

ASAL Based Livestock and Rural
Livelihoods Support Project

Camel Milk

A Practical Guide to Hygienic Production and Handling for Improved Market Access



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Abbreviations

ALLPRO:	ASAL Based Livestock and Rural Livelihoods Support
ARSP II:	Arid Land Support Programme Phase II
ASAL:	Arid and Semi Arid Land
DLPO:	District Livestock Production Officer
FCP:	Famer Communication Programme
ICIPE:	International Centre for Insect Physiology and Ecology
ILRI:	International Livestock Research Institute
KARI:	Kenya Agriculture Research Institute
KCA:	Kenya Camel Association
MOLD:	Ministry of Livestock Development
UAE:	United Arab Emirates
CMT:	California Mastitis Test
TB:	Tuberculosis

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This study has led to a greater understanding of some of the indigenous products and as a result two manuals have been produced: (1) Camel Milk: A Practical guide to Hygienic Production and Handling for Improved Market access as well as (2) Camel Meat: Guide to Commercialising Traditional Products — A Case Study of Nyirinyiri (yet unpublished).

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1. Background information

Importance of Camels in ASAL

As climate change becomes more and more pronounced, the benefit of keeping camels in ASAL areas is becoming more and more obvious. Camels have a range of advantages over other livestock in dry areas as:

- camels can sustain long periods without water,
- camels can travel long distances making them able to use forage far from water points where other livestock cannot reach,
- camels can produce much more milk than other livestock under ASAL conditions,
- camels browse on trees so do not compete with cattle and small stock.

Importance of Camel Milk

Camel milk plays a vital role in household food security, prevention of malnutrition and acts as a source of cash to camel keepers and traders. However there are major restraints in marketing – particularly hygiene issues. Among the factors that contribute to poor hygienic standards of the milk in the ASAL are scarcity of water, traditional ways of milking, high temperatures, dusty environments and inadequate knowledge on clean milk production and handling.

The users/consumers of marketed camel milk is so far the growing urban population, both in Eastleigh and Garissa, with the Garissa market now consuming far the largest share of camel milk. And consumers are quite particular as to the quality of milk they prefer to consume. Informally marketed milk must have most of the same qualities as formally marketed milk, such as a good taste, cleanliness and reliability of this quality. The price seems to matter much less, as consumers will buy expensive long life milk if the informally marketed milk is not of good enough quality.

Camel milk has the following advantages to other kinds of milk:

- Under the same climatic conditions, camel milk yield potential is far higher than cows. The *Bos indicus* cattle able to survive in ASAL areas give 3–4 L milk/each daily under favourable conditions right after the rains, whereas good camels under favourable conditions can reach a milk yield of 15–20 L/day.
- Whereas cows stop producing milk during droughts, camels continue producing for prolonged periods, provided they have access to enough browse.
- Camel milk has different properties from that of cows. It is more heat resistant, giving it a longer shelf life even during extreme transport conditions
- Camel milk is also perceived as a food that heals and sustains life, so is a highly priced commodity, fetching better prices than any other kind of milk.
- The following health benefits have been reported in literature, some of it confirmed by medical studies, but far more research is needed. Camel milk properties as reported:
 1. Consumption of ½ L camel milk per day will reduce the insulin needs in patients with Diabetes Type I by 30% or more. Some patients are reported to have become symptom free after constant daily intake of camel milk (Agrawal *et al.*, 2005).
 2. Camel milk has positive effects in controlling high blood pressure.
 3. Camel milk helps in the management of Arteriosclerosis and Osteoporosis.
 4. Camel milk has been shown to have potent anti-bacterial and anti-viral factors. Clinical trials shows that patients with infectious diseases (Tuberculosis) has a significantly higher recovery rate if they consume camel milk.
 5. Camel milk has 3 times the content of Vitamin C compared to cow milk (see table below).
 6. Camel milk does not produce lactose intolerance in people as far as known (Restani *et al.*, 1999)
 7. Camel milk should be beneficial for autistic children (Sima Ash 2013).

Economic importance of camel milk

According to extrapolated figures from the Kenya Camel Association, the annual value of dryland camel milk production (2012) is in the region of Ksh 32 billion (based on a market price of Ksh 60 per litre). Part of this production is consumed locally and part of it is marketed through informal channels, with producers receiving the Ksh 30+ and another Ksh 30+ being netted by the substantial marketing chain. Figures on how big a part is marketed annually in Kenya are not available.

