

PREFACE

The seventh edition of this Smallholder Dairy Handbook underwent a major revision from the sixth edition, including introduction of sections, reorganization of chapters, and substantial revision of content. Previous editions were written piece-by-piece since 2004 when the authors started working with smallholder dairy farmers in Kenya. It is the product of a **successful partnership between Farmers Helping Farmers (FHF - a Canadian volunteer non-governmental organization which works with Kenyan farm groups) and the University of Prince Edward Island (UPEI) in Canada, and was spear-headed by Ken Mellish (focusing on agronomy and cattle nutrition) and John VanLeeuwen (focusing on dairy health management)**, with support from others, as needed. Initially, they worked with the highly successful Wakulima Dairy Ltd in Mukurwe-ini. Over the years, they have talked with many people from dairy farming communities (dairy farmers, dairy co-operatives, animal health providers, etc.) in order to incorporate the collective wisdom of a wide variety of perspectives into the chapters of this handbook. In addition, for three weeks each year, Ken and John have organized and delivered on-farm seminars to smallholder dairy farmers in Kenya on various topics of dairy health management. At the beginning of each seminar, Ken would ask farmers what issues they had with growing crops and feeding cattle, and John would ask farmers to ask him questions on anything they were wondering about regarding dairy health management, milk productivity, and animal disease control. As a result, they have been able to determine the most frequent questions and concerns, and develop new chapters in the book to address these questions and concerns. During the seminars, Ken and John were also able to gauge the level of current knowledge that the farmers had in these areas, and what information was needed in new chapters.

In addition to these seminars, John and many senior veterinary students from the Atlantic Veterinary College at the UPEI and the Faculty of Veterinary Medicine at the University of Nairobi traveled to farms to examine animals who were sick or in need of some health management assessments, such as reproductive exams or subclinical mastitis tests. John was able to determine the level of management currently being utilized, and got first-hand impressions of the most important diseases and bottle-necks to improved productivity. Beginning in 2008, John, with funding from the Canadian Queen Elizabeth II Diamond Jubilee Scholarships, also started conducting research projects on Kenyan smallholder dairy farms each year in order to obtain data to better answer some of the farmers' questions. Research projects have included: 1) internal and external parasite control; 2) mastitis diagnosis, treatment and control; 3) cow and calf nutritional enhancement; 4) calf diarrhea control; 5) frequency and causes of abortion; 6) factors of milk productivity; 7) reproduction status and management, including sexed semen; and 8) cow and calf comfort improvement.

Other research projects have also evaluated the impacts of the Canadians' and Kenyans' efforts over the years in terms of improvements in productivity and fertility, and how those have translated into better sustainable livelihoods, through improved income, better human nutrition and education, and increased purchasing power for home improvements such as biogas digesters that transform the cattle manure into methane for cooking, reducing wood gathering and use, and exposure to wood smoke.

Other contributors include Colleen Walton who developed and field tested the section on Milk Quality and Human Nutrition. Daniel Scothorn contributed to the section on Feeding and Shad Olingo, FHF field staff, wrote sections on forage production. Farmers Helping Farmers has two full time staff working with dairy cattle, Leah Kariuki and Steven Chandi who visit farms and give feedback on needs of dairy farmers.

During the first 10 years between 2004 and 2014, it is estimated that the veterinary team checked over 1500 animals and dewormed over 5000 animals from over 2400 farms. At each farm, numerous neighbouring farmers congregated, sometimes with a cow or calf in tote, to observe and ask questions regarding their cattle. It was estimated that over 7500 farmers received health management information and/or services from the efforts, with most of them getting free handouts in the early years, or various editions of the “Handbook for Kenya Dairy Farmers” in later years. At least that many farmers have also received information and/or services on milk quality control and cattle nutrition over the years.

As a result of all of these efforts, we have seen significant improvements in farm management and production among farms visited during previous Kenyan trips. For example, one farm couple said that prior to coming to one of our seminars, they were getting only **4 Kg/day of milk from his cow** (which is common among Kenyan smallholder dairy farmers). During the following dry period and lactation, they followed our recommendations on nutrition, cow comfort and disease control from our Handbook for Kenyan Dairy Farmers, and the following year, they told us that **they were getting 26 Kg/day** from their cow, a dramatic improvement in one animal. They were doing so many things well now, from transition cow feeding and lead-feeding, growing better forages, to mastitis and parasite control. Their cow was in great body condition, partly because they planted and fed Calliandra (a leguminous shrub) and Mulberry leaves now. We also polled farmers at one seminar to find out how many farmers had seen improvements in milk production from changes they made on their farms after attending one of our seminars. All of them said yes, 70% of them said they were getting double the milk production that they used to get, and 10% of them were even getting triple the milk production they used to get. These farmers have said that now they can afford to send their children to secondary school and even college, and their quality of life is much improved. They are excellent examples of farmers learning how to farm better.

