral form of T. vivax, tapeworm cysts in the brain, inflammation of the brain by other viruses or bacteria.
Seasonality	None
Treatment	None. Isolate and/or kill sick animals. Do not slaughter! All persons and animals that had contact with the rabid camels must be vaccinated against rabies as soon as possible! Rabies vaccine can be obtained from government veterinarians.
Prevention/Control	In areas where rabies in dogs and predators occurs regularly, vaccinate all camels every year (the vaccine is cheap). Vaccinate your dogs against rabies once per year. Protect camels from stray dogs, hyenas and other predators. Kill dogs that show abnormal aggressive behaviour. Isolate sick animals and ensure they do not bite other camels or people!
Can it affect humans	The most dangerous disease transmitted from animals to humans, it cannot be treated, but vaccination immediately after the bite prevents the person that was bitten from becoming sick.
Notifiable disease	Yes, you must report to veterinary officers and insist that they carry out vaccination immediately.
Economic and social impact	Infected aggressive animals spread deadly infection to other animals and people.



3.1.4 Diseases affecting the foetus and the udder

Table 1: Abortion

Name	Dhies, d'ess, l'ess (Somali); nkiboroto (Samburu); akiyech, akiyechum, akiecium (Turkana), iralii (Borana, Gabbra)
Definition	Loss of foetus during pregnancy.
Causes	The majority of abortions in camels are caused by infections, the most common ones being: <ul style="list-style-type: none"> ▪ Trypanosoma, Rift Valley Fever (RVF), Camel Pox; Brucella, Salmonella, Q-Fever ▪ Abortion can also be caused by severe malnutrition and by plant poisoning.
Mode of transmission	<ul style="list-style-type: none"> ▪ Trypanosomes are transmitted by biting flies ▪ Rift Valley Fever is transmitted by mosquitoes ▪ Brucella and other infectious abortions are transmitted directly through contact with fluids, foetus and placenta expelled by aborting females; Brucella is mostly transmitted via the contaminated boma and pasture (occasionally it is transmitted by infected bulls); after the abortion, Brucella infected female camels calve again but remain infected and continues to transmit infection to clean camels. ▪ Pox is transmitted through contact, flies and through contaminated boma ▪ Q-Fever is transmitted through ticks and through contact
Affected age group	Pregnant heifers, pregnant adult female camels
Major clinical signs	Pushing out the foetus before the end of the pregnancy, discharge from vagina, sometimes retained placenta. Can be overlooked if it happens in early stages of pregnancy. There are no signs specific to a particular cause of abortion, different kinds of abortion can all look the same.
Diseases with similar clinical signs	None
Seasonality	<ul style="list-style-type: none"> ▪ Rift Valley Fever abortions occur in outbreaks which follow heavy rains with a lot of mosquitoes. (See next table) ▪ Trypanosoma abortions are more common when there are a lot of biting flies. ▪ Brucella abortions can occur throughout the year.
Treatment	Treatment of already infected animals is not effective. Pregnant animals at risk can be protected against Trypanosoma by giving a prophylactic treatment of Quinapyramine to prevent infection (see Trypanosomiasis).
Prevention/Control	The most important measure is to separate aborting camels from other female camels to prevent transmission. If abortions take place inside the Boma immediately remove foetus and placenta and bury deep or burn. If possible move all clean females to a new Boma. Vaccinate camel heifers against Brucellosis before breeding age; use same vaccine as in cattle; vaccine is affordable and available. Specific vaccines can also protect against Camel Pox and against Q-Fever (but are rarely available). Vaccination against Rift Valley Fever (only in non-pregnant animals and only during outbreaks). Only to be done by veterinarians (See next table)
Can it affect humans	Abortions are dangerous for humans, especially RVF and Brucellosis! RVF is deadly for humans and cannot be treated! (see RVF) Brucellosis is transmitted through contact with the aborting camel and especially by drinking raw milk from infected camels. It causes very severe chronic disease in humans, which can look like malaria. Brucellosis kills humans if not treated. The risk is invisible because Brucella infected camels appear healthy and give normal milk! To prevent Brucella infection in humans do not handle aborted foetus or placenta with bare hands and boil or pasteurise raw milk before drinking. Q-Fever can also infect humans, transmission similar to Brucellosis

Notifiable disease	Owner should report to veterinary officer, especially when many abortions occur within his herd over a short time.
Economic and social impact	With the loss of a calf, there is no milk production until the camel becomes pregnant and calves again. For a long time there is less food for the camel owner and his family. Also herd growth is reduced. Infection of humans with RVF, Brucellosis and Q-Fever leads to severe disease and can even cause death.



A camel keeper reporting a case of abortion to CASPRO



Burying the foetus in a 6 foot-deep hole



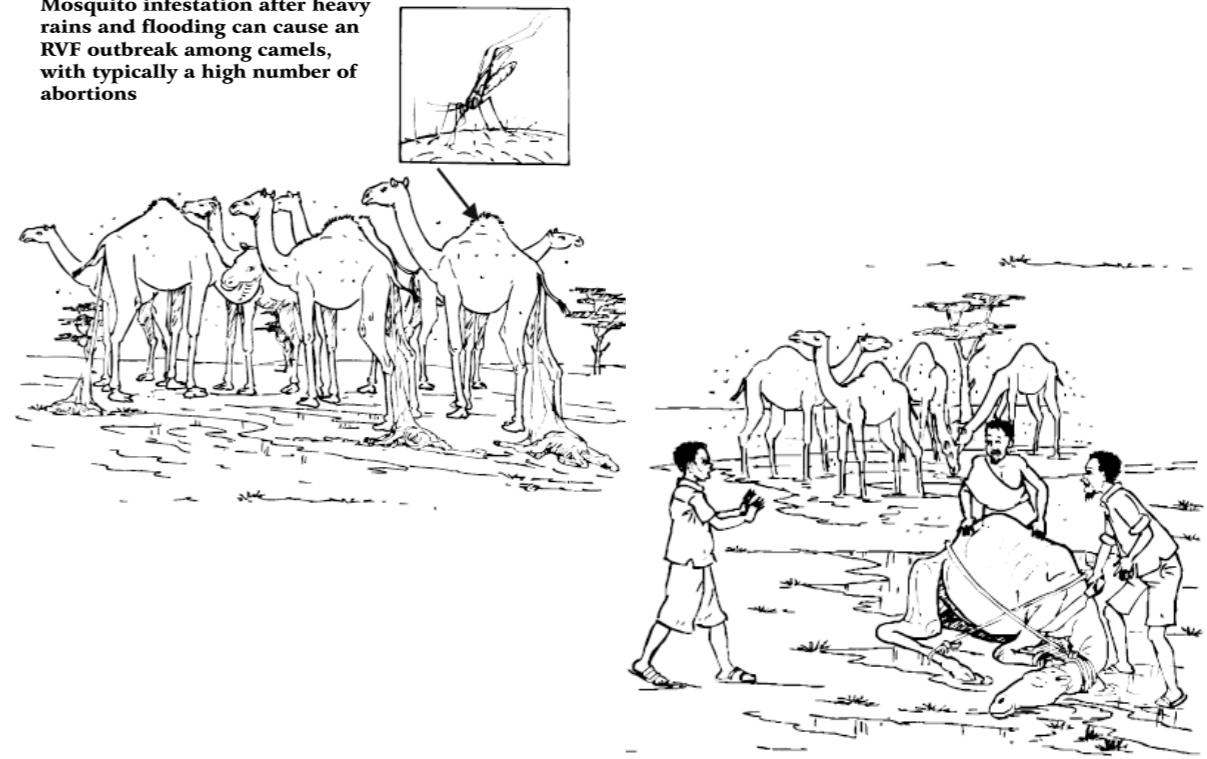
Burning the foetus

Fig 3.1 What to do in case of abortion

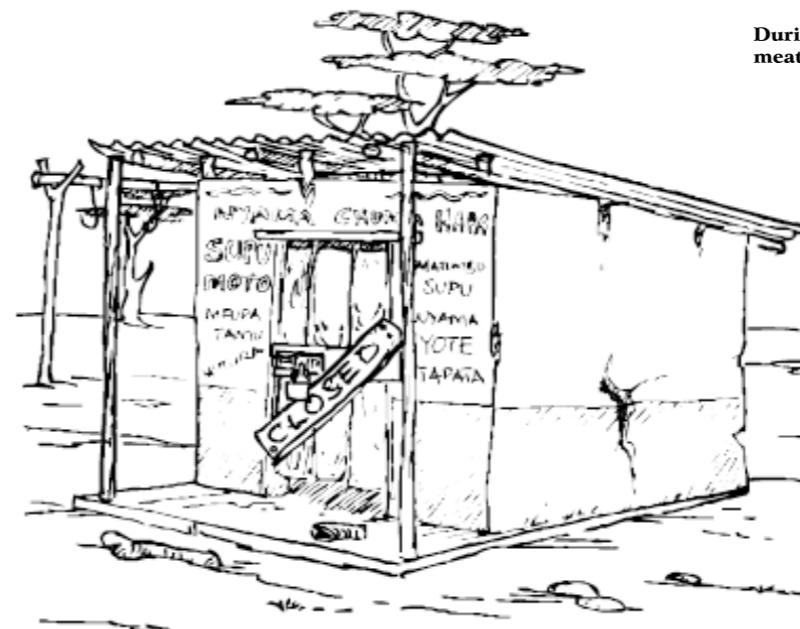
Table 2: Rift Valley Fever

Name	Referred to as "Rift Valley Fever" by most people. (RVF)
Definition	A viral disease transmitted by mosquitoes, common during excessive rainfall and flooding. This disease is characterised by simultaneous occurrence of massive rainfall/floods, plenty of mosquitoes, mass abortions in livestock and a haemorrhagic fever killing especially young animals.
Causative agent	Rift Valley Fever Virus.
Mode of transmission	Through mosquito bites.
Affected age group	All, but particularly deadly in the newborn and in the young. Camels, sheep and goats usually more affected than cattle.
Major clinical signs	<ul style="list-style-type: none"> ▪ Mass abortions in a herd (can reach almost 100%). Abortion occurs at any stage of pregnancy, and aborted foetuses can be of different sizes. ▪ Sudden high death rate in newborns (can reach almost 90%) immediately after being born and during first weeks of life.
Diseases with similar clinical signs	All diseases causing mass abortion, especially Trypanosomiasis, Brucellosis.
Seasonality	Outbreaks occur every 5 to 15 years after very heavy and prolonged rains associated with flooding and high mosquito population.
Treatment	None
Prevention/Control	<p>Stop all livestock trade and especially stop slaughter in affected areas until outbreak is over and veterinary authorities lift slaughter ban.</p> <p>Vaccinate in RVF-prone areas as early as possible before outbreaks occur. Vaccine contains live virus and may cause abortion in pregnant camels; vaccination can only be done by professional veterinarians.</p>
Can it affect humans	<p>Apart from Rabies, this is the most dangerous disease that humans can contract from livestock in Africa!</p> <p>Affects and kills humans, especially those in close contact with animals (herders, butchers, veterinarians). No treatment available for humans!</p> <p>In humans, transmission is direct through inhalation of the virus during slaughter of infected animals, while carrying out post mortem or via contact with abortion fluids and with aborted foetuses.</p> <p>Do NOT slaughter any livestock during outbreak and avoid aborted foetuses and abortion fluids!</p>
Notifiable disease	Yes, if there is a sudden abortion outbreak report immediately to DVO or VO. Early warning and early vaccinations can only work if camel owners provide information to veterinary authorities (DVO, VO) as early as possible.
Economic and social impact	Severely disrupts pastoralist economy, causing massive losses through abortion, disrupts reproduction/lactation, and brings complete ban on trade and slaughter. This disease is of high international and trade importance and very dangerous for humans!

Mosquito infestation after heavy rains and flooding can cause an RVF outbreak among camels, with typically a high number of abortions



During RVF outbreaks do not slaughter or eat meat from sick animals!



Butcheries should be closed during RVF outbreaks! Do not handle aborted foetus!