Consumer preference and public health concerns

As evidenced in the interim study report (2008): Consumption patterns, Marketing Channels and Consumer Demand for Camel milk and meat in Kenya, consumers rate milk as per the following criteria:

Attribute	Percent relative importance			
	Eastleigh		Garissa	
	All tribes	Somalis	All tribes	Somalis
Freshness	40	42	36	35
Unadulteration	20	16	35	35
Colour	0	0	3	3
Packaging	18	20	18	19
Price	22	22	8	8
Total	100	100	100	100

It is thus very clear that quality parameters rate much higher than price concerns for the consumers. Whether milk is packed or not is also less important than freshness, but fear of adulteration will deter some customers from buying informally marketed milk. So in the absence of proof of non-adulteration only personal relationships between sales person and customer – mainly the level of trust that can be built – will determine the level of sales from the informal sector. Price is evidently a more important issue in Eastleigh than in Garissa.

Public Health concerns concerning the informal milk trade include the prevention of the spread of communicable diseases as described in the chapter on Good Milk Quality/Healthy milk.



2. Why the manual

During the study of marketing, processing and value adding of camel milk and meat products in the ASAL region of Kenya which concentrated on the Garissa market, as there were other projects starting up in both Isiolo and Wajir. During the course of the study a great need was identified for training manuals on hygiene in informal camel milk marketing, as a huge and increasing demand for safe camel and other milk was identified. Camel milk is fetching highest prices of any milk, and all camel milk is marketed in an informal manner by women with mostly inadequate knowledge on hygienic milk handling. Towards the end of the study and due to training traders on proper milk handling the camel milk market in Garissa had expanded manifold, and an increased interest in producing camel milk for commercial purposes was emerging, as Garissa seems to be able to consume rather enormous amounts of milk provided it is marketed in a hygienic manner. Garissa has during the study stopped exporting milk to Nairobi and is now consuming milk from a much larger upland than ever before.

The basis on which hygiene was chosen

The above study identified some of the constraints in the camel milk marketing chain, such as consumers being discouraged from using raw camel milk due to the perceived unhygienic way of marketing the commodity:

- *Lack of clean containers:* At the beginning of the study all centres except Garissa displayed quite dirty milk containers in the milk market and most often black debris from manure, dust at milking place, etc., visible on top of every milk can. Milk handlers in Garissa had had some basic training on hygiene from the office of the DLPO between 2004 and 2006 following an early initiative from KARI ARSP II, training communities on milk hygiene. That is why the Garissa milk containers were the only clean containers found in the baseline survey. Market for milk had also started to pick up in Garissa by this time.

- *Quick spoilage:* A very high spoilage rate (often up to 70%) was found, and though sour camel milk is marketable, it is not preferred, as the main use for milk is for making milk tea. Contributing factors included long transport hours in hot sun, poor roads, unhygienic containers.
- *Very varying quality of the commodity:* Nobody had any clear idea why milk sometimes tasted sweet and sometimes had a very tainted taste. This was also a discouragement to customers.
- *Sales points in dusty streets with no appropriate storage facilities:* Customers buying milk would be discouraged by dusty inappropriate milk selling points.
- *No quality control:* Informal milk marketing was never controlled by Public Health officers, and as milk can be a medium for disease transfer, this also created some uncertainty with customers.
- *No value addition:* Value addition was unheard of most places – there was even a predominant misconception that camel milk would spoil if boiled.

Targeted camel milk manual users

All players in the camel milk value chain – camel owners, milkers, herders, traders, processors along with their service providers. Also students and researchers can use the manual as resource material.

3. Good milk quality

Good quality milk comes from clean healthy animals, whether camel, cow or goat. Milk from sick animals often carry diseases along, which results in unattractive taste of the milk as well as storage problems. Milk from sick animals does not keep well. Dirty milk does not keep well. If an animal has been treated with antibiotics or trypanosomes, this will be evident in the milk and is dangerous for people to consume, so withdrawal instructions must be respected.

Milk Composition

Parameters	Camel milk values	Cow milk values	Units
Water	90	87	%
Total solids	10	13	%
Fat	2	4	%
Insulin	40.5	16.3	pU/ml
Iron	0.05	0.27	mg/100g
Calcium	132	120	mg/100g
Potassium	152	140	mg/100g
Zinc	0.50	0.4	mg/100g
Vit C	35	10	mg/l
Niacin	4.6	0.6	mg/l
Pantothenic acid	0.9	3.8	mg/l

Compositional differences of camel and cow milk in UAE. Adapted from: Wernery 2007. Note; Much higher vitamin C and Insulin content in camel milk compared to cow milk.