Improvements were reported to us again and again. Collectively, one of our dairy group partners has continued to show remarkable progress: **in 2011, the first year we started working with them, they collected 300 Kg/d from their farmers; in 2012, they had doubled that to 600 Kg/d; in 2013, they doubled it again to 1200 Kg/d; and in early 2014, they were collecting nearly 2000 Kg/d.** The milk from this village was being primarily sold to a cheese maker in a nearby town, willing to take all the milk they could produce. As a result, funds from the town was being distributed to this village, with obvious results: new buildings being erected, and fresh paint being applied to existing buildings, along with improved farm structures and more kids going to school.

Some of their stories can be found on the Farmers Helping Farmers website (farmershelpingfarmers.ca), and documentation of benefits has been published in various journal articles written by the authors listed below.

We hope that this handbook helps you in whatever capacity you are using it: as an educator, an agronomist, a milk quality control officer, an animal health and welfare provider, or a farmer. We hope that it assists dairy groups and farmers toward self-sufficiency, not “giving them a fish” but rather “teaching them how to fish better”. And we thank all our supporters for your assistance in making this all possible.

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SECTION 1: OVERVIEW



CHAPTER 1.1

6 Essentials of Maximizing Milk Production

Prepared by Drs. Riane Dykstra, Alyssa Brosha, Robert Schicht and John VanLeeuwen

1. Lots of Good Quality Feed and Water

When a cow or calf takes in energy and protein in their feed, their body sends it to where it is needed most first. The first priority is for the animal's body growth and maintenance of bones and muscles. Secondly, any energy that is left over can be put into milk production, and lastly reproduction. Therefore, if you want your cow to give lots of milk and get pregnant fast, then you need to give her lots of good quality feed. Also, milk is composed of 85% water, so your cow needs lots of water, especially when it is hot outside.

- At all hours of the day and night, cows and calves (and other animals on your farm, too) should have feed and water available to them. The feed manger must never be empty of forage. Hungry skinny cows will give low milk production and take longer to get back into calf. If all that is left in the manger is stalks from tall Napier grass or maize (cows don't like to eat them), remove them and give fresh leafy feed – something they want to eat.
- Dairy meal (purchased or home-made) and minerals are an absolute necessity for lactating cows as well as dry cows that are being steamed up. How much they should be given depends on their needs (higher in growing heifers, non-pregnant lactating cows) and the forage quality being fed (high quality forage allows you to feed less dairy meal). Forage quality depends on the plants and how you store them.

Many nutritious plants that are also high in protein can be cheaply grown on your own farm and can reduce daily dairy meal requirements (for example: Desmodium, sweet potato vines, calliandra, lucerne, etc. – Chapter 2.1). Short Napier grass (1 metre tall) has at least twice as much protein as tall Napier grass. Weeds and banana leaves and stems have very poor nutrition for your cow and some can be harmful to their health. Read about fodder shrubs (Chapter 2.7) for more information.

*Store high quality forages (such as grass or maize silage, dried grass or maize) during the rainy season or early dry season to have nutritious feed available during the late dry season. It is important to harvest forage crops while they are still green and then dry them (rather than letting them dry standing in the field) to preserve the energy and protein inside the plant. See Chapters 2.3 and 2.4 on silage.

2. Dry Period & Steam Up - See Chapter 2.1

Cows are working really hard to produce milk, they put so much energy into producing milk that they need a break before they calve and start their next lactation. This also gives the udder a rest, a chance to cure mastitis and prepare the udder for more milk production in the next lactation. Cows need a 45-60 day rest period at the end of their lactation, prior to calving. During the end of the dry period, it is important to steam up your cows by slowly increasing the amount of dairy meal they receive during the 3-4 weeks before calving. Steaming up helps their stomachs get used to getting dairy meal again. Remember:

- Provide dry cow treatment in the udder to prevent and treat mastitis, especially teats that are positive on a CMT test (see Chapter 4.1) because dry cow tubes are more effective to treat mastitis at dry off because you are not milking the medicine out, and the medicine is stronger because we are not worried about not selling milk because we have stopped milking the cow.
- Provide dry cow mineral (Ca:P is not more than 1:1, and selenium) especially during steaming up (see Chapter 2.8 and 2.9).
- Provide clean, dry bedding because dry cows can still get mastitis

3. Disease Prevention

When a cow has an infection and poor appetite, she must put energy into fighting off that infection. Until she recovers from the illness, she will produce less milk, and will possibly give less milk for the rest of her lactation. It is best to treat sick cows quickly, and prevent your cow from getting sick in the first place.