Fig 3.10 Rift Valley Fever has devastating effects

Table 3: Mastitis

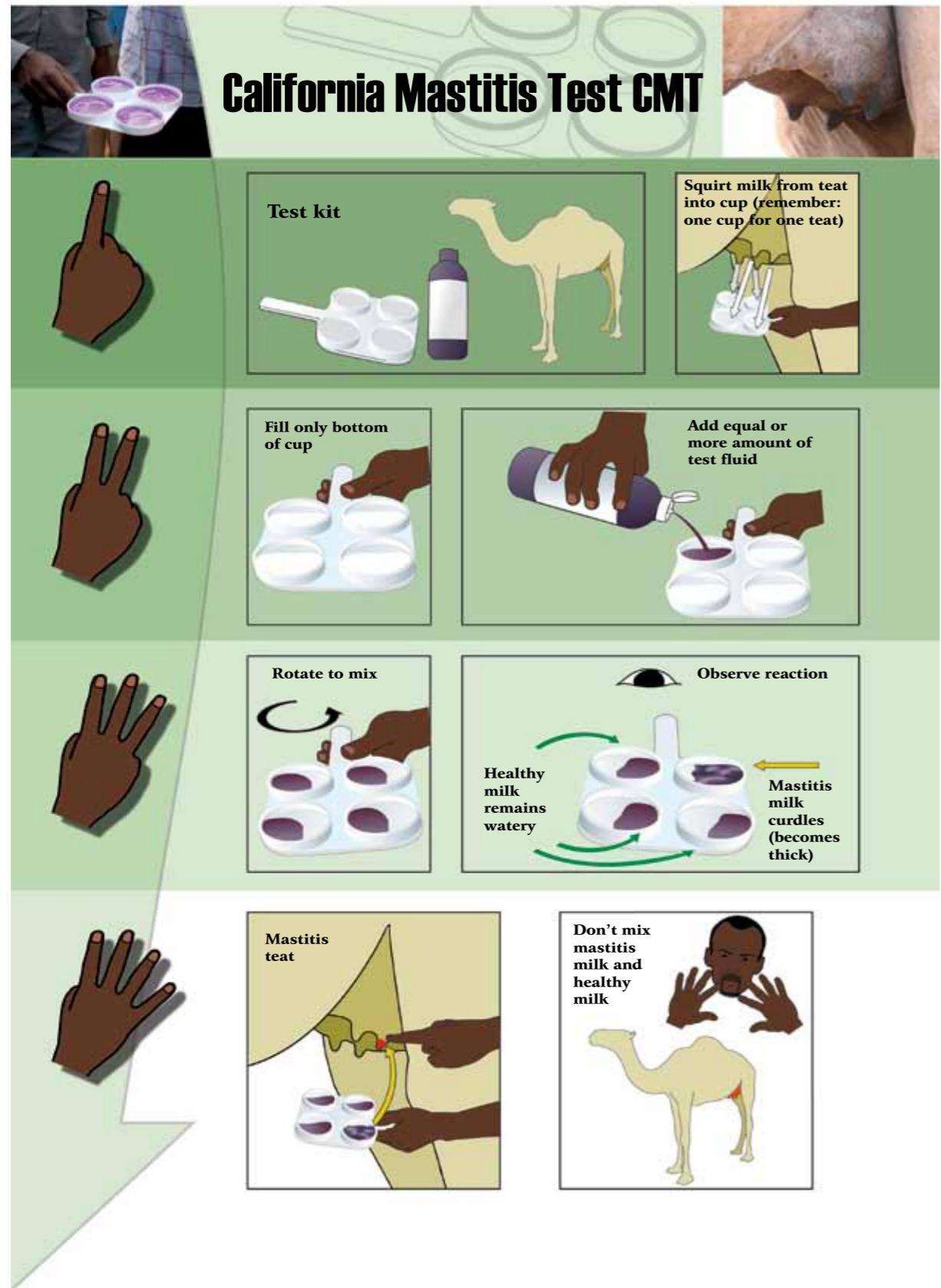
Names	Qanyara (Gabbar); Canda-barar (Somali); Loebeta (Turkana); Nolkina (Samburu); Ugonjwa wa kiwele (Swahili); Giid (Rendille).
Definition	Swelling of one or more quarters of the udder and secretion of abnormal milk.
Causative agent	Bacteria (especially <i>Streptococcus agalactiae</i> , <i>Staphylococcus aureus</i>).
Mode of transmission	Bacteria that cause mastitis are transmitted from infected to clean camels by the hands of the herder who milks an infected udder first and then a healthy one; in addition, bacteria can be transmitted when a calf suckles more than one dam. A dirty Boma is also a source for mastitis bacteria transmitted from the ground to the teats by flies. Pus from skin abscesses is another source for mastitis bacteria. Especially wounds on the skin of the teats caused by ticks are a constant source of mastitis bacteria. Mastitis bacteria can enter the udder only through the teat opening or through small injuries on the teat. The teat is the barrier between the outside environment and the milk gland, the inside of the udder. Oversized, damaged or abnormal teats that cannot close tightly in between milking times are much more prone to infection than normal shaped teats. Caution: Teat tying (Somali "Marrak") damages the teat and predisposes the udder to infection!
Affected age group	Adult lactating females; mastitis is more common in older than in young females.
Major clinical signs	Acute ("visible") mastitis: One or more quarters of the udder are swollen, painful and hot. Milk production is reduced or stops completely. The milk can look and smell abnormal (yellow or brownish colour, very thick like pus or thin like water, may contain clots or blood). There can be difficulties in milking as teat canals are blocked and no more milk is released from the gland. In severe cases, the camel may stop feeding, as the quarter remains hardened, does not return to normal and becomes a "dead quarter," which no longer contains any gland tissue and cannot produce any more milk. Mild ("visible") mastitis has the same signs as acute mastitis but changes in the milk and quarter do not last long and are less intensive. Chronic ("invisible") mastitis: After recovery from mild mastitis, the quarter looks normal, but can remain infected forever. Such a constantly infected quarter changes over 1 to 3 lactations from normal soft gland tissue to hard dead tissue and becomes a "dead quarter." This is called chronic mastitis and is much more common than the "visible" mastitis. Chronic mastitis in some herds affects every second camel and in almost every camel herd there are camels with one or more "dead quarters." Chronic mastitis is the most important source of infection for young female camels (1st calving heifers) with clean healthy udders!
Diseases with similar signs	Abscess of the udder skin
Seasonality	None
Treatment	Swollen quarter should be milked frequently and calf should be allowed to suckle. It is also useful to cool hot swollen quarters and to massage them. Penicillin-Streptomycin or Sulphonamide injected at a double dose for minimum 3 days can cure fresh mastitis. Chronic mastitis cannot be cured. Caution: Intra-mammary treatment (used sometimes in dairy cattle) is NOT recommended for camels because the camel teat has 2 to 3 fine openings. Each opening leads to a separate gland, so one quarter of the camel udder contains two to

	three separate glands. It is not possible to apply one intra-mammary tube per gland (= 2 to 3 tubes per teat!). Also the nozzle size of the intra-mammary tube is designed for cattle teats, not for the finer openings of the camel teat. Forcing the intra-mammary tube into the teat damages the teat openings and can cause very dangerous infections!
Treatment Prevention/Control	Always milk young camels (especially 1st calving heifers) with clean udders first, even though they are often more difficult to milk than the older ones. This prevents transmission of mastitis from old camels with "unclean" udders to young camels with "clean" udders. If possible, keep camels with chronic mastitis (less than four healthy quarters) separate from camels with healthy udders for milking and overnight (two different Bomas, two different herdsmen milking). Sell camels with less than four healthy quarters to remove the main source of infection from the herd. Treat all skin wounds early with iodine or blue spray to prevent them from becoming abscesses and producing pus. Remove ticks from the teat skin and treat the tick bite lesion with iodine or blue spray. Do not practice teat tying! Observe hygienic milking and check udders at every milking for early detection and treatment. The California Mastitis Test (CMT) detects chronic mastitis (see figure 3) and can be used to identify and separate camels with clean from those with unclean udders.
Can it affect humans	Mastitis causing bacteria can be transmitted through milk to humans. It is recommended that all milk for human consumption be boiled.
Notifiable disease	No
Economic and social impact	Chronic mastitis reduces milk yield by 20% to 40%, resulting in loss of milk available for consumption and for sale. Mixing mastitis milk and clean milk in the same container leads to fast spoilage of all the milk, which fetches a lower price at the market or cannot be sold. Reduction of both milk yield and milk value threaten household food security and lead to loss of income. Mastitis bacteria in milk also cause diseases in humans, especially in children

Camel keepers sometimes tie the teats of a she-camel with a piece of cloth or plant material to prevent calves suckling and finishing all the milk (Somali: *Marrak*). The material used is usually not washed and is often shared among many dams, transmitting mastitis infections, leading to teat wounds and damaging the teat.



(Source: Maurizio Dioli)



3.1.5 Poisoning and diseases of unknown cause

Table 1: Poisoning *Capparis tomentosa*

Names	<i>Laturdei</i> (Samburu); <i>Gomborlik</i> , <i>Goryafun</i> , <i>Gumbor</i> (Somali); <i>Ekorokoite</i> (Turkana); <i>Gorrahgel</i> (Rendille, Gabbra).
Definition	Plant poisoning caused by eating fruits, flowers and leaves of the <i>Capparis tomentosa</i> tree.
Causative agent	Poison in leaves, flowers and fruits of <i>Capparis tomentosa</i> .
Mode of transmission	Eating leaves, flowers and fruits of the plant
Affected age group	All.
Major clinical signs	Sideways bending of the neck, difficulty in walking, paralysis and emaciation in prolonged cases.
Seasonality	Common when the fruits are in season and during drought
Treatment	No known treatment, although camel keepers have traditionally tried branding.
Prevention/Control	If possible, avoid grazing in area where tree is known to occur; if such areas have to be used for grazing (during dry season/drought) prevent camels from feeding on this tree.
Can it affect humans	Yes, if humans eat the fruits, especially young boys when herding.
Notifiable disease?	No.
Economic and social impact	Affected animals may die; if herdsmen are inexperienced or careless, whole groups of camels may be lost to poisoning.

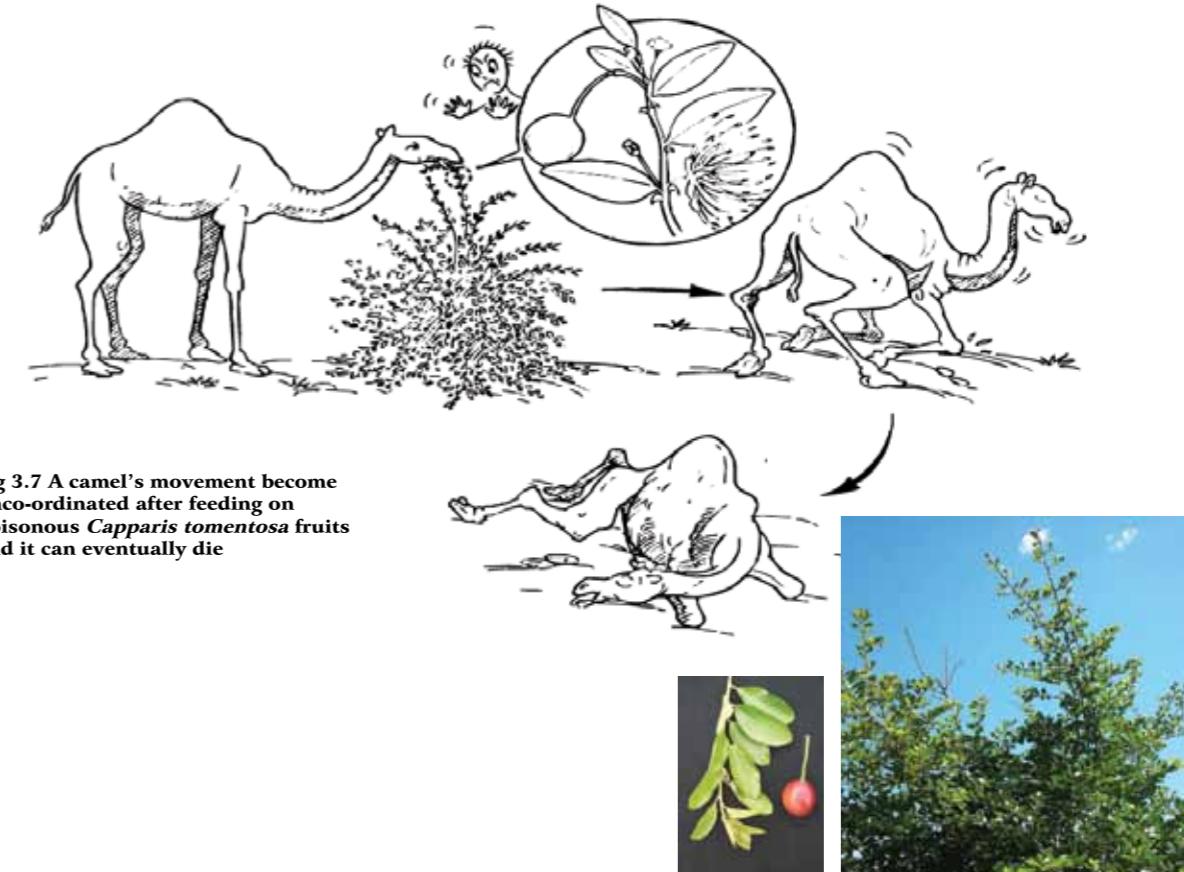


Fig 3.6 CMT test: Source - Somalia Pastoralist Dairy Development Project (VSF Germany)

Capparis tomentosa (Source: upload.wikimedia.org)

Table 2: Wry Neck

Names	<i>Chachapsa</i> (Gabbra); <i>Shimpurr</i> (Somali); <i>Dahasi</i> (Rendille).
Definition	Twisting of the neck
Causative agent	Not known, can be caused by <i>Capparis tomentosa</i> , and maybe also by other plant poisoning; theory that it is infectious is not proven; can result from fighting or other physical trauma
Mode of transmission	Wry neck occurs very sporadically and is most likely not infectious; no indication that this is a transmissible disease.
Affected age group	All.
Major clinical signs	Twisted neck, often double bent (S-shape); in severely affected cases it interferes with or even prevents feeding. Camel becomes weak and rapidly loses condition. Some animals recover spontaneously, even overnight.
Disease with similar clinical signs	See <i>Capparis tomentosa</i> .
Seasonallity	Not known
Treatment	Give multivitamin injection (especially Vitamin B complex) to stimulate nerve regeneration (you can also feed the camel baker's yeast, which is rich in vitamin B). Branding of the neck is practiced as traditional treatment by camel keepers.
Prevention/Control	Avoid <i>Capparis tomentosa</i> infested areas and supplement with adequate minerals to discourage bone chewing.
Can it affect humans	No.
Notifiable disease	No.
Economic and social impact	Loss in production and high possibility of death



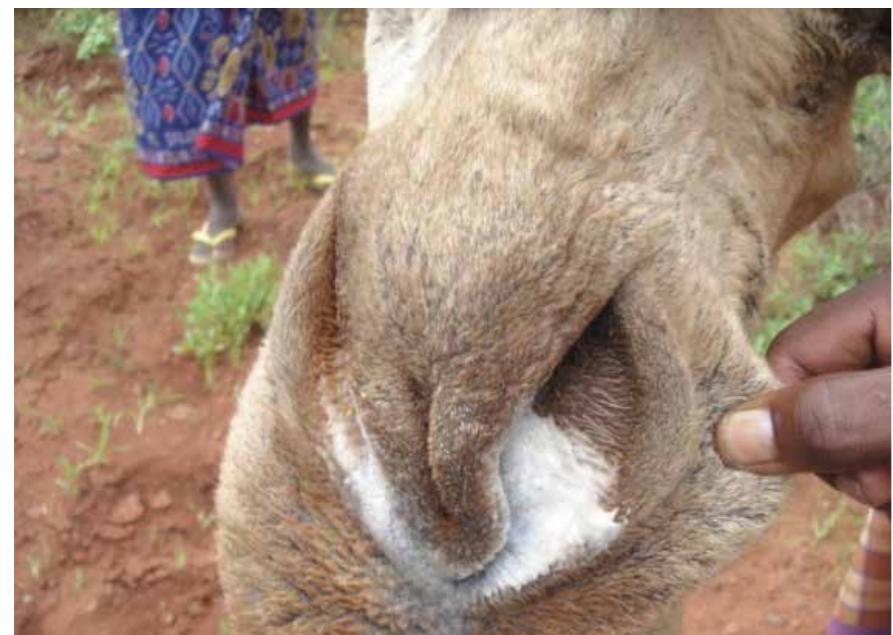
Camel with a twisted neck, a typical symptom of wry neck.
Source: Maurizio Dioli