Good quality milk is:

- Sweet tasting,
- Has a fresh clean smell,
- Looks clean,
- Is free from contaminants such as dirt, etc.,
- Is stored in a clean attractive container,
- Is healthy to drink – Does not carry diseases.

Taste issues:

Clean healthy milk has a fresh, clean, sweet (for camel milk at times slightly salty) taste, which is highly preferred by customers.

Bitter taste can be caused by:

- Camels eating bitter herbs,
- Milk from camels in late lactation changes taste to become less sweet.

Unclean (various shades of rotten) taste is most often caused by:

- Dirt in the milk,
- Mastitis present in the milk.

Smell issues:

All milk consumers learn quickly to smell the quality of milk. Fresh clean milk smells fresh and clean and boiled milk has its own aroma.

Unpleasant smell can be caused by:

- Contamination with dirt (smell of manure).
- Mastitis (can give a slightly sickly smell).
- acaricide that is applied to the udder for tick control. There have been cases of poisoning after consumption of such milk.
- Spoilage of milk. Various spoilage bacteria can give various odors.

Sour smell is caused by the beginning fermentation of the milk. This can be pleasant or unpleasant depending on consumer preference.

Contamination issues:

As customers all over clearly prefer clean milk, efforts should be made to make sure no contaminants enter the milk. A sterilised tea sieve with small holed netting is a useful tool for straining milk after milking to avoid sending milk to market with contamination by any dirt.

Containers:

All milk containers must be clean and attractive looking to encourage customer confidence. See chapter on Milk Quality.

Healthy milk

Healthy milk does not pose a threat to consumers. Thus healthy milk is free from:

Diseases transmitted to humans through camel milk

Milk is a near perfect food for humans, animals as well as microorganisms. Milk can transfer disease germs from animal or person/milker/handler to customers if not boiled or pasteurised. The following diseases are transferable in milk:

1. **Brucellosis** (instantaneous abortion fever) affects people and animals alike. In people the fever, which may feel like a bad case of malaria, gives symptoms such as headache, fever, joint pains, general fatigue, and in pregnant women – abortion. The cure after proper diagnosis in the lab is a long expensive treatment with antibiotics. Animals may be vaccinated against this disease. Brucellosis is common in ASAL areas both in animals and people.

Brucellosis and Tuberculosis (TB) can be transmitted through uterine discharge and urine which may contaminate milk and milker's hands. **Milkers should therefore NOT touch urine, retained afterbirth or aborted fetuses as these can all transmit Brucellosis and TB.**

2. **Tuberculosis.** Any milker who has TB can transfer this disease to the milk via hands, sneezing or even breathing onto the milk. TB is common in ASAL areas especially in people.

Camels can also be carriers of Tuberculosis and transmit it to people drinking raw camel milk: Tuberculosis is known to affect

all species of livestock. Camels can transmit it to humans via milk especially to children.

3. **Scarlet fever**
4. **Cholera**
5. **Q-fever**
6. **Dysentery**
7. **Diphtheria**
8. **Typhoid**
9. **Mastitis.** This is an infection of the udder of the animal, and all milk producing animals (as well as humans) can become infected. The presence of mastitis in milk will give a very tainted taste, which does not disappear after boiling, so will discourage consumers from buying.

Please note:

- The threat of disease transfer is removed if the milk is boiled or pasteurised.
- Towards the end of this study, many milk sellers had discovered that customers actually have started preferring boiled milk, as it is safer for their families to consume.