Here are some simple ways to help you keep your cow healthy and prevent disease

- Provide a zero-grazing unit to reduce exposure to tick-borne diseases. See Chapter 6.3.
- Provide regular deworming for your cattle and spraying for ticks. If your cattle are being zero-grazed, then you don't need to deworm your cows or spray for ticks as often. When deworming your cattle, ensure that they are getting the proper amount. Weigh your cattle with a weight tape (Chapter 6.2) and dose accordingly. See also Chapters 6.1 and 6.3.
- Adequate nutrition and mineral supplementation are important for a cow's immune system to fight off disease. See Chapter 2.1 and 2.8.
- Cows need to breathe fresh air while lying in stalls, so good air flow is important in stall design. However, blowing dust can cause tearing eyes and coughing in cattle, so in the dry season, some water could be sprayed on the dust around the head of cows.
- Artificial insemination breeding is important to prevent the transmission of diseases from bulls to cows. See Chapter 3.1.

Mastitis is a disease of the udder caused by germs that get into the udder through the teat. When the udder is infected with mastitis, the milk will be rejected by the Dairy, and during treatment, the milk cannot be sold or drunk by humans. Mastitis also decreases the amount of milk she will be able to produce from the quarters both while infected and for the rest of the lactation. Therefore, it is much cheaper to prevent mastitis rather than to treat it. See Chapter 4.2.

- To prevent mastitis, you have to help the cow keep her udder dry and clean. You can do this by providing a clean and dry well-designed stall that cows want to lie in. See Chapters 4.2 and 4.4.

- Good milking technique can help your cow's teats stay in good condition. Also, washing your hands and the udder before milking (and between cows) is important. After you are done, it is important to teat dip your cow's teats with a good antiseptic teat dip. See Chapter 4.2.
- California Mastitis Test (CMT) can help detect mastitis even when the milk looks normal. Ask your daktari or your Dairy about this test when your milk is rejected. See Chapter 4.1.

4. Stall Design and Cow Comfort – See Chapter 4.4

Listen to your cows - if they are not lying in the stall, you are providing for them, they are trying to tell you that they do not like it and it is not comfortable for them. Cows produce more milk while they are lying down than when they are standing (they waste energy standing). Cows should be lying down for 10-14 hours a day: If they are not eating, drinking or being milked, they should be lying down. Important to have:

- Proper placement of boards, with adequate lunge space to stand, built for your cow sizes.
- Clean, soft, and dry bedding in big enough stalls, with non-slippery floors where they walk
- Grouping cows/calves of similar size to decrease competition at the feed bunk.
- Shade and ventilation where cows spend the most time: in stalls AND at the feed bunk

5. Genetics and Breeding - See Chapter 3.1 and 3.2

Bull selection through AI can be used to select for easier calving deliveries and cows that have the potential to produce more milk. Good heat detection is also important to get your cows bred back 3-4 months after calving, so that they return to peak milk production sooner. Remember:

- Make sure a cow gets bred within 12-16 hours of when she is in standing heat.
- Heifers can be bred once they reach 60% of a mature cow's body weight – $400\text{kg} \times 60\% = 240\text{kg}$.

6. Calf Management – Your Milk Cows of the Future – See Chapter 5.1 to 5.4

Calves are an investment into your future for when they become cows. While they are not making any money for you as calves, if you raise them properly, they will reach a breeding size younger, deliver a calf earlier, and start making money for you with their milk sooner. A good start in life for a calf is necessary for their future earning potential. Remember:

- Provide adequate colostrum intake (4 litres within 6-12 hours) to fight sickness
- Provide adequate milk volume (4-6 litres/day) until weaning for body growth
- Provide calf pellets for first 3 months of life and then pencils until pregnant
- Make sure high quality forages, minerals, and water are available at all times

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SECTION 2:



COW NUTRITION AND NUTRITION-RELATED DISEASES:



CHAPTER 2.1:

Feeding Energy and Protein to Cows

Prepared by Ken Mellish, Daniel Scothorn,

Drs. John VanLeeuwen and Ayub Kaniaru

Well-fed dairy cattle will produce more milk. When cows give more milk then more profit can be made. To achieve high milk production, many strategies must be used to ensure cattle are well fed during the dry period and while milking.