Table 3: Swollen Glands / Haemorrhagic Septicaemia (HS) of camels

Name	<i>Khanid</i> (Rendille); <i>Kandich</i> , <i>Khando</i> , <i>Qando</i> (Gabbra, Borana); <i>Qarir</i> , <i>Kharar</i> , <i>Kurri</i> (Somali); <i>Nalugarrngarr</i> , <i>Ngarngar</i> , <i>Nolgoso</i> (Samburu); <i>Longarrue</i> , <i>Aengarre</i> , <i>Lorarrurei</i> , <i>Elukunoit</i> , <i>Lobolio</i> , <i>Lobolibolio</i> (Turkana).
Definition	Acute disease associated with enlarged sub-mandibular lymph nodes.
Causative agent	The cause of Swollen Glands / Haemorrhagic Septicaemia (HS) in camels is unknown; camel HS is different from HS in cattle.
Mode of transmission	Unknown, most likely contact.
Affected age group	Swollen Glands common in young animals (weaners and sub-adults). Acute camel HS outbreaks affect mainly adult camels in good condition.
Major clinical signs	Swollen Glands (common in North Kenya) Swollen lymph nodes, especially those of head and neck. Camels are very dull and have problems breathing. They may die after 3-5 days or have very slow recovery. This form occurs regularly in certain herds and affects mainly weaners and young adults. Acute Camel HS (less common) Very acute breathing problem; camels lying down with neck stretched out, unable to stand up, die after less than 1 day before swelling of glands appears; sometimes intestine is also affected, resulting in bloody or dark faeces. This form occurs very suddenly in herds that may not have experienced the disease for many years and mainly affects adults in good body condition. On post-mortem, lungs and/or intestines show characteristic bleeding (haemorrhaging).
Disease with similar clinical signs	In young camels: Acute Camel Pox, acute Orf, Pneumonia. In adult camels: Camel Sudden Death, Anthrax, acute Trypanosomiasis.
Seasonality	Some outbreaks associated with sudden onset of chilly and wet conditions.
Treatment	Antibiotic treatment (Oxytetracycline 20% LA, Sulphonamide, Amoxycillin) only effective if given very early as a prophylaxis before camels show symptoms. Animals that have already developed the full symptoms may show adverse reaction to antibiotic (die faster!). Do not force affected camels to move and avoid handling them.
Prevention/Control	Evidence from herders is that antibiotics given as a prophylaxis to healthy animals in affected herds cut outbreaks short. Avoid all contact with affected camel herds and mixing of camels from affected and non-affected herds in one Boma; outbreaks appear to spread through herd contact (especially at watering points).
Can it affect humans	Not known
Notifiable disease	No
Economic and social impact	Swollen Glands regularly causes disease and death in young camels, affects herd growth. Sporadic camel HS outbreaks may result in up to 20% mortality in adult camels and thus have a great economic impact on affected herds.

Table 23: Camel Sudden Death

Names	Risasi (Swahili); Maal oh aar; Habad (Somali, Borana).
Definition	Sudden death in camels.
Causative agent	Not known.
Mode of transmission	Unknown, possibly through close contact.
Affected age group	Almost exclusively adults, pregnant and lactating females, breeding and working bulls, heavy animals and/or animals in good condition.
Major clinical signs	Sudden collapse; difficulty in breathing; white froth in the nostrils and death within 1 hour after collapse. There are no warning symptoms before the collapse; sporadic deaths occur in one herd over a limited period and then stop.
Diseases with similar clinical signs	Anthrax, HS/Swollen Glands, Trypanosomiasis (<i>T. vivax</i> , <i>T. congolense</i>).
Seasonality	One outbreak in Kenya (2007) reported so far.
Treatment	None.
Prevention/Control	During outbreak: <ul style="list-style-type: none">▪ Avoid contact with affected herds.▪ Avoid stressing pregnant and lactating animals on long treks.▪ Avoid sudden intake of large amounts of salt and/or water.
Can it affect humans	Not known. There were no reports of humans falling sick during 2007 outbreak in Kenya.
Notifiable disease	No, but cases should be reported to veterinary authority.
Economic and social impact	Only a few animals lost, but big economic impact because losses affect the most valuable breeding stock. Loss of pregnant/lactating females means loss of milk production and reduced herd growth; loss of breeding and working bulls means new ones need to be kept and to be trained (fewer bulls available for sale and slaughter).



Suspected Camel Sudden Death. (Source: Mario Younan)

Drug Cards

Drug withdrawal period: The time during which milk or meat from treated animals must not be consumed by humans

Drug Card 1: Albendazole

Name of ingredient	Albendazole
Brand names	Valbazen, Alfafas, Tramazole, Hook
Drug Category	Anthelmintic for oral application (= to be given through the mouth)
Presentation	Bolus (600mg, 2500mg, 3000mg), Drench (10%)
Dosage	<p>Recommended dosage: 7.5mg/kg</p> <p>This means for:</p> <p>600 mg Bolus – 1 bolus per 120kg 2500mg Bolus – 1 bolus per 500kg 3000mg Bolus – 1 bolus per 600kg 10% Drench - 10ml / 100 kg body weight.</p> <p>Dosage Examples: 12 ml drench (10%) for a calf of 120 kg body weight, 25 ml drench (10%) for a young adult of 250 kg body weight, 50 ml drench (10%) for an adult camel of 500 kg body weight. One 600mg Bolus for a calf of 120kg body weight Half a 2500mg Bolus for a young adult of 250kg body weight One 2500mg Bolus for an adult camel of 500kg body weight One 3000mg Bolus for heavy adult camel of 600kg</p>
Withdrawal period	Milk: 60 hours = 2.5 days = 5 milking times (if you milk twice per day)
	Meat: 14 days
Storage	Cool and dry place. Avoid direct sunlight.
Disease	Gastro-intestinal worm infestation

Drug Card 2: Ivermectin

Name of ingredient	Ivermectin.
Brand name	Ivomec, Noromec, Endact.
Category	Injectable anthelmintic against endo- and ecto-parasites.
Presentation	Injectable 1% solution.
Dosage	1 ml/50 kg. (0.2 mg/kg) In case of mange, injection to be repeated after 8 days (not after 14 days as recommended by manufacturer for treatment of cattle).
Mode of application	Inject subcutaneously (under the skin).
Drug withdrawal period	Meat 21 days. In cattle, the drug withdrawal period for milk is 28 days (= 4 weeks); nobody knows exactly how long it is in camels but it is also several weeks. NEVER use Ivermectin IN LACTATING camels; this makes correct timing of herd treatment for mange in camels very difficult!
Storage	Cool and dry place, avoid direct sunlight.
Disease	Mange, Round Worms, Nasal bot fly, maggots that infect wounds. (Effect on ticks is weak and inconsistent, better use external acaricides against ticks).

CHAPTER 4

CAMEL PRODUCTS AND MARKETING

'Camel products for improved livelihoods'

Chapter Authors: Kajume, Julius K M, Fredrick O. Aloo, Mario Younan, Amos Adongo



Drug Card 3: Gentian Violet

Name of ingredient	Gentian Violet
Category	Skin tincture
Presentation	Blue-violet watery solution
Dosage	Sold at working strength, use undiluted.
Mode of application	Apply on affected area.
Drug withdrawal period	Nil.
Storage	Cool dry place.
Disease	Treatment of skin infections like open wounds, Infectious Skin Necrosis, Orf lesions on the mouth.

Drug Card 4: Hydrogen Peroxide

Name of ingredient	Hydrogen peroxide.
Category	Disinfectant.
Presentation	Sold normally as 20% solution.
Dosage	Dilute to 2% working strength; 20% solution diluted 1:10 in clean water (= 1 part Hydrogen Peroxyde 20% plus 9 parts water).
Mode of application	Inject into wound with syringe (CAUTION NO NEEDLE) and flush out the pus and dirt.
Drug withdrawal period	Nil.
Storage	Always store in tightly shut brown bottle and protect from sunlight, loses strength rapidly in improperly sealed bottle
Disease	Cleaning, flushing and disinfection of infected and dirty wounds, abscess (after opening by incision), Infectious Skin Necrosis.

Drug Card 5: Iodine

Name of ingredient	Iodine or Lugols Iodine.
Brand name	Tincture, Glubose, Providon and Wokadine Betaisadonna.
Category	Disinfectant.
Presentation	Brown watery solution.
Dosage	Can be used undiluted, otherwise follow manufacturer's instructions; many brands are mixed one-to-one with clean water.
Mode of application	Apply on affected area. Note: Iodine does not work well on dirty surfaces, clean wounds first and remove pus and dead tissue before applying.
Drug withdrawal period	Nil.
Storage	Cool dry place, always in brown bottle, loses strength in sunlight.
Disease	Wounds, abscesses after flushing, Infectious Skin Necrosis, also good for use on operation wound after castration.

A camel milk hall in North Somalia (Source: Klaus Lorenz)

Many camel products are of commercial importance – meaning that they can be sold in large quantities to the rest of the population. These are milk and naturally fermented milk, meat, hump fat, hides, and by-products (like camel feet [trotters] sold for soup kitchens).

Camel blood, bones, bone marrow and urine are useful in one way or another to pastoralists, but do not have much commercial value. The potential exists for processing milk into various products and also for processing blood and bones into bone meal and blood meal. Camel bones are also used for carving. Still, the profitability of any processing enterprise needs first to be carefully explored.

4.1 Meat

4.1.1 Meat hygiene and fresh meat marketing

'Cleanliness is next to Godliness.' This saying shows the importance of hygiene in human life. Meat hygiene rules must be strictly followed in order to produce safe and wholesome meat. This requires:

- Healthy and clean slaughter-stock.
- Hygienic slaughtering.
- Proper meat inspection.
- Hygienic handling, storage and transportation of the meat

These principles are explained in **Table 1**.

Table 1: Production of safe and wholesome meat

What to do	How its done
Make sure camel is healthy and clean	<ul style="list-style-type: none"> ■ Should be well fed and in good body condition. ■ Have no signs of disease or serious injury. ■ Not be mistreated before slaughter. ■ Presented to and approved by a meat inspector before slaughter. ■ If treated, not slaughtered before drug withdrawal period is over.
Make sure slaughtering is hygienic	<ul style="list-style-type: none"> ■ Choose clean site (slaughterhouse if accessible). ■ Use clean materials to prepare slaughter site. ■ Slaughter when and where it's cool (early morning, in the shade). ■ Make sure water for washing is available. ■ Slaughterer should be healthy and observe personal hygiene. ■ Use clean & sharp tools. ■ Avoid contact between meat and stomach/gut contents. ■ Avoid contact between meat and outside surface of the hide. ■ Avoid contact between meat and soil or bare ground. ■ Proper separation of meat from offal. ■ Observe <i>Halal</i> slaughtering and humane killing.
Make sure meat is inspected	<ul style="list-style-type: none"> ■ This is a legal requirement to protect consumers against meat borne infections. ■ Ensure meat is inspected by a qualified meat inspector. ■ Refer to Meat Control act, CAP.356 of the laws of Kenya.
Ensure correct handling, storage, transportation and marketing of meat	<ul style="list-style-type: none"> ■ Do not leave fresh meat in the open – it will spoil quickly. ■ If not consumed immediately, protect from flies, other pests, dust and mud (use fly proof netting). ■ Hang carcasses to allow sufficient drainage before cold storage (where available). ■ Use clean and closed containers for transport. ■ During transport, do not mix meat and offal in the same container. Meat will get contaminated and spoil rapidly. ■ Use cold storage where available.
Meat hygiene guarantees you safe and wholesome meat. It is a safeguard against meat-borne infections and food poisoning; it attracts more customers and improves your business!!	



Open air butchery (Source: Maurizio Dioli)