4. Camels and udder health

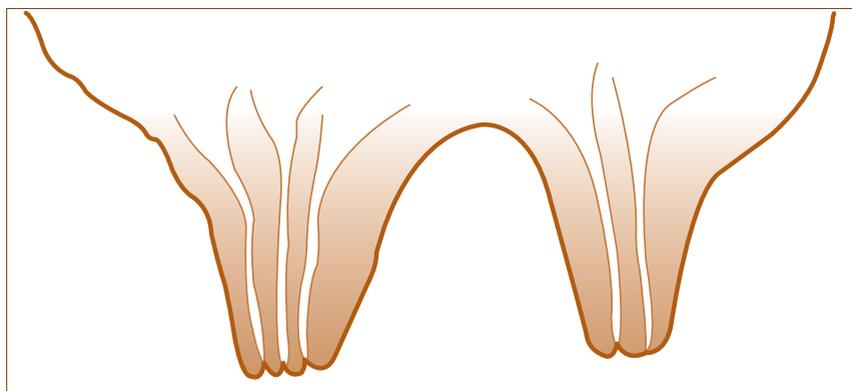


Illustration of camel udder structure

Camel udders differ from all other known milk producing animals in that they have 2 or more milk canals in every teat. This is probably another adaptation to their environment – even if one gets spoiled there are still others to produce milk for the calf. It does pose a challenge in the control of mastitis, as the methods for mastitis control in cows cannot be used for camels.

Zoonosis

Zoonotic diseases like brucellosis and tuberculosis can be spread to humans through milk. For camels brucellosis transmission to humans is probably the biggest problem. See more under Healthy Milk.

Mastitis

Mastitis is the name for the inflammation of one or more milk canals and the udder of milk producing mammals.



Mastitis symptoms in high yielding camel (note large milk vein). The quarter has become hard and hot to the touch, and a red swelling has appeared. The camel may kick excessively as the quarter has become painful to the touch. PHOTO CREDIT: A. B. Nganga

Mastitis is common in all pastoral areas, and camels are as badly affected as goats and cows. Good milkers who know about mastitis, will milk healthy animals first and affected animals last to avoid carrying the disease to healthy animals.

The main cause of mastitis is dirt – unclean milker hands, dirty animal beddings, manure getting into contact with the udder, flies, etc. North American and European farmers have shown that it is possible to boost animal immune systems against mastitis with a combination of good feeding practices and very good hygiene and culling of susceptible animals to completely avoid mastitis in cows, but it takes a great effort. Some research is currently ongoing, so camel mastitis will eventually be better documented.

Another factor that predispose to mastitis is traumatic injury (wounds). This can be caused by poor milking technique, ticks or any other wounds such as thorn scratches.

Mastitis not only reduces the milk yield of the lactating animal, sometimes whole quarters of udders dry up – it also negatively affects milk quality,

taste and keeping time. A small addition of mastitic milk to any can of milk will make it acquire a very bitter taste, which can not be removed by boiling. Mastitis bacteria live off the fat of the milk and produce toxins (poisons) which can cause food poisoning, sore throats, etc.

Many types of germs can cause mastitis including *Staphylococcus aureus* which also causes hair loss and rough coat on especially camels. *So it is not a good idea to wipe hands on the coat of the camel before or after milking.*

Whereas there are medicines for the treatment of mastitis in cows, such as ready made syringes containing various antibiotics, this remedy is **NOT POSSIBLE FOR CAMELS AND GOATS**. Both camels and goats have much narrower milk canals than cattle and trying to insert a cow syringe in any of their udders will cause a lot of damage in the milk canal. There is no space for it.

Before the arrival of antibiotics, mastitis could sometimes be cured by very frequent milking of the affected quarter. But this would include milking every hour even during the night until the temperature goes down in the quarter and the milk returns to normal, which is quite an undertaking. If the camel has wounds on the udder, stripping technique of milking should be discouraged and use of milking salve be encouraged especially for camels which are not suckling calves.

In camels, an early infection can at times be cured by giving the calf to the affected animal and avoid milking by human hands.



If this is not possible, care should be taken to milk the affected animal(s) last in order not to carry the disease to a healthy animal.

Care should be taken to **NOT MIX** mastitic milk with clean milk. Always wash hands between milking every animal.



Washing hands before milking and in between milking every animal

Testing for Mastitis

Mastitis symptoms (such as clotting of milk) is only visible in camel milk in very advanced stages. Early stages can be suspected if the camel kicks too much when one or more teats are touched, the udder is hot and the skin over the quarter seems tight even after milking.

- **Using CMT:** California Mastitis Test kit. This consists of a small plastic tray with 4 bowls and a handle and a solution of detergent. Generally it may be a good idea to imagine the handle of the tray represent the TAIL of the animal, and look at the different quarters separately from there. Follow instructions in the manual to identify even hidden mastitis. In pastoral herds in Kenya, often more than 50 % of animals are infected by mastitis in one or more quarters. A small amount of the first milk stripped is mixed with a similar amount of test chemical, the mixture swirled around and if mastitis is present, the mixture becomes thick and slimy. Non-infected milk stays liquid.



California Mastitis Test (CMT)

- **Alcohol test:** 2 ml milk is mixed with 2 ml alcohol (65%) and poured into a transparent glass. Twirl it to spread over the side of the glass. If separation is seen the milk can either be mastitic or acidic.

One of the routine tests for mastitis is strip cup

But any black surface can serve the purpose. In rural areas, some individuals have been known to use black paper bag wrapped over a cup. This will identify advanced stages of camel mastitis, but is less useful for early cases, when action needs to be taken.



Strip cup

5. Sources of milk contamination & spoilage

1. The animal being milked

The outside of the animal's udder may have soil, bedding, dust or manure on it. For pastoralists in dry areas where no clean water is available for washing of udders, wiping a dry udder with clean dry hands can reduce the amounts of contaminants on the udder that would otherwise have dropped into the milk. In wetter seasons water should be boiled or disinfected with chlorine and used for washing the udders before milking. Also hairs from the animals coat and swishing tails or dribbles from the mouth of the calf may fall into the milk. Dry scabs or scales of skin especially from animals with skin problems may be another source of contamination.



The inside of the udder may also carry germs, which can come through the teat canals. Usually the first milked out milk has high bacterial counts, while the last milk has a reduced amount. Early mastitis can be detected as it appears as clots in the first 2–3 strips of milk especially from cows and goats. Camels can have hidden (chronic) mastitis, which can only be detected by tests such as CMT (Please see above).

- Ensure milking takes place in a clean, dry place, free of dust and mud,
- Milk healthy animals first,
- Do not mix colostrums (the milk produced the first 7 days after calving) with normal milk.

2. The milker

The person milking animals can be a source of milk contamination. He or she may be ill, or may carry dirt from elsewhere that can contaminate milk.

- People suffering from diarrhea, TB or typhoid should not milk camels or other milking animals. Sick people should get medical treatment and not resume milking until they are fully recovered.
- The person milking animals should NEVER touch urine, retained afterbirth or aborted calves, as these can all transmit Brucellosis and TB both to the person and to the milk shared with other people.

During milking, do NOT...



...have long nails



...smoke



...sneeze or cough

- During milking the milker should NOT have long nails, smoke, sneeze or cough.

3. The environment

Dust and very fine light manure particles can blow into the milk in dry areas. To reduce the dust content of the air at milking:

- Milk in a clean place.
- Sweep the milking area before milking.
- If there is a strong wind, choose a milking area away from the wind.
- Choose milking area away from flies and other insects.

4. The temperature

Good quality milk has a long shelf life at low temperatures (below 5°C) but the higher the temperature milk is kept at, the faster it spoils. Milk stored in the sun in any container will quickly start the process of fermentation – quickest for goat milk, slightly less quick for cow milk and slowest in the case of camel milk. Camel milk can withstand high temperatures for longer than any other types of milk, but if milked 5–6 am even if kept in a clean container the process of fermenting will start 5–6 hours later for camel milk. Keeping the milk protected in shady places will delay this process, and boiling and cooling the milk before sending it, will delay the fermentation process for up to 24 hours.

5. The milking equipment

Equipment and utensils used for milking, storage and transportation of milk may act as major sources of contamination if not well cleaned. The number of utensils used to handle milk between milking and sale to customers should be as few as possible, because the more handling equipment the more sources of contamination.

The traditional wooden or woven milking containers, which are used in pastoral areas, are almost as good and hygienic as modern metal milk cans when they are properly cleaned and smoked. However increasing amounts of non camel keeping customers will not buy smoky tasting milk.

Plastic jerricans are very unhygienic. They cannot be cleaned properly inside. If smoking is tried, they melt where the coals hit the side of the wall. The handles are hollow and can hide a myriad of germs, which no cleaning method can get properly rid of. Though cheap to buy, they are expensive in the long run. Milk traders in Garissa, Kenya buy new ones every 2 weeks, when the old ones break down or become damaged.

6. How to achieve good quality milk & prevent milk spoilage

As we have seen customers prefer to buy **clean, healthy milk with an attractive sweet taste**. This is the product with the highest amount of customers. If customers cannot get this quality from the informal milk market they will buy any alternative including the very expensive long life milk.

The informal market can produce good quality milk by ensuring the following actions become a habit:

Handling at milking level

- Maintain clean and healthy milking animals – milk unhealthy animals last.
- Use appropriate sterilised containers for milking.
- People milking animals must be healthy and maintain good personal hygiene and wear clean clothes when milking.
- After milking, the milk must be covered to avoid contamination.
- Transport containers must be very clean and be sterilised each day before using.
- The milk gets boiled or pasteurised before it is filled into transport containers and quickly cooled, so that it can reach the market in good condition if long transport hours are predicted.