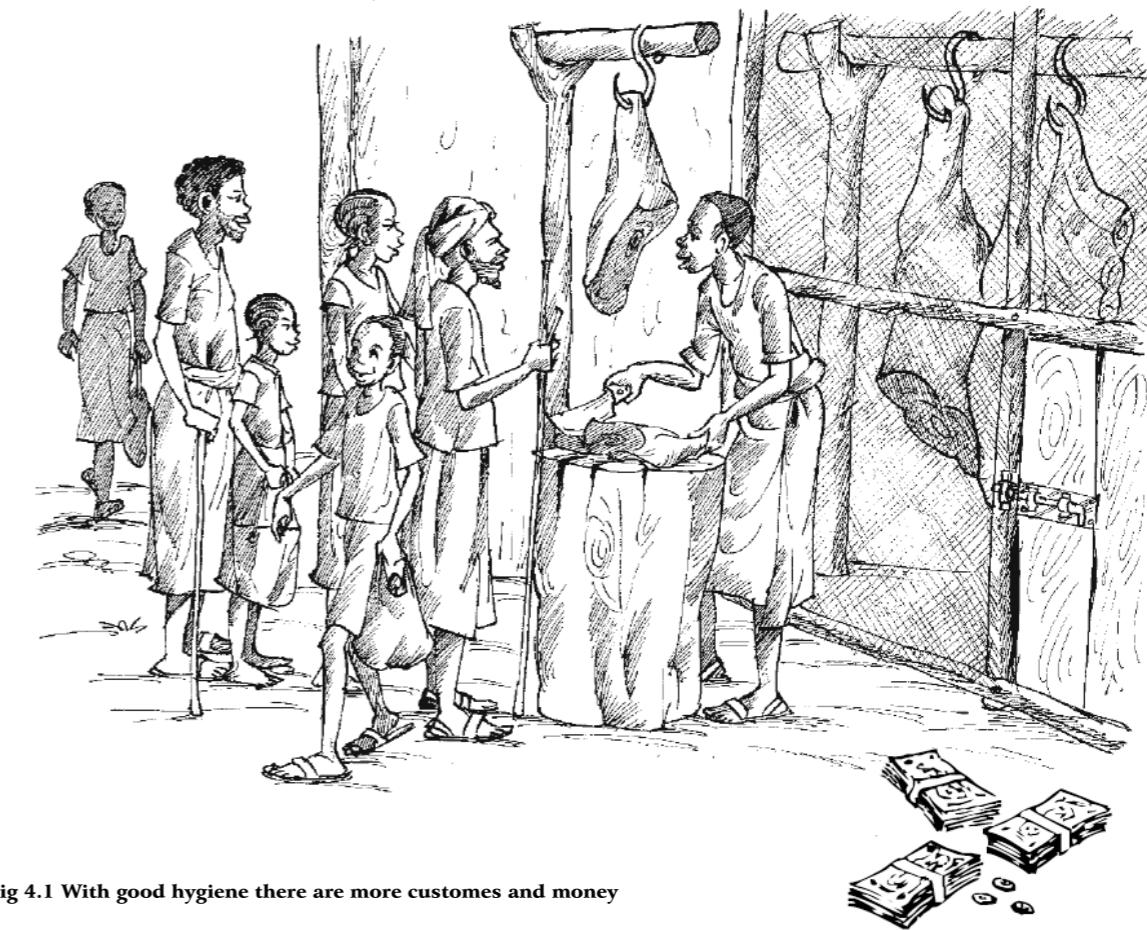
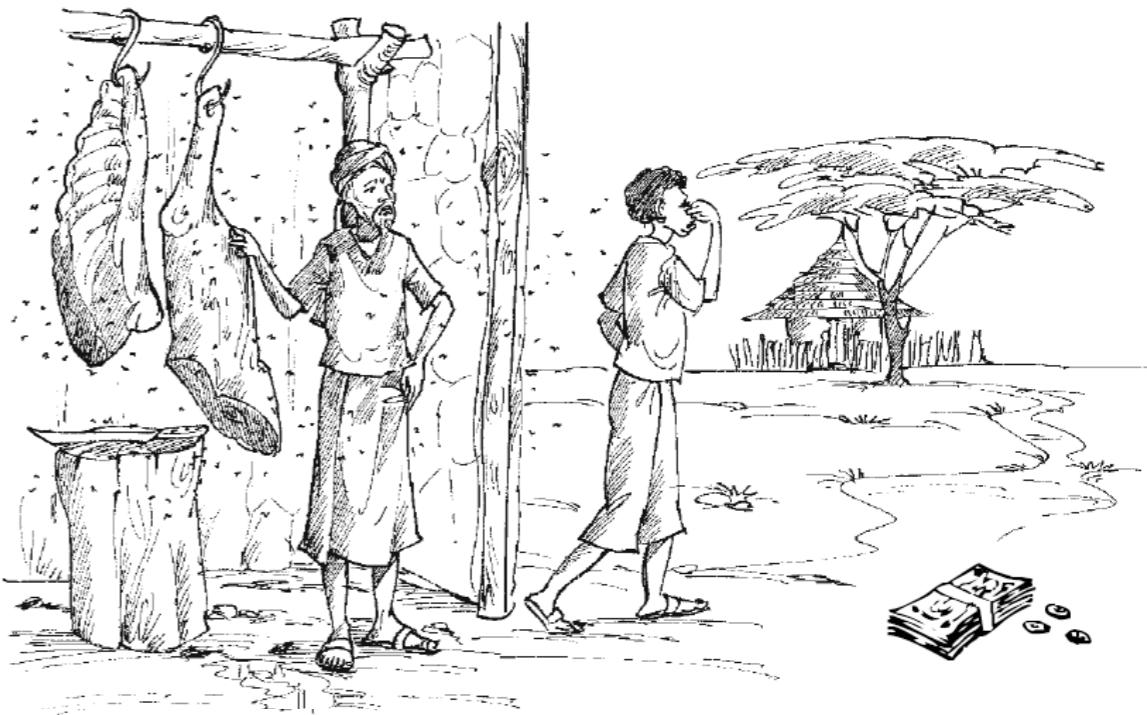


Fig 4.1 With good hygiene there are more customers and money

4.1.2 Health risks from meat

People can catch diseases like Anthrax, Tapeworm, Hydatidosis, Rift Valley Fever, Salmonellosis, Brucellosis, and food poisoning (like Clostridium) from handling or eating diseased meat. To avoid such risks, follow the advice in **Table 2**.

Table 2: Safe and unsafe meat

Unsafe Meat	Why
Do not consume meat from sick camels or those that die of disease	Dead or sick animals are potential sources of deadly diseases that can infect humans and cause death.
Do not consume raw or uninspected meat or blood	Many deadly human anthrax cases arise from consumption of uninspected meat.
Do not consume meat with an abnormal smell or colour	Abnormal smell or colour are signs of spoiled meat. Such spoiled meat is a potential source of poisoning and infections.
Do not slaughter during outbreaks of Rift Valley Fever or other dangerous diseases	During outbreaks, many animals are infected and some of them may not show obvious signs; if slaughtered for meat, they can easily infect humans. Slaughtering Rift Valley Fever infected camels and handling their meat can be deadly for humans!!! For humans there is no treatment for Rift Valley Fever!
If a camel was treated with drugs recently, observe the drug withdrawal period before it is slaughtered for human consumption	Risk of drug residues that can cause microbial resistance to drugs. Such drugs may be rendered ineffective when used to treat human or animal diseases. Additionally, drugs can cause harm to humans if consumed.
These are real risks!!! Take care!!	



Fig 4.2 Consumption of meat from dead animals, uninspected meat, contaminated or spoiled meat is dangerous

4.1.3 Meat cutting, and processing

Because fresh meat spoils quickly, it must be sold at once. If it is preserved – for example through drying, smoking, salting etc – or processed – for example into sausages, biltong etc – it will keep longer, and can be sold over a longer period and taken to far away markets, where it can fetch better prices. This is known as improving marketability by adding value. **Table 3** gives an overview of meat processing methods.

Table 3: Processing meat after slaughter

Process	Why	Product example	Procedure
Meat cutting	<ul style="list-style-type: none"> ■ For ease of consumption, marketing, storage and transportation. ■ Preparation of prime or retail cuts. ■ Value addition. 	<ul style="list-style-type: none"> ■ Sides. ■ Quarters. ■ Sirloin. ■ Topside. ■ Silver-side. ■ Shank etc. 	<ul style="list-style-type: none"> ■ Observe basic hygiene — use clean knives and meat cutting saws; observe personal hygiene; wear clean protective clothing; make sure there is plenty of water; use clean working surfaces ■ When de boning the various cuts, make sure as little meat as possible is left on the bones. Detailed procedures will depend on what is required and are outside the scope of this manual ■ Note: Cutting of bones should be done with a saw to avoid splitting, which could cause injury during eating.
Preservation	<ul style="list-style-type: none"> ■ To prolong shelf life by killing or reducing pathogens, hence longer storage. ■ To add value through improved flavour, shelf-life and minimised risk. ■ NB: <i>Nyirinyiri</i> can stay for up to 6 months while dried meat lasts 2 to 3 months. 	<i>Nyirinyiri</i> . Biltong. Pickled meat. 'Corned camel'.	<p>Detailed procedures for drying, smoking & roasting, cooking and storing are given in Table 4.</p> <p>In all cases, proper hygiene must be observed:</p> <ul style="list-style-type: none"> ■ Personal hygiene. ■ Clean working surfaces. ■ Clean working tools, equipment and containers. ■ Clean premises. ■ Trim meat free of fat and connective tissue. ■ Do not expose fresh meat under processing to temperatures above 100° C for more than 6 hours.

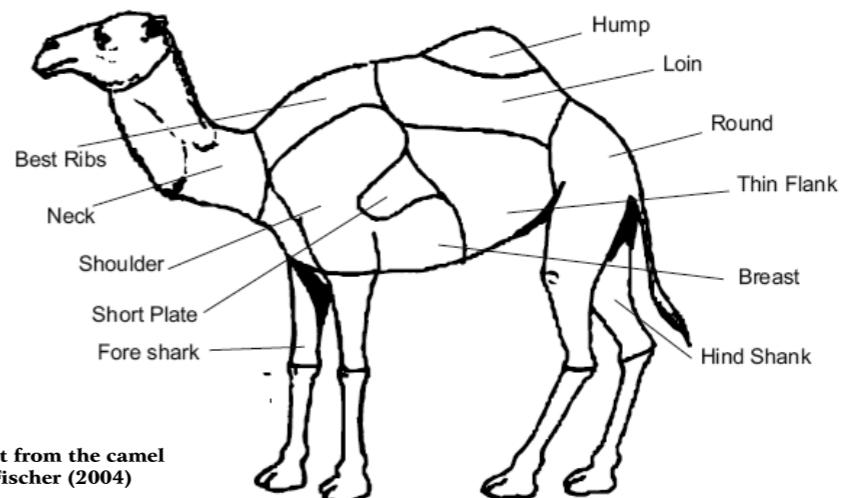


Fig 4.3 Best cuts of meat from the camel
Source: Farah, Z. & A. Fischer (2004)

4.1.4 Adding value to camel meat

Traditionally in Kenya pastoral camel keepers deep fry and store meat in fat (Nyirinyiri).

Table 4 describes how to preserve meat.

Table 4: How to preserve meat

Method	Procedure
Drying Traditional drying of meat is known as "derein," (Somali), "Jaji" (Boran) and "Lesirikan" (Samburu)	<ul style="list-style-type: none"> ■ When butchering a camel, lean meat should be used and trimmed of fat. ■ The carcass should be properly bled and larger pieces of lean meat cut into smaller pieces. ■ Strips of meat are cut in the direction of muscular tissue. They may vary from 20 to 70cm in width. ■ The strips are cut the same size so they take the same time to dry. ■ The meat is hung on lines in the sun with good air circulation. ■ Meat dried on racks should be turned every two hours to ensure even drying. ■ The lines or racks should be protected from insects and other pests by mosquito netting and by standing the legs in tins of water. ■ Meat dries in 5 days and even less in very dry, windy areas such as around the Chalbi desert in Marsabit, but requires protection from dust. ■ Dried meat is best stored in closed sisal sacks hung from the ceiling of a cool, dry, well-ventilated store to keep out pests.
Roasting and smoking	<ul style="list-style-type: none"> ■ The two activities often occur together: Smoke particles absorbed by the flesh have a preservative effect and prevent growth of bacteria on the surface of the meat. ■ The two activities affect the taste and colour of meat. ■ If the temperatures of the wood fire is high enough the meat becomes cooked, which is called 'roasting'. ■ If the product is well dried, it can be kept for a long time. ■ The safest process is to first cook the meat by hot smoking and then dry it by more prolonged smoking at temperatures between 45° and 85°C.
Salting	<ul style="list-style-type: none"> ■ Salting is occasionally used in order to make the drying process more complete. Among the Orma, meat is salted before roasting. When drying meat, the Boran add salt to keep away flies.
Cooking and storing in fat or honey	<p>A major tradition among Kenyan pastoralists involves cooking and storing meat in fat. The meat is known as Nyirinyiri (Somali) or Koche (Boran).</p> <ul style="list-style-type: none"> ■ The meat can be beef, goat or camel, but camel is preferred. ■ Rump steak is cut into thin strips and sun dried for four hours to a day depending on the weather conditions. ■ It is then cut into small pieces, about the size of a finger nail. ■ The cuts are then fried in ghee, <i>Samuli</i> or camel fat. ■ Spices such as cardamom, cloves, <i>Karafu</i> or garlic provide flavour. ■ The <i>Nyirinyiri</i> is then stored in the fat in special containers. ■ If dried and fried well, <i>Nyirinyiri</i> can last for up to two years

4.2 Milk

Camel milk is a very important staple food for Kenya's pastoralists. During the dry season, camels will keep giving milk when milk from all other livestock species has dried up. So the milk can keep pastoralists and their children from starving during drought and periods of scarcity.

Camel milk is also very healthy. It contains three times more Vitamin C than cow's milk and so is the main source of vitamins and high quality protein for pastoralists, allowing a balanced diet in the arid lands where vegetables and fruit are hard to get and meat is only eaten occasionally. Camel milk thus prevents nutritional deficiencies in pastoralist communities. It is also thought to have medicinal properties and is traditionally used to treat illnesses like diabetes and other chronic infections.

But camel milk is also the most expensive milk in Kenya. The highest prices are paid for fresh clean camel milk, with sour camel milk fetching less. Because it stays fresh for longer than cow's or goat's milk, it can be transported to more distant markets in towns and cities.

The important thing to remember is that only milk that is produced, handled and transported in a clean and hygienic way will reach the market as fresh milk, attracting customers and fetching good prices.

4.2.1 Production of clean and safe milk

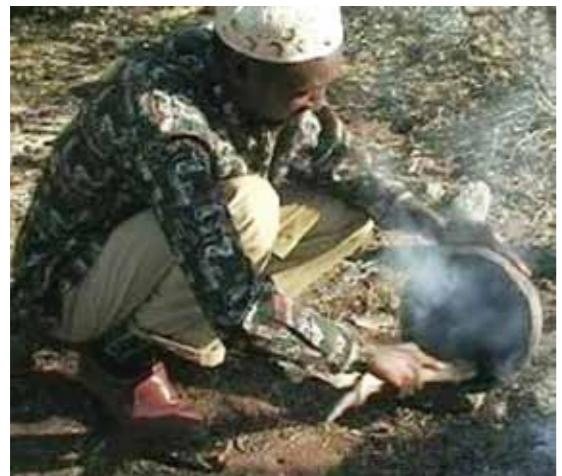
Clean, fresh milk fetches the highest price in the market. How milk is produced determines its quality and value.

Table 5 shows how to produce clean and fresh milk

Table 5: How to produce clean and fresh milk

Important points	Why is this important
Hygienic milking	<ul style="list-style-type: none"> ■ The camel must be healthy and feeding normally ■ The udder and the teats must be free of wounds, abscesses and ticks, no swelling or signs of mastitis ■ Herdsman must wash hands with water and soap before milking; because clean water is often scarce or not available for washing the teats, dry cleaning of the teats can be done with tissue paper or with a fresh clean cloth (cloth has to be washed, boiled and dried before use) ■ If a camel was treated recently observe drug withdrawal period for milk
Which camels to milk first?	<ul style="list-style-type: none"> ■ Milk calving heifers and young camels with four intact teats first, also milk all camels that do not react to the California Mastitis Test (CMT) before milking those that do react (see Chapter 3, Mastitis and fig 3.6) ■ Although it is easier and faster to milk old camels before milking first-calving young camels, milk the young camels first ■ Leave until last the milking of old camels that have less than four intact teats, swollen and sensitive udder, wounds on the teats, show abnormal milk, or give milk that reacts in the CMT ■ The source of mastitis infection is older camels with chronic mastitis; milkers' hands transmit mastitis from infected to non-infected udders ■ Young camels, with normal udders and camels not reacting in the CMT are not infected with mastitis. ■ Old camels and camels with abnormal milk and deformed teats that react in the CMT are infected with mastitis; if they are milked first, all camels milked later by the same person can easily get infected with mastitis.

The milker	<ul style="list-style-type: none"> ■ Milker should be healthy – no coughing or sneezing, no open wounds, no diarrhoea ■ He must observe personal cleanliness – clean clothes, washed and dried hands and trimmed clean finger nails 	<ul style="list-style-type: none"> ■ If unclean or sick, the milking person can easily contaminate the milk. ■ Dirty milkers produce dirty milk that spoils fast and may cause harm to consumers.
The milking site	<ul style="list-style-type: none"> ■ Choose a clean place for milking, if possible outside and upwind from the boma; this is particularly important if camel milk has to be taken to faraway markets ■ Change to new clean boma frequently 	<ul style="list-style-type: none"> ■ The boma contains dirt, faeces and has dust and flies that can get into the milk container and spoil the milk, wind keeps dust and flies away. ■ The boma if occupied for long periods becomes very dirty and has a lot of flies.
The milking bucket	<ul style="list-style-type: none"> ■ The best milking equipment is stainless steel buckets and galvanised metal containers, normally not readily available in the arid lands and expensive in the short run ■ Traditional buckets that are properly sanitised by heat treatment ('smoking') are hygienic and should be used when metal buckets are not available ■ In between milking times, milk buckets must be stored upside down away from dust, flies and soil ■ Plastic buckets are intended only for single use as food containers and must not be used for milking! 	<ul style="list-style-type: none"> ■ Milk from the udder is very clean, but if milked into a dirty bucket it is contaminated immediately and spoils quickly. ■ Only buckets that can be cleaned thoroughly should be used ■ Correct storage prevents contamination of the bucket. ■ The plastic bucket's surface is soft, so it corrodes quickly and cannot be properly cleaned and sanitised; plastic buckets are therefore an important source of milk contamination.



Smoke treatment of traditional milking bucket.
(Source: Mario Younan)

4.2.2 Risks from drinking raw milk

Fresh milk from a healthy camel kept in clean containers is safe to drink. When bacteria get into the milk, they multiply rapidly and the milk can become dangerous to drink, especially for children and frail, elderly people.

Table 6 shows different ways in which raw milk can become contaminated and dangerous to drink.

Table 6: Is it safe to drink raw milk?

There is always a risk of contracting diseases when drinking raw camel milk	Why is it risky?
<p>Dangerous milk comes from:</p> <ul style="list-style-type: none"> ■ Camels that have aborted ■ Sick camels ■ Camels treated with veterinary drugs ■ Camels with mastitis ■ Camels with abscesses and wounds ■ Milking done by unclean or sick milker ■ Dirty plastic containers ■ Addition of dirty water to milk (adulterated milk) 	<ul style="list-style-type: none"> ■ Any disease or infection affecting the camel also affects its milk and the person drinking the milk. ■ Some infections are 'silent' — the camel shows no visible signs of disease — but its milk is infected and dangerous. Especially with Brucellosis, the camel looks healthy but its milk is very dangerous! ■ Veterinary drugs, including acaricides, given to the camel are excreted in the milk for some time; many of these drugs are poisonous to humans. ■ When we don't know anything about the camel and the milk container, it is safer to pasteurise or boil the milk before consumption.

4.2.3 Fresh milk marketing

It is important to protect milk from dirt and heat; this delays souring and keeps the milk fresh until it reaches the market. And fresh milk can fetch between 20% and 40% higher prices than sour milk. When there is a lot of milk in the market, sour or spoiled milk is difficult to sell.

Table 7 shows how to handle and transport fresh milk safely in different types of containers (Remember, never use plastic jerricans!) See figure 4.5 and also refer to Handbook on milk collection (1990)

Table 7: Containers for milk storage and transport

Important points	Why is this important?
<ul style="list-style-type: none"> ■ Do not transport milk in plastic jerricans! ■ For milk storage and transport use quality metal or aluminium milk cans with proper lids that can be closed and locked tightly. Milk cans should be seamless and easy to clean; metal containers cost more, but last for many years 	<ul style="list-style-type: none"> ■ Plastic jerricans (old food containers or even containers for engine oil) have very narrow openings, so they cannot be cleaned properly; their surface is very soft and rapidly develops mini-cracks which contain dirt; old plastic surface also releases substances into the milk that cause cancer ■ Plastic jerricans are the main source of milk contamination and the reason for rapid milk spoilage during transport. They only last a few weeks; if milk cans cannot be tightly closed, clean milk gets contaminated from outside during transport. Saving money ONCE on a cheap container means losing money EVERY DAY through lower prices due to sour or spoiled milk

- | | |
|---|--|
| <ul style="list-style-type: none"> ■ Wrap a wet cloth around the container to cool it* and always try to keep containers in the shade; if possible put milk in fridge and cool it down before transporting it over long distances ■ Traditional containers (gourds or the Somali <i>Haan</i>) properly sanitised by heat treatment ('smoking') are hygienically OK and good for milk storage. They are particularly suitable for milk fermentation ■ Do not mix fresh morning milk with old milk from the evening before | <ul style="list-style-type: none"> ■ Keeping milk cooler slows down souring, milk stays fresh for longer ■ Transferring milk from traditional heat treated (smoked) containers into metal containers is safe. ■ Old milk spoils the fresh milk when mixed together. |
|---|--|

* This is called evaporative cooling. A good way of doing this is using gunny bags (see picture below) into which the milk cans fit; they are cheap and easy to make and must always be kept wet during transport.



Wet gunny bags for milk cooling during transport
(Source: Amos Adongo)

Experience from North Somalia

In most markets sour camel milk (*susa*) costs 20% (sometimes up to 40%) less than fresh milk (*Dhay gel*). When Fatuma, a milk trader in Garowe, was using plastic jerricans to transport her camel milk to market, she used to sell most of her milk as *susa* ("Six out of ten cups would go sour"). Since she switched to aluminium milk cans, she sells most of her milk as fresh milk ("Now I sell seven out of ten cups as fresh milk"). Her fresh milk also attracts more buyers. Her income has increased because of her investing a little extra money in clean milk containers.

4.2.4 Processing and marketing of camel milk products

Heat treatment of camel milk – for example, pasteurisation and yoghurt making – creates products that need to be kept cold until they are consumed. Such products also need hygienic packaging to protect them from contamination. They can spoil easily if not packed in sterile containers. What is more, they are costly to produce and need a lot of investment in starter cultures, cold chain, processing and packaging equipment. For producers in Kenya's arid lands, it can be difficult and risky to market products that need a cold chain. The starter lactobacillus culture commonly used in making yoghurt needs to be kept in a deep freezer.

People often ask about making cheese from camel milk. Camel milk cheese is much more difficult to produce than cheese from cow milk or from goat milk. Cheese making also needs special equipment and cooling facilities. Currently there is no market for camel cheese in Kenya.

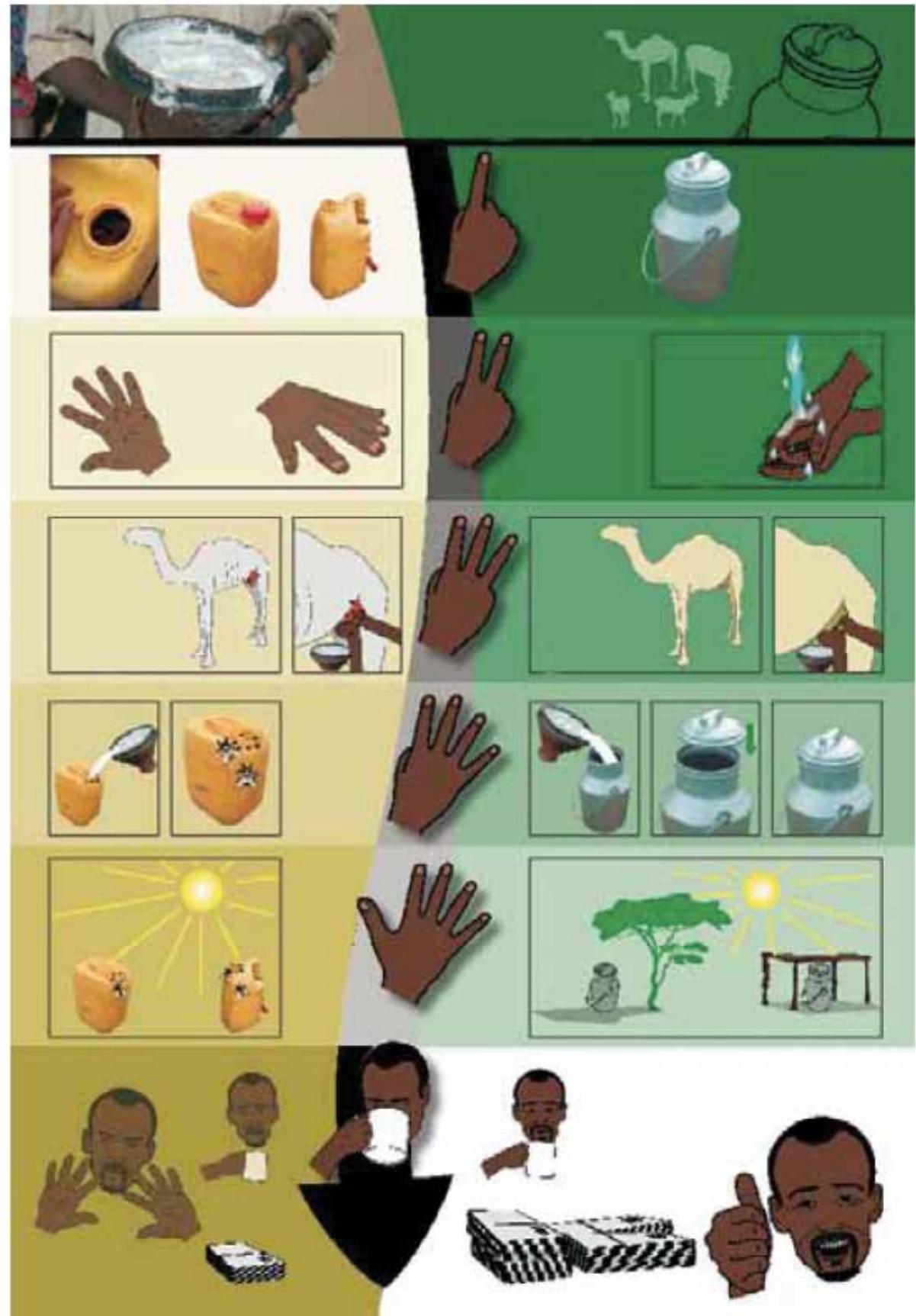


Fig 4.5 Sell clean milk, attract more customers: Source - Somalia Pastoralist Dairy Development Project (VSF Germany)

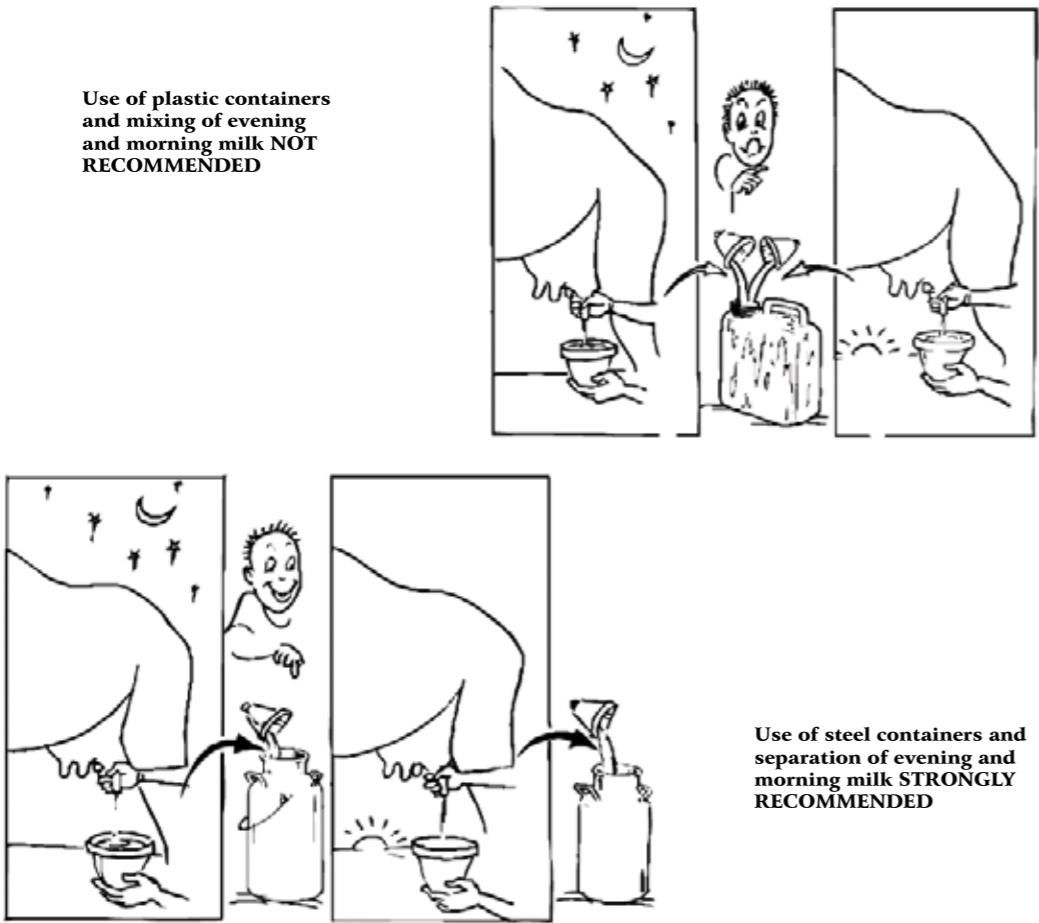


Fig 4.4

Table 8 looks at pros and cons of processing camel milk, especially pasteurising and yoghurt making.

Table 8: To process or not to process camel milk?