Handling at bulking/storage level

The agent must make very sure that bulking containers are very clean, and sterilised before taken into use.

- Clean the bulking container very well.
- Pour some boiling water into the bulking container and swish it around till all corners have been sterilised. Pour the water out.

- Put boiled milk in separate containers and raw milk in separate containers.
- Do NOT mix boiled and unboiled milk or evening and morning milk.
- Close the container with a clean sterilised lid.
- Boiled milk should be cooled in the storage container.
- All milk waiting for transportation should be kept as cold as possible – under shade, in the wind, etc.

Handling at transportation level

Presently all milk transporting vehicles in dry areas tie milk containers to the top and side of their lorries and transports them in full sun. This is not the best as the milk will heat up and start the spoilage process. However examples have been observed of bulking agents sending their milk container in a wet bag. This would help cool the milk during transportation.

Transport options are usually shared with transport of people and other goods, so normally people wait until the vehicle is full. Long waiting time is bad for the milk. Try to discuss with the transporters how the milk can be shaded or protected and reach the market without delay. The following are some possibilities of improving the milk transportation conditions:

- Cover the milk cans with a canvas for shade, with free air movement underneath.
- Send the milk cans in a wet bag to help cool the milk on the way.
- If there is a lot of milk in an area the transporter may be willing to make an early milk transport without waiting for passengers – try negotiations with transporter, i.e. use of dedicated means of transport.

Handling at distribution/selling level

After reaching the market, milk is often again redistributed to smaller containers and delivered to separate customers. This is a new source of possible contamination. The following precautions are recommended:

- Wash milk containers very well, till no traces of old milk is seen.

- Sterilise containers with boiling water, pour the water again.
- Clean and sterilise all tools including funnels, etc.
- Decant the milk into clean containers.
- Close the milk containers with a clean sterilised top/cover. Do NOT transport milk uncovered, as it will attract flies and other contamination.

Handling at the market place

Customers are very particular about the premises they want to buy milk from. Business will be comparatively poor on a dusty street, and comparatively lively in a well defined clean shaded market place, with access to clean water and staffed by people in clean (light coloured aprons) clothes. Customers must also be able to enter the market place without getting soiled, so proper access is important. Public health issues can be taken care of in clean premises, but not in dusty streets. Well organised milk sellers will be able to find support for the construction of clean market shelters.

Economics of improved milk cans

In November 2007, Long term cost of plastic jerricans in Garissa was compared to Perdini sealed aluminum milk cans with a lifespan of at least 5 years:

Perdini milk cans	Plastic jerricans
25 L, price about Kshs 2000 (factory price). Lifespan at least 5 years	20 L. buying 2/month = 24/year 24 cans @ 150 = Kshs 3600/year
Price for 5 years: Kshs 2000	Price for 5 years: 3600 x 5 = Kshs 18000

Thus whereas the price of buying a new aluminium milk can is fairly high, it is a one time investment. The same can last for at least 5 years, whereas a (cheap) plastic jerrican will have to be replaced every two weeks or so. Over a 5 year period the aluminium can saves the buyer Kshs 16,000 (2007 prices).

Above table clearly shows the financial benefits of purely using metal milk cans instead of plastic jerricans. Perdini milk cans are imported by Kaluworks and available in 10 and 25 Litre sizes.



A: Perdini 25 L milk can; **B:** NOTE: Securely closing lid. A padlock can be added; **C:** NOTE: inside rubber seal in lid to make sure it does not spill

Other milk cans

The ordinary Kaluworks aluminum milk cans of 2, 5 and 9 L are good for delivering milk from transport site to customers. They are cheap compared to the Perdinini cans and can last a long time if properly cared for.

In high potential areas heavier duty milk cans are used as they need to be able to withstand punishment in a different type of transport – pure milk transporting vehicles.