Pros and cons	Why is this important?
<ul style="list-style-type: none"> ■ Pasteurised milk and yoghurt need to be kept cold (at fridge temperature: +4°C to +8°C) during transport and until sold and consumed ■ Pasteurised milk and yoghurt are more vulnerable to contaminants than raw milk and must be packed in sterile containers and kept cold; if not chilled they must be sold and consumed very quickly ■ Do not attempt to process and pack camel milk, unless you have access to a cold chain or to a nearby market where products are sold and consumed on the day of production 	<ul style="list-style-type: none"> ■ Transporters in ASALs do not have cold storage in their vehicles and most traders and consumers do not have fridges. ■ Under warm conditions, pasteurised milk and yoghurt do not go sour but become watery and produce a smelly gas and can no longer be sold or consumed ■ Milk traders and customers are used to raw camel milk going sour, which can then still be sold and consumed (e.g. as <i>susa</i>)

Tables 9A to 9E give an overview of processing options for camel milk, for more technical details consult Farah, Z. & A. Fischer 2004 (see references)

9A HOW TO PRODUCE PASTEURISED MILK

Requirements

- 2 metal cans (size depends on volume of milk)
- Piece of clean sterile (boiled) cotton cloth
- Measuring cup
- Large *sufuria*
- Source of fire (energy saving *jikos* preferred)
- Thermometer (for literate processors)

Procedure

HOW TO PASTEURISE MILK TO MAKE IT SAFE FOR DRINKING

- » Prepare a water bath (*sufuria*) with the right temperature [65°C or 75°C].
- » Fill the milk into a clean milk can and stand the can inside the water bath.
- » Measure milk temperature with a food grade thermometer.
- » When milk temperature reaches 65°C keep that temperature for 30 minutes.
- » [Alternatively, when milk temperature reaches 75°C, keep that temperature for 2 minutes].
- » This procedure kills all dangerous bacteria in the milk.

9B HOW TO PRODUCE SOUR MILK (*susa*) AND YOGHURT

- Sour milk can be produced by natural fermentation and is of excellent quality if traditional containers (*Haan*) are used for fermentation and good milk hygiene is observed.
- Traditional sour milk can be flavoured with sugar or commercially available food additives (e.g. strawberry flavour).
- Use only metal cans for transport of sour camel milk; plastic jerricans spoil sour milk during transport.
- Sour milk keeps longer than fresh milk, can be transported over long distance and is in high demand in urban markets of Kenya; small urban milk bars offer a niche market for different varieties of flavoured *susa*

HOW TO PRODUCE YOGHURT

- Yoghurt is produced from camel milk by first heating the milk and then adding commercially available starter cultures after the milk has cooled down.
- Small urban milk bars can process camel milk (e.g. into yoghurt) and market it daily fresh without packaging or refrigeration.
- Starter cultures for yoghurt are expensive and need storage in a deep freeze until used for processing milk.

9C HOW TO PRODUCE GHEE

- Ghee (Somali: Subaq) is storable and can be made from camel milk using special manual processing equipment.
- Making ghee from camel milk is very difficult because the fat particles do not separate easily like those of cattle and goat milk.

Requirements

- Cream separator.
- 2 small sufurias.
- Aluminium milk can.
- Colander Sieve.
- Clean hygienic milk.
- Water (for cooling and cleaning).
- Storage containers.
- Source of fire for heating milk with less smoke.
- Clean sterilised cotton cloth.
- 1 small sufuria for collecting cream.

Procedure

- Sterilise all the utensils/containers to be used in cream processing.
- Heat milk to 60°C (camel milk) or 45°C (cows, goat's milk).
- Separate cream from skim milk using manual cream separator.
- Boil the cream and let it cool to room temperature.
- Add culture (mesophillic) available from any dairy product shop.
- Let it stay overnight. You can also boil directly from the cream separator till oil separates out. This will lack the fermented flavour preferred by some consumers.
- Cook fermented cream over slow heat till all particles turn brown.
- Sieve the ghee using dry sterile (boiled in clean drinking water) cotton cloth.
- Before complete cooling, pack ghee in suitable clean containers depending on purpose and targeted market.

There is no big market demand for camel milk ghee; camel ghee's taste and consistency are close to that of camel hump fat, which is cheap.

- Making ghee is a good way to store surplus milk that cannot be consumed or marketed.
- Firewood may be scarce or expensive.
- The extra costs can be justified by the household food security during drought.

9D HOW TO PRODUCE CONDENSED MILK

- Condensed milk can be produced easily using household items. It keeps for a long time - up to 1 year.
- A lot of firewood is needed for preparation.
- It needs sugar and clean containers that can be shut tightly.

Procedure

HOW TO MAKE CONDENSED MILK

1. 4 Parts Camel Milk + 1 Part Sugar, for example $4\text{cups milk} + 1\text{cup sugar} = 5\text{ cups}$
or $4\text{kg milk} + 1\text{kg sugar} = 5\text{kg}$
2. Boil gently with frequent stirring until
5 parts are reduced to 2 parts $5\text{cups reduced to 2 cups}$
or $5\text{kg reduced to 2kg}$
3. Fill boiling hot milk into clean screw cap glass jars
Fill jars up to the brim, such that no air remains inside
(Clean metal tins with press down lids may also be used)
4. Close the jar immediately and allow it to cool in inverted position
Condensed milk keeps for up to 1 year. It is very nice when added to tea or *uji*.

9E HOW TO PRODUCE CAMEL MILK SWEETS

- Need clean hygienic working environment.
- Use only basic household type equipment.
- Ingredients can be stored at room temperature.
- Different varieties and flavours possible.
- No need for cold storage or starter culture.
- Products popular in local markets and can also be sold to distant urban markets.
- Profit needs to be calculated against cost of inputs.

HOW TO MAKE CAMEL MILK SWEETS

- Hygienically made *susa* will separate after some time in storage. When this happens, the watery part (=whey) can be poured off and the solid part (=curds) strained directly without addition of anything. Addition of small amounts of boiled cow or goat milk during *susa* fermentation speeds up the separation.

Drain remaining water from the curds through a clean cloth

Weigh available curds

When the curd is well drained add about an equal amount of sugar

Add 0.1 % citric acid

Optional: add nuts, sesame seeds or spices

In a thick-bottomed pot, cook mixture on slow heat and with constant stirring till colour starts turning light brown and the mixture is thick enough to harden

Pour onto serving plate or shallow bowl in layer of about 1-2 cm thickness and let cool

Form into small balls and set on another plate to dry for about 24 hours

Pack in suitable containers for sale (e.g. wrap in thin aluminium foil)

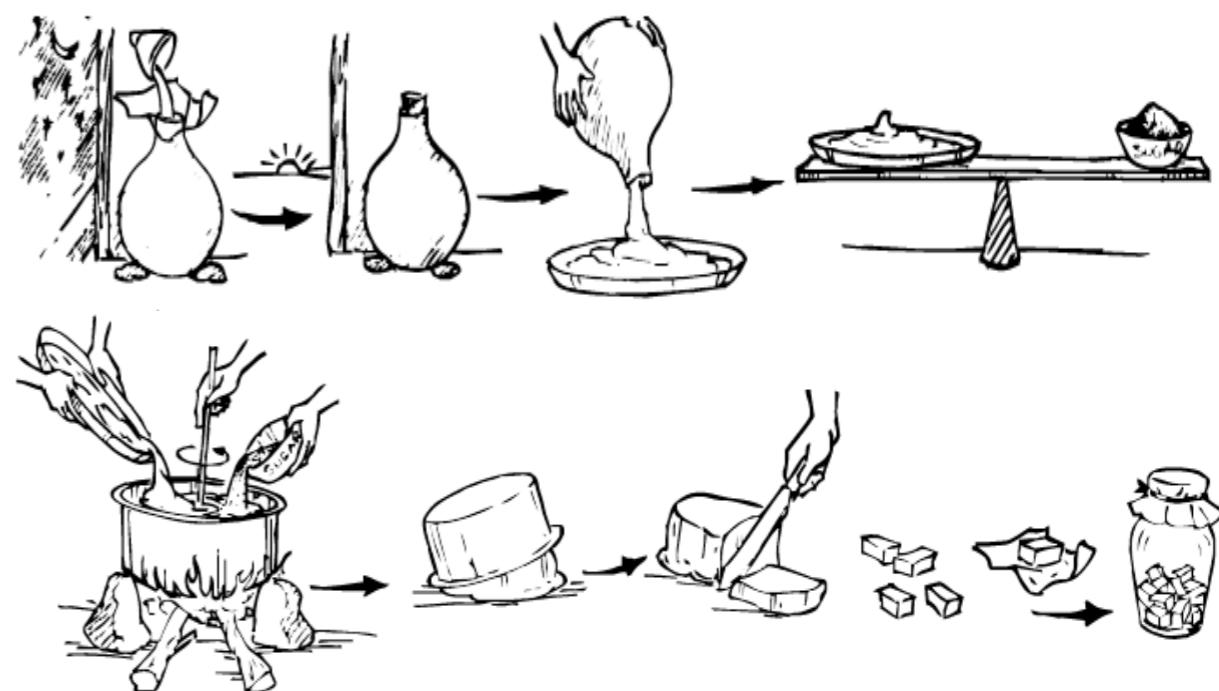


Fig 4.6 Making camel milk sweets

4.3 Hides

Camel hides are used by pastoral communities to make all sorts of things, like sleeping mats, sandals, ropes and whips. The Turkana community also use hides as food during severe drought. Commercially, camel hides are used in the making of army boots and other products. But there are many other commercial possibilities, and pastoralists can make much more money from selling hides than they do now if reliable markets are found and quality standards are met.

For quality production of hides, management practices like those shown in **Table 10** are recommended.

4.3.1 Skinning, handling and preservation of raw hides

Good slaughtering practices will always bring out best value and grade for a hide. But bad preservation after slaughter can cause defects like flaying and rotting of the hide. Curing is a way of preserving the quality of hides for longer periods and preparing them for tanning.

The most common methods of curing are air-drying and salting. However, salting is much better for successful curing. Salt-cured skins have a good market value compared with air-dried hides, which have no market at all. Salting is done by rubbing white coarse industrial salt on the green hide. There are two methods of salting – dry salting and wet salting. For best results, follow the suggestions in **Table 11** when skinning the camel and preserving the raw hide.

4.3.2 Tanning and value addition

Tanning is a long process with several steps. It is a method of converting green or cured hides into an intermediary product called pelt from which the final product, leather, is made. Different items such as footwear, belts and bags can be made from the leather. Where a tannery is situated nearby, the fresh raw hides can be processed directly without curing. This should be done within 6 hours after skinning.

How to construct an ideal hides and skins store (Wet salting method)

Note: With wet salting technology, the curing house also serves as a store.

1) Size depends on the volume of hides/skins being handled.

2) Floor must be slightly slanting so as to direct fluids to one corner, where there is an outlet to a septic pit.

3) The hides/skins should be stacked for curing and storage on wooden platforms raised 15cm above the floor.

The size of the platform should be 2 by 2 metres but the top should be curved upward in the middle to allow fluids to drip to the floor.

The maximum stacking height above the ground should be 5 feet.

Table 11: Skinning and handling hides

Procedure	How it should be done
Skinning	<ul style="list-style-type: none"> ■ When skinning do not cut too deep or incision will show in the hide. ■ Pull out hides or use proper flaying knives to avoid damaging the hide. ■ Proper ripping lines should be followed for better hides. ■ For easier flaying, removal of hides should be done immediately to avoid cooling of the carcass. ■ Skinning is a skill, so proper training is a good idea.
Defatting	<ul style="list-style-type: none"> ■ Remove as much fat and meat as possible to avoid putrefaction (decay). ■ Caution: Camel hides have a lot of fat that can lead to putrefaction, lowering the quality of the hide.
Dry salting method	<ul style="list-style-type: none"> ■ In dry salting, after one day the salt is shaken off and the hide is dried in the sun. ■ Salt is applied on the flesh side. For best results, this should be done 3 to 6 hours after flaying. ■ This is done by sprinkling the salt on the hide, then rubbing it in by hand, using gloves if possible. ■ About 7kg salt is needed per hide; the average weight of a fresh camel hide is 30kg. ■ Salt acts as a dehydrating agent and preserves the hide.
Wet salting method	<ul style="list-style-type: none"> ■ Recommended because it produces a better product that commands a higher price. ■ Hides are washed and spread with the flesh side up on a dome shaped stand, in a well ventilated protected shed. ■ The area should be free of dogs, rats, beetles and ants. ■ Coarse industrial salt is used, again about 7kg per hide ■ In hot areas, shuffling of the stacked salted hides is recommended. ■ The stacked hides will be cured within 21 days; if not taken straight to market after 21 days, the hides should be reshuffled to allow aeration and avoid heat burn.

Table 10: Production of quality camel hides

Production practices	Why it's important
Physical care	<ul style="list-style-type: none"> ■ Avoid external damage to camels when carrying loads so their hides will not have defects. ■ Rutting male camels may bite each other, causing damage to the hides.
Pest and disease control	<ul style="list-style-type: none"> ■ Hides from a sick animal will fetch lower prices. ■ Sick animals can infect other healthy ones and even cause death or infections to humans handling the hides (Anthrax!) ■ When buying or exchanging camels with other herds check thoroughly and observe quarantine to avoid disease getting into your herd that directly affect hides, especially mange, camel pox and anthrax. ■ Treat camels against ticks to avoid tick bite damage to hides.
Branding and marking	<ul style="list-style-type: none"> ■ Should be done on neck or lower parts of the legs so hides are not marked. ■ The marks should be put on the same side of each animal for ease of recognition.



The severing knife



The ripping knife



The flaying knife

Fig 4.7 Use correct tools to get quality hides

4.4 Marketing of Camels and Camel Products

Table 12 summarises problems in the marketing chain of camels and camel products and **Table 13** contains some general marketing tips.

Table 12: Problems of marketing camel products

Problems with:			
Camel Production Area	Marketing Meat	Marketing Milk	Marketing Hides
<ul style="list-style-type: none"> ■ Poor infrastructure. ■ Poor marketing information. ■ Poor policy support. ■ Diseases. ■ Negative attitude of some camel owners. 	<ul style="list-style-type: none"> ■ Lack of approved camel slaughter facilities. ■ Low slaughtering and hygiene standards. ■ Lack of markets. ■ Lack of cold storage facilities. ■ Lack of orientation towards marketing of camel meat. 	<ul style="list-style-type: none"> ■ Low hygiene standards in camel milk production. ■ Lack of adequately equipped collection points near milk production areas. ■ Lack of camel milk storage and processing facilities. ■ Inadequate road infrastructure. ■ Risks associated with milk borne diseases. 	<ul style="list-style-type: none"> ■ Markets are erratic. ■ Low volumes. ■ Low standards of preservation and storage. ■ Hide defects resulting from branding, tick bites, skin diseases, wounds etc. ■ Poor flaying and handling techniques leading to poor quality.