Aluminum and stainless steel milk cans are much easier to clean than both the traditional containers and the jerricans. They can be disinfected after washing by dipping in boiling water, and become virtually germ free – which means longer shelf life for the milk as there is no contamination from cans

7. Cleaning of containers

All milk cans, containers and utensils must be properly washed and disinfected. The procedure is as follows:

1. Wash hands with soap and rinse.
2. Wash all containers with soap or detergent and superbrite or similar non metal scouring pad material (sisal or plastic sacking can also be used provided it is washed and boiled after use).
3. Rinse out the soap/detergent
4. Sterilise in boiling water
5. Dry upside down in the sun on a clean table or rack. The sun is a very good steriliser as well, but care should be taken that recontamination from blowing dust does occur.



A: Rinse out the soap/detergent; **B:** Sterilising in boiling water; and **C:** Dry upside down in the sun on a clean table or rack

Do NOT dry containers inside with any cloth. Cloths may be very dirty and can add serious contamination to an otherwise clean container.

Any cloth used for straining milk must be properly rinsed to remove milk with cold clean water after use, then washed with detergent and sterilised along with the milk cans. The boiling water can then be used as a water bath to pasteurise milk in the milk cans.



How to clean inappropriate containers

Although metal cans (aluminum or stainless steel) are the best type of milk containers, they are not always available in any practical sizes. So in the absence of proper containers, plastic jerrycans are mostly used. Plastic jerrycans are light, and seem practical transport containers, but they are almost impossible to clean inside. However if nothing else is available, the following cleaning procedures will give a fairly clean plastic container:

- Rinse the jerrican for all traces of milk.
- Boil some clean building/river sand in water, add a handful to the jerrican and use this sand for shaking around the jerrican till all spots and visible contamination has disappeared.
- Discard the sand.
- Repeat the washing with dishsoap or similar detergent (do not use omo – it is very difficult to rinse out again and will leave an unpleasant taste).
- Rinse with clean water.
- Sterilise with boiling water – swish the boiling water around till all corners have been sterilised.
- Discard the water.
- Close the container with the sterilised lid and keep it closed till you need to use it.

Water quality

Milk containers and the hands of milk handlers need to be washed with soap and clean water. Many places the available water is not clean. However all chemists can stock very cheap water purification chemicals such as Aquaguard or similar. A bottle top full of **Aquaguard** put into a 20L jerrican of water and left for 24 hours, will have made the mud settle and purified the water so it can be used for drinking, or cleaning udders, hands and utensils. Boiling water is also good but may not always remove all the mud. Ask the chemist for the best and cheapest water purification methods.

8. Milk testing

How do we know if the milk we buy is of good quality?

For primary milk buyers (buying directly from producers) there are 4 useful milk testing techniques possible:

- **CMT (California mastitis test):** measures whether there is major mastitis contamination in the milk (appropriate at producer level).
- **Organoleptic test:** (a) look, (b) smell, (c) taste (appropriate at all levels).
- **Lactometer:** measures if water has been added to milk (calibrated to cow milk at 18–20°C, so not very suitable for use in hot areas unless recalibrated).
- **Clot on boiling:** measures acidity, when milk is too sour to be boiled. A table spoon of milk is held over a candle or similar to see if it boils well (appropriate at all levels).



Lactometer



Clot on boiling test; if it clots the milks has gone bad

- **Alcohol test:** also measures acidity, more sensitive than clot on boiling, but needs special equipment and training in order to get reliable results.
- **Lactoscan (US\$ 1000):** This equipment available at around US\$ 1000 (Ksh 75,000) is a very sensitive milk testing tool. Suitable for dairy associations and NGOs supporting the clean milk trade.



Many models of the Lactoscan available (please check the internet)

9. Preservation of milk

As most of the informal milk market customers are looking for fresh milk, the best preservation methods include boiling, pasteurising and cooling. If there is a well paying market for fermented milk products like yoghurt or mala/suza, this can be undertaken as a special value addition for income generation project.

Boiling or pasteurising of milk

Boiling of milk will kill all disease causing germs. However the toxins produced especially mastitis by causing germs will not disappear. Mastitis milk will have to be identified at producer level.

Early last century a method of killing disease germs in milk was invented. It is called pasteurisation. Many people believe – quite rightly – that boiling of milk reduces the nutritional value of same milk. Especially the vitamin C content is reduced by boiling.

Pasteurisation in a closed milk can has several benefits over boiling milk over an open fire while stirring:

- No or very little milk loss due to evaporation (make sure the lid is closed)
- No skin on the milk (again make sure the lid is closed)
- Very little loss of vitamins
- No burnt taste
- No boiled taste

Pasteurisation process:

Heating milk in a water bath to 65°C for 20 minutes, or heating to 72°C for 15 seconds then cooling quickly by transferring the milk cans to cold water bath.

This process will kill all known disease causing germs. The cooling is also important for milk, as there can be some heat resistant spoilage bacteria that can cause the milk to curdle at high temperatures (sweet curdling). Anyone used to leaving hot milk in a thermos flask will have seen this sweet curdling.



To determine when the milk has reached the above temperatures we can simply measure with a food thermometer, but these are not easily available and besides are made of glass so they break easily.

NAREWAMA (Faustine Odaba "Mama Solar" – Facebook) have introduced a small gadget called a "WAPI". This is a small clear nylon tube containing a bit of green (melting at 65°C) or white (melting at 75°C) wax and sealed in both ends.

The "WAPI" – is attached to a string and some small steel washers to keep it balanced. After use it can simply be inverted for the melted wax to again be on top for the next pasteurisation.

Immersing this wapi into the milk and checking from time to time will clearly show when the milk is hot enough – the wax has melted and sunk to the other end of the WAPI, and the milk can be cooled. Such a gadget can be bought at KSh 150/- and will last a long time provided it is not given to children to play with. It is also easy to clean and sterilise with a bit of boiling water. Using a WAPI or a thermometer can save firewood when pasteurising milk



Solar cookers can also be used for pasteurising milk in small quantities when the sun is shining from a clear sky, thus saving firewood collection.

Cooling of milk

Milk keeps very well under cold temperatures. However temperatures in ASAL are never cold, so temperature is a major factor affecting milk spoilage.

Some measures can be employed to lower the temperatures where you store the milk:

- Build shaded shelters to screen out the major part of the solar heat for milk storage while waiting for transport. A shaded area is many degrees lower than the full sunshine of the environment, especially if there is a bit of wind passing through. Storing milk in a shaded area will make it keep longer
- Try evaporation coolers. This technology has been around for a long time. The principle behind it is that water uses heat to evaporate. This heat can be taken from a small chamber storing milk and other products if properly constructed. Evaporation coolers can lower temperatures up to 10°C compared to the surrounding environment. Several designs have been tested in various parts of the world depending on available materials.



10. Marketing of camel milk

Packaging and labeling

It was shown during the KARI ARSPH project that simple packaging of milk in sealed and labeled plastic bags really enhances customer confidence and willingness to buy the product. This technology can be adapted using a solar panel so does not necessarily depend on proximity to electricity.

Product diversification

Camel milk is very popular in fresh form, and so far most customers in Kenya prefer fresh camel milk above all other products. Camel milk is also not so easy to process in to alternative products, but where the markets demand such products and are willing to pay, it is possible to make very good:

- Feta cheese
- Camelbert cheese (similar to brie cheese)
- A yoghurt health drink that can further improve camel milk health benefits (this does not become thick like yoghurt from cow or goat milk)
- Camel milk ghee (this is more of a food preservation product and visually resembles camel body fat, but chapattis fried in camel ghee taste very delicious)
- Improved suza – a MILD alternative to traditional suza, using special milk cultures. Special camel milk cultures are under development.
- Dried and fresh ITITU – a form of fresh cheese traditionally mostly made with goat milk, can also be made from camel milk if there is a market for such products. In areas with milk surplus this fermented product can be dried and preserved for leaner times,

where it can be crushed and added to porridge and enrich the diets of children in times of shortage.

- Camel milk sweets and candy
- Camel milk ice cream
- Collective marketing – advantages, dynamics

Collective Marketing – advantages, dynamics

Marketing of milk – milk kiosks – groups

There is general understanding that milk customers, being concerned for the health of their families will prefer to buy milk from a clean metal container sitting on a clean table under a shade rather than from a scratched plastic jerrican sitting in the sun for several hours.

In order to be able to afford such facilities, it is an advantage to work together in groups. Working in groups can also free some time for conducting other business for all members, as they can take turns marketing all the groups' milk. With time the groups can also decide to try out simple milk processing such as making yoghurt and mala/suza and possibly buy a fridge for better storage. All these measures will greatly improve the income earning possibilities of the groups.

MILK COOPERATIVES in other parts of the country have proven a highly successful way of collective milk marketing and processing.

Creation of awareness and market promotion

Any new product to be introduced to the market can use some of the following marketing demonstration strategies:

- a. Taste sessions during agricultural shows,
- b. Field days, etc.,
- c. Mass media adverts (print and electronic).



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Camel Milk

Camel Milk: The Healthy Option



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