Table 13: Marketing tips (extension messages)

Local markets	What to do
Camels for slaughter	<ul style="list-style-type: none"> ■ Animals to be sold must be healthy. ■ Obtain livestock movement permit where applicable. ■ Obtain up-to-date information on pricing and prices, also from border and outside Kenya if possible. ■ Sell camels in good condition in order to fetch prime prices. ■ Avoid selling under pressure; then prices are bound to be low. ■ Be ready with information about the weight, breed and history of the animal as this will help to negotiate a fair price.
Meat	<ul style="list-style-type: none"> ■ Observe sound hygiene practices: <ul style="list-style-type: none"> » Personal hygiene and cleanliness. » Clean retail sites and premises, keeping them protected from flies. » Use clean knives and other tools for cutting or preparing meat. » Do not cover meat with dirty or contaminated materials. » Do not handle contaminated or dirty items (e.g. Money) alongside meat. » Avoid sneezing or coughing directly on to the meat; a sick person must not carry out slaughtering! ■ Sell on the day of slaughter, unless kept in refrigeration. ■ Transport in a clean container. ■ If moved over long distances to markets, a meat transport permit and certificate of transport will be required – Meat Control Act, CAP 356 of the laws of Kenya.

Milk and milk products	<ul style="list-style-type: none"> ■ Ensure hygienic production and fast transport in closed metal containers.
Hides	<ul style="list-style-type: none"> ■ The hides can be bought or sold in a green or cured state. In both states, hides are sold by grade as well as by weight. ■ Hides contain different percentages of water depending on the curing method used. It is important to know this to avoid being cheated when buying or selling hides. ■ The grading and pricing of hides is controlled by the buyers and this makes it difficult for the pastoralists to get fair prices; awareness needs to be created to avoid exploitation by unethical traders.
Export	<ul style="list-style-type: none"> ■ Buyers should display price boards showing the grades and prices offered against each grade for that particular day, since prices of hides fluctuate depending on the demand. ■ Producers can also get information on current market prices from the Ministry's extension staff.
Camels	<ul style="list-style-type: none"> ■ Exported camels need health certification by the veterinary authorities. ■ Consult the nearest Veterinary Office for more information and advice. ■ Refer to Disease Control Act CAP 364 of the laws of Kenya. ■ Check current prices in different locations; at the Kenyan border, export prices for camel bulls may be far above local prices in Kenya!
Milk and milk products	<ul style="list-style-type: none"> ■ Under current poor infrastructure, export of milk is very difficult. ■ Quality control requirements in Kenya (Raw whole camel milk specification: Kenya Bureau of Standards KS 2061: 2007, ICS 67.100.10). ■ Check regulations for milk in the country you want to export to (e.g. UAE prohibits import of any camel milk!) ■ Certification.
General considerations	<p>Check market demand first</p> <ul style="list-style-type: none"> » It is no use attempting to market a product that has no buyers. Compare the production costs with the price you can hope to get; if the raw material and ingredients are too expensive, there may be little or no profit. <p>Check whether equipment and ingredients needed are easily available and can be used under local conditions, e.g.</p> <ul style="list-style-type: none"> » Starter cultures for yoghurt and cheese making are expensive and need deep freeze storage – otherwise they get spoiled very quickly. » Food additives and flavours are cheap and don't need cold storage » Link your production to existing active markets

Training Tips

Meat: Demonstrate processing of Nyirinyiri; participants to bring their own ingredients.

Milk: Demonstrate principles of clean milk production and ensuring clean milk containers and evaporative cooling (wet cloth) during transport; make condensed milk.

Hides: Visit a hide banda and demonstrate wet salting methods. Participants to bring their own hides, salts and flaying knives.

CHAPTER 5

CROSS-CUTTING ISSUES AND THE WAY FORWARD

Chapter Authors: Christopher R. Field, Khalif A. Abey, Kajume K. Kithinji



Traditional milking technique. Among the Turkana ethnic group of northern Kenya camels are milked by women; however, in almost all other nomadic societies the milking of camels is carried out by men.
(Source: Maurizio Dioli)



5.1 Introduction

As we reflect on where we have come from and on the problems facing camel development, we also need to look ahead, think about what we need, what we can achieve by working together, and the challenges that face us on the way. When we think of how many people derive their livelihoods from camels and camel-related activities, we realise that the government and other stakeholders must redouble their efforts to develop the camel industry, and that the way to do this is to concentrate on value addition and marketing of camels and their products in line with Vision 2030.

5.2 Reflections

5.2.1 Research

The camel has come a long way in the past one-third of a century since serious research began in Kenya. Initially, the main thrust was applied research to understand the camel's special attributes and how they were being utilised by pastoralists. However, in 1984, the great drought raised questions over the usefulness

of the research findings, and as a result the research took a more practical direction.

5.2.2 Camel development

Equipped with new methods for approaching and training pastoralists, the development worker was able to reach them with useful messages and practical advice and solutions to their problems. Pastoralists began to be empowered to make their own decisions on camel development. Community-based self-help groups sprang up and received training in group dynamics, financial management and other needs. For the first time, pastoral women acquired a voice and gender issues became topical.

While this was going on, human population density in the arid and semi-arid lands was mushrooming, increasing the pressure on their fragile environment. Competition for resources became an issue and led to conflict, especially during drought when resources were reduced to a bare minimum. This was eventually brought under some control by Community Based

Peace Committees. Government resources, when divided among more than twice the previous population, were woefully inadequate for livestock development. In the spirit of self-help and self-reliance, pastoralist communities therefore embraced the idea of Community Animal Health Workers who have for the past 20 years been providing some essential animal health services in remote areas.

5.2.3. The Kenya Camel Association

Rising populations and intensified range use have brought the camel into sharper focus, as it has been herded strategically in the most distant areas where its unique attributes enable it to survive, produce and score over all other alternatives. The Kenya Camel Association, when launched in 1995, aimed to respond to the felt needs of its members and others, but without funding and largely on a voluntary basis. Gradually, the importance of its work has come to be recognised by the government and donors, so that its position has been strengthened and it can be more effective. Annual Forums have been held at 10 venues in the pastoral lands to share camel problems and jointly seek solutions.

5.2.4 The private sector

The need for expert advice at the camel camps has been rising, and is being met by trained CAHWs. Although less dramatic than animal health, the services of animal production experts are equally necessary and are indeed often needed on a daily basis (for example, in milk production and marketing). Scaling up the training of the CAHWs, drawn from camel camps, to provide additional advice on camel production seems to be a logical approach. Otherwise, it would be difficult for the service provider to generate a living from animal production services alone. It is still not entirely clear how this will be achieved, or whether the government will embrace this new approach wholeheartedly. Certainly, the establishment of the new Ministry for the Development of Northern Kenya and other Arid and Semi Arid Lands gives reason for hope.

5.3. The way forward

The future of the camel seems for the most part to be assured. But unchecked population growth and increasing demands on the rangelands can still have negative consequences for camels.

5.3.1 Policy

Owing to their ability to survive without water for long periods, camels are kept in remote pastures untouched by other domestic animals. Being out of sight, they have suffered from being out of mind too, and have been neglected by both government and donors. There is now an urgent need to realise the potential

of the camel to be of greater benefit to its owners and the nation as a whole. To make this possible, the government should formulate, publish and implement a camel development policy as part of its overall livestock development policy.

The following components should be incorporated in such a document:

- A preamble recognising the camel's unique position to provide communities with a means of livelihood in the arid lands, where conditions are becoming more extreme due to global warming.
- The need to mainstream the camel in livestock development in the ASALs with funding proportional to its importance in the region.
- Incorporation of the camel in the national curriculum at primary, secondary and tertiary levels.
- Sourcing of funds and appropriate techniques for regular censuses of camels alongside other livestock at the national level to aid in allocation of appropriate resources.
- Establishment of an effective and sustainable camel service delivery system in every camel concentration area in the country; this would have to be part of establishing services for all livestock in the ASAL.
- Support for research relevant to the needs of camel owners such as identification, diagnosis and treatment of unknown diseases of economic importance to camel pastoralists; registration and local and/or regional production of camel specific vaccines (especially Camel Pox), marketing value addition to marketable camel products; development of appropriate safety standards and quality assurance guidelines for ethno-veterinary medicines used in camels.
- Support for integration of the camel into the existing market information system and for new ways of extending credit to camel keepers to drive local and international trade.
- Establishment of a camel breeding centre, either by state corporations and/or supported by private ranchers in order to genetically improve the national camel herd.
- Recognition of the development potential in the camel rangelands and the recognition that settlement, cultivation, and petroleum exploration may be detrimental to camel pastoralism and should first receive the support of the pastoralists.
- Incorporation of camel pastoralism in the National Land Use Policy.
- Continued support for the Kenya Camel Association to achieve its objectives of improving pastoralist livelihoods and wellbeing using the camel.

5.3.2. Communications

The extension and eventual completion of tarmac roads from Isiolo to Moyale on the Ethiopian border and Garissa to Mandera on the Somali border will have a major impact on camel pastoralists similar to what has been seen over the past decade in Garissa. By enabling rapid transport, it will serve as a stimulus to trade in live animals and their perishable products such as milk.

However, it has been noted that the interval between major disease outbreaks in camels has become shorter, very likely because of increased contact between camel herds. Some measures to control movements may be necessary in the future.

5.3.3. Global warming

Finally, global warming is a serious cross-cutting issue likely to affect everyone. Camel owners, however, will be in a good position to exploit this. It is anticipated that the interval between droughts and floods may shorten. Since camels seem to have the least overall mortality in periods of drought, they are likely to replace cattle in marginal areas where the latter's numbers have insufficient time to recover before the next episode (Ndikumana et al. 2000). Following floods, Rift Valley Fever outbreaks have had devastating effects on the camel economy and prophylactic measures need to be put in place to minimise these recurring losses.

Worsening of droughts, with less moisture penetration and increased runoff during intervening floods will,

unless there is a significant increase in total rainfall, lead to an overall intensification of the aridity of the ASALs. In relation to other livestock, this is likely to favour only the camel.

5.4. Cross-cutting issues: Camels and humans in the wider world

So far in this book, we have talked about camels and the humans who keep them. We have also looked at their contacts with the outside world, and at the problems of preparing and selling camel products – meat, milk and hides – to this outside world. But there are many other things happening in the wider world they live in. Out there, gender roles are changing, HIV and AIDS are destroying people's lives and health, the environment is being quickly degraded, there is frequent conflict between communities, there are problems of good governance, human rights and drug abuse. Rapid social change also leads to erosion of the extremely valuable traditional knowledge base of camel keeping communities, which must be preserved for future generations. These 'cross cutting issues' affect first the humans and through them the camels they keep. Ignoring these issues is not wise as they can have large, sometimes sudden and devastating, effects on the lives, income and even survival of the camel keeping community.

5.5. Gender roles

The gender roles in pastoralist society – in simple terms, the different tasks and responsibilities of men, women and youth – have a big impact on camel



Fig 5.1 Women play an active role in milk trade while men are key in management

production and management. Of course, gender roles differ in different communities.

Training tips

- While discussing the cross-cutting issues, the following questions can be raised:
- How to mainstream gender and other cross cutting issues into the camel production system?
- Gender issues especially in the arid lands are not fully understood by many stakeholders including policy makers, and quite often they are not given due attention – what should be done?
- More capacity building on cross-cutting issues – in which specific area is capacity building required?

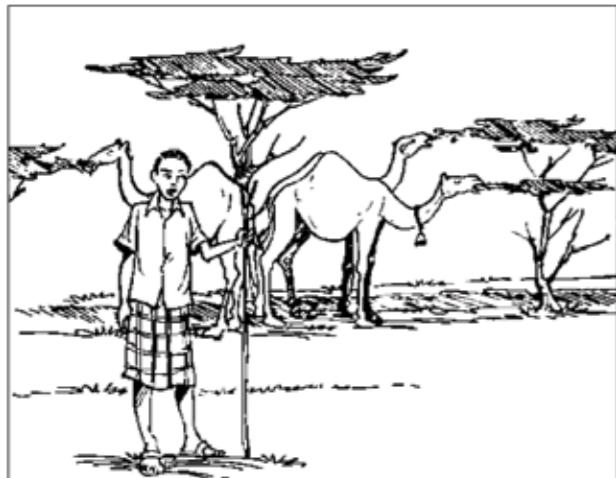


Fig 5.2 Healthy people mean healthy camels



Fig 5.3 Effects of HIV AIDS on camel management

ACKNOWLEDGEMENTS

The authors of this manual would like to thank the Government of Kenya (GoK) through the Kenya Agricultural Research Institute (KARI), Kenya Arid and Semi-Arid Lands (KASAL) Research Programme, the Ministry of Livestock Development (MOLD), the ASAL - Based Livestock and Rural Livelihoods Support Project (ALLPRO), Veterinaires sans Frontieres Switzerland (VSF Suisse) through PSEC and Enhanced Livelihood in the Mandera Triangle (ELMT) and the Kenya Camel Association (KCA) for supporting the development of this very important camel service providers' manual.

Special thanks to the camel keepers, the 63 participants of the camel Training of Trainers (ToT) course (annex) and 39 Camel Service Providers (CASPROs) trainees (annex) for validation of the information in the draft manual; Simon Ndonye, Boniface Adala, Nicholas Muema and Koskei Kirui for the illustrations as well as Alfred Karanja for the graphic designs.

Lastly the African Development Bank (ADB), the European Union (EU), United States International Development Agency (USAID) and Wellcome Trust are acknowledged for funding.



REFERENCES AND FURTHER READING:

- Alquarawi and Ali (2000). A survey of the literature (1995-2000) on the kinetics of drugs in camels (*Camelus dromedarius*). *Vet. Res. Comm.* 24; 245-260
- Anon (1993) *Camel Production*. In: S. P. Simpkin *Camel Production*, A series of lectures by FARM-Africa at Nairobi University. FARM-Africa, London. 84 pages
- Bornstein, S., I.V. Gluecks, M. Younan, P. Thebo and J.G. Mattsson (2008), Isospora orlovi infection in suckling dromedary camel calves (*Camelus dromedarius*) in Kenya. *Veterinary Parasitology*, Vol. 152, 194-201
- Camel Husbandry and Production, best practices from FARM-Africa's Pastoralist Development Project in Kenya*. The complete version of this document is available in PDF format (27 pp; 511Kb) at this link: <ftp://ftp.fao.org/docrep/nonfao/LEAD/X6172e/X6172e00.pdf>
- Dahlborn K, Benlamlah S, Zine F R, Guerouali A, Hossaini H J and Oukessou M. (1992). *Food deprivation and refeeding in the camel*. The American Physiological Society. 262 (Regulatory Integrative Comp. Physiol. 31 :1000- 1005.
- Engelhardt W, Haarmeyer P and Lechner-Doll M. (2006). *Feed intake, forestomach fluid volume, dilution rate and mean retention of fluid in the forestomach during water deprivation and rehydration in camels (Camelus sp.)*. Comparative Biochemistry and Physiology, Part A, 143:504-507.
- Evans, J.O., Simpkin, S.P. and Atkins, Debbie, J. (1995) *Camel Keeping in Kenya. Range Management Handbook of Kenya* Vol III,8, Republic of Kenya, Ministry of Agriculture, Livestock Development and Marketing, Nairobi, 230 pages
[This is the most relevant reference for camel keepers in East Africa! REPRINTS ARE AVAILABLE FROM KARI PLEASE CONTACT KARI HEADQUARTER LIBRARY in Nairobi-Kangemi, Kaptagat Rd.]
- FAO, Basic Biology and Anatomy of the Tsetse Fly. <ftp://ftp.fao.org/docrep/fao/011/i0535e/i0535e01.pdf>
- Farah, Z. & A. Fischer (editors) (2004), *Milk and Meat from the Camel, Handbook on Products and Processing*, vdf Hochschulverlag AG, ETH Zuerich, Zuerich/Singen, Switzerland 2004
- Farah Z, Rettenmaier R and Atkins D. (1992). *Vitamin Content of Camel Milk*. International Journal of Vitamin Nutrition Research, 62: 30-33.
- Field C R (1988). *Characteristics and physiology of camels*. In: S. P. Simpkin *Camel Production*, A series of lectures given by FARM-Africa at Nairobi University pp 23
- Field, C.R. and Simpkin, S. P. (1985) *The importance of camels to subsistence pastoralists in Kenya*. IPAL Technical Report E7, UNESCO, Nairobi.
- Gitao G C. (2006). *Camel Husbandry: A Practical Guide to Camel Husbandry*. Intermediate Communications Ltd., Nairobi (Kenya).
- Glücks I V. (2007). *The prevalence of bacterial and protozoal intestinal pathogens in suckling camel calves in Northern Kenya*. Freie Universität Berlin, Mensch und Buch Verlag, Germany
- Guliyev A Y, Noor I M, Bebe B O and Kosgey I S. (2007). *The role of camels (Camelus dromedarius) in the traditional lifestyle of the Somali pastoralists in the arid and semi-arid areas of northern Kenya*. Outlook on Agriculture, 36(1):29-34.
- Handbook on Milk Collection in Warm Developing Countries (1990). Published by: International Dairy Federation Special Issue No 9002, Brussels Belgium ISBN 92 9098 004 0
- Heller R, Lechner M, Weyreter H, Von Engelhardt W. (1986). *Forestomach fluid volume and retention of fluid and particles in the gastrointestinal tract of the camel (Camelus dromedarius)*. Journal of Veterinary Medicine, Series A 33, 396-399.
- Higgins A. (1986). *The camel in health and disease*. Bailliere Tindal, London, Philadelphia, Toronto, Mexico City, Rio de Janeiro, Sydney, Tokyo, Hong Kong, ISBN 07020-1167-3
- Hülsebusch C G and Kaufmann B.A. (2002). *Camel breeds and breeding in northern Kenya: An account of local camel breeds of northern Kenya and camel breeding management of Turkana, Rendille, Gabra and Somali pastoralists*. Kenya Agricultural Research Institute (KARI) , Nairobi.150 pages.
- Kaufmann J. (1996). *Parasitic Infections of Domestic Animals – A Diagnostic Manual*. Birkhäuser Verlag, Basel, Boston, Berlin
- Kay R N B and Maloyi G M O.(1989). *Digestive secretions in camels*. Options Méditerranéennes -Série Séminaires – No. 2 -1989: 83-87.
- Koehler-Rollefson, I., Mundy, P., Mathias, E., (2001), *A field manual of camel diseases: Traditional and Modern Veterinary Care for the Dromedary*. ITDG Publishing, London, UK, ISBN-10: 185339503X
- Kuria S G. (2005). Mineral nutrition on settlement (manyatta) based milk camel herds among Rendille community of northern Kenya . PhD Thesis, University of Nairobi – Kenya
- Kurtu M Y. (2004). *An assessment of the productivity for meat and the carcass yields of camels (Camelus dromedaries) and of the consumption of camel in the eastern regions of Ethiopia*. Tropical Animal Health and Production, 36:65-76.
- Lechner-Doll M, Rutagwenda T, Schwartz H J, Schultka W, Von Engelhardt W. (1990). *Seasonal changes of ingesta mean retention time and forestomach fluid volume in indigenous camels, cattle, sheep and goats grazing a thornbush savannah pasture in Kenya*. Journal of Agricultural Science, 115:409-420.
- Manefield G W and Tinson A H. (1996). *Camels, A Compendium*, in The TG Hungerford Vade Mecum Series for Domestic Animals, Series C, No 22, University of Sydney Post Graduate Foundation in Veterinary Science
- Ndikumana,J., Stuth, J., Kamidi,R., Ossiya,S., Marambi,R. and Hamlett,P. (2000) *Coping mechanisms and their efficacy in disaster-prone pastoral systems of the Greater Horn of Africa. Effects of the 1995-1997 drought and 1997-1998 El Nino rains and the responses of pastoralists and livestock*. ILRI Project Report, Nairobi, Kenya, 124 pages.
- Ndung'u J N, Nyamori B O, Kuria S G and Njanja J C. (1999). *Pastoral livestock management practices: A participatory rural appraisal of the Rendille community of Marsabit at Korr*. Kenya Agricultural Research Institute, Marsabit - Kenya
- Ngeiywa, K J Z J; (1993). "Clinical and pathological investigations on camel skin diseases in some camel rich districts of northern Kenya". MSc Thesis, 1993, University of Nairobi
- Njanja J C, Gathuma J M, Gitau G K, Njeru F M and Kinuthia R N. (2003). *Pastoralists' perception of livestock production systems and opportunities and for improvement in southwestern Marsabit, Kenya*. Livestock Research for Rural Development 15(7)
- Rutagwenda T, Lechner-Doll M, Schwartz H Z, Schultka W, Von Engelhardt W. 1990. *Dietary preference and degradability of forage on a semi-arid thornbush savannah by indigenous ruminants, camels and donkeys*. Animal Feed Science and Technology. 31, 179–192.
- Schwartz, H.J. and Dioli, M. (Eds) (1992), *The one-humped camel in Eastern Africa - A pictorial guide to disease, health care and management*. Verlag Josef Margraf, Berlin, Germany, ISBN-10: 3823612182, **[This book presents information on the camel in Eastern Africa. Distribution, adaptation to arid environments, feeding behaviour and nutritional physiology, products, performances, economic importance, productivity, traditional and modern management practices, diseases, health care and post-mortem procedures, are treated with special reference to Eastern Africa. The book is famous for its photo collection, especially of camel diseases, and serves as a good reference book.]**
- Wernery, U. and Kaaden O.-R. (2002) *Infectious Diseases of Camelids*, Blackwell Science Berlin Vienna, Boston, Copenhagen, Edinburgh, London, Melbourne, Oxford, Tokyo, Georg Thieme Verlag, 2nd Edition, ISBN 382633047 **[Best handbook on camel diseases at present]**
- Wilson R T. (1989). *The nutritional requirements of camels*. Options Méditerranéennes -Série Séminaires- n.O 2 -1989: 171-179.
- Wilson R T. (1998). *Camels*. The Tropical Agriculturist Series, Macmillan Education Ltd (London) and CTA(Wageningen).
- Wanyama J B. (1997). *Ethno veterinary knowledge among the pastoralists of Samburu of Kenya*. Intermediate Technology Development Initiative, Maralal Samburu-Kenya
- Yagil R. (1985). *The Desert Camel: Comparative Physiological Adaptation*. Comparative Animal Nutrition, Vol. 5, Basel (Switzerland).
- Younan, M., Ali, Z., Bornstein, S., Mueller, W., (2001), *Application of the California Mastitis Test in intramammary Streptococcus agalactiae and Staphylococcus aureus infections of camels (Camelus dromedarius) in Kenya*. Prev. Vet. Med., 51, 307-316
- Younan, M., (2002), Parenteral treatment of *Streptococcus agalactiae* mastitis in Kenyan camels (*Camelus dromedarius*). Rev. Elev. Méd. Vét. Pays trop., 55 (3), 177-181
- Younan, M., Kenyanui, M., (2003), Camel milk hygiene and camel mastitis in Kenya and Somalia. Proceedings of the "Atelier International sur le Lait de Chamelle en Afrique", published by FAO & CIRAD, Niamey, Niger 5.11.-8.11.2003, <http://www.fao.org/ag/againfo/resources/en/publications/agapubs/ChamelleBook.pdf>
- Younan, M., Bornstein, S. (2007), *Lancefield Group B and C streptococci, important opportunistic pathogens in East African camels (Camelus dromedarius)*. Vet Rec. 2007, 160: 330-335.
- Younan, M., Gluecks, I.V. (2007), *Clostridium perfringens* type B enterotoxaemia in a Kenyan camel. Journ. of Camel Practice and Research, Vol. 14, 1, 65-67
- Younan, M., Bornstein, S., Gluecks, I.V. (2007), *Peri-Articular Abscesses in Camel Calves in North Kenya*. Journal of Camel Practice and Research, Vol. 14, 2, 161–164
- Zakaria Farah, Matthias Mollet, Mario Younan and Ragge Dahir (2007), Camel dairy in Somalia: Limiting factors and development potential. Livestock Science, available online at [www.sciencedirect.com](http://sciencedirect.com)

CASPRO MANUAL AUTHORS

Simon G. Kuria (PhD)
Centre Director
Kenya Agricultural Research Institute - Marsabit
P.O. Box 147 - 60500 Marsabit
e-mail: simongkuria@yahoo.com



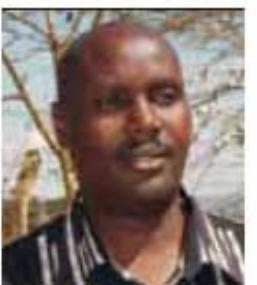
Younan Mario (PhD)
Technical Assistant
Kenya Agricultural Research Institute
Kenya Arid and Semi Arid Research Programme
P.O. Box 57811 00200 Nairobi
e-mail: marioyounan@gmail.com



Christopher R. Field (PhD)
Vice Chairman, Kenya Camel Association
Camelot, P.O. Box 485, Nanyuki, Kenya
e-mail: camelot@wananchi.com



Ernest Mbogo
Provincial Director of Livestock Production
North Eastern Province
Ministry of Livestock Development
P.O. Box 34188 - 00100 Nairobi
e-mail: ernest_mbogo@yahoo.com



Dr. George Wamwere Josiah Njoroge
Community Development Officer
GoK/ADB ASAL-Based Livestock and Rural Livelihoods
Support Project (ALLPRO)
Ministry of Livestock Development, Ngong Road
Hill Plaza Building, 10TH Floor Room 10-03
P.O. Box 34188-00100 Nairobi, Kenya.
Tel: +254 (728)546069 e-mail: gwjnjoroge@yahoo.com



Tura A. Isacko
Officer In Charge
Kenya Agricultural Research Institute, Garissa
e-mail: iturah@yahoo.com



Gluecks V. Ilona (PhD)
Programme Manager VSF Suisse - Kenya
P.O. Box 25656 - 00603 Nairobi - Kenya
e-mail: igluecks@vsfsuisse.org



Abdi Yakub Guliye, PhD
Senior Lecturer, Animal Production/Nutrition
Dept. of Animal Sciences, Egerton University
P. O. Box 536 - 20115, Egerton NJORO, KENYA
Tel.: +254(0)51-2217979 Mobile: +254(0)723800242
e-mail: guliye@egerton.ac.ke, guliye@gmail.com



George G. Chege (PhD)
Dept. Vet. Pathology & Microbiology
P.O. Box 29053 Nairobi
e-mail: cggitao@gmail.com; gitao@uonbi.ac.ke



Mr. Fredrick O. Aloo
Chief Livestock Production Officer
Ministry of Livestock Development
P.O. Box 31188 00100 Nairobi
e-mail: fredricka.loo@gmail.com



Dr. Kisa Juma Ngeiywa
LIVESTOCK EXPERT (DDVS)
ASAL Based Livestock and Rural Livelihoods Support Project (ALLPRO)
Tel: + 254 20 2396433 (office); +254-722-376237 (mobile)
e-mail: kisajuma@yahoo.com



Amos Otieno Adongo,
Kenya Agricultural Research Institute,
National Arid Lands Research Centre
P.O. Box 147 (60500), Marsabit. KENYA
Tel: +254692102040. Fax +254692102220.
Mobile Phone: +254727348140
e-mail:adongoam@yahoo.co.uk.



Dr. Kajume J. Kithinji
Private Consultant
e-mail: jkajume@yahoo.co.uk

Dr. Njihia G. Kinyanjui
Senior Assistant Director of Veterinary Service
Ministry of Livestock Development
P.O. Box 34188 - 00100 Nairobi
e-mail: georgenjehia@yahoo.com



Mr. Khaf A. Abey
National Representative
Kenya Camel Association
P.O. Box 6067 - 00100 Nairobi
e-mail: Khalifabbey@yahoo.com



Maurizio Dioli (PhD)
camel4ever@fastemail.us



Raymond E. Mdachi, MSc, PhD
Head of Chemotherapy Division
KARI-TRC