By working with members of the Wakulima Dairy, we have demonstrated how to improve milk production of cattle. This chapter summarizes some of the discussion notes from these talks.

In general, dairy cattle must be healthy and kept in dry, comfortable housing. Cattle need high quantities of fresh forage and grain containing protein, energy, vitamins and minerals to produce milk. For good milk production, reproduction and general health, these nutrients must be fed in the right amounts. We are going to focus on protein and energy and how best to feed them.

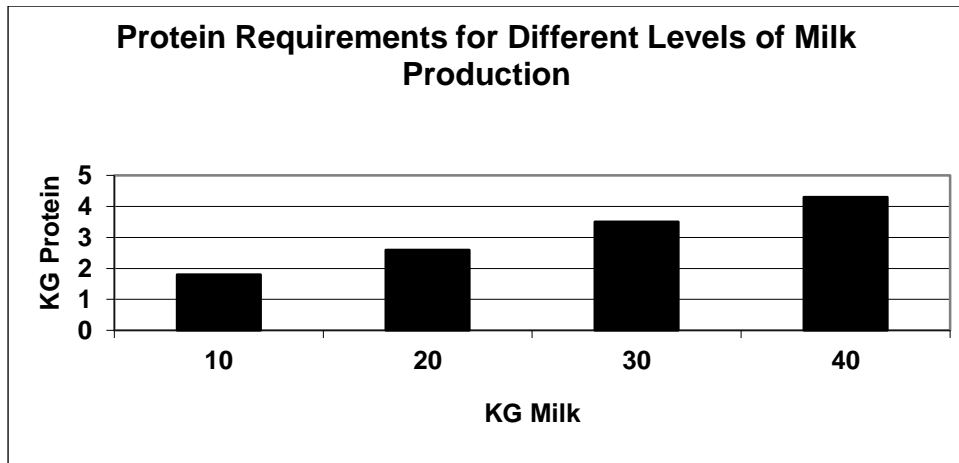
FEEDING

Cows need to be fed forage several times a day, especially after milking when they are hungry and we want them to not lie down for about an hour after milking to allow the teat hole to fully close after being stretched for milking (this helps to prevent mastitis – see Chapter 4.2). The manger should be cleaned out at least once per day - any old feed in the bottom of the feeder can get moldy which will reduce feed consumption and lower milk production and even make them sick.

Grasses and maize stalks should be chopped into ½ to 1 inch pieces. If these forages are not chopped, the cows will prefer to eat the leaves and the smaller stalks and leave the bigger stalks. These bigger stalks are usually of lower feed value (low energy and protein) but they can still contribute to milk production if combined with high energy and protein feed (e.g. lucerne). A chaff cutter is best to chop forage but cutting with a panga is better than feeding whole plants.

PROTEIN AND ENERGY IN FEED

The two most important nutrients for dairy cattle are protein and energy. As milk yield increases after calving, cattle should be fed more protein and energy in the first 3 weeks after calving. Forages such as Napier grass, *Desmodium* and *Lucerne* provide high amounts of protein and energy if they are cut early. Early cut forages can lead to more milk and less dairy ration required.



Proteins are the building blocks which the cow uses to grow and to make milk. There must be enough protein to allow the cow to make milk. If a cow has the breeding and is big enough to make 20 kg of milk and she is only given 2 kg of protein (from forage and dairy meal), she will not produce more than 10 kg of milk.

As another example, a large Holstein (600 kg) that is able to produce 30 kg of milk daily needs 3.5 kg of protein in her diet. Good quality Napier grass, when fed free choice, can provide half of her requirement for protein. The other half must come from dairy meal or other high protein forages such as *Desmodium*, *Lucerne* or forage trees like *Calliandra* or *Sesbania*.

FEED ENOUGH PROTEIN FOR THE COW TO MILK UP TO HER POTENTIAL

The more milk the cow can give, the more **energy** she must also be fed. There is a very close link between energy and protein in the cow. The cow's rumen uses the energy and protein to make the nutrients needed to make milk.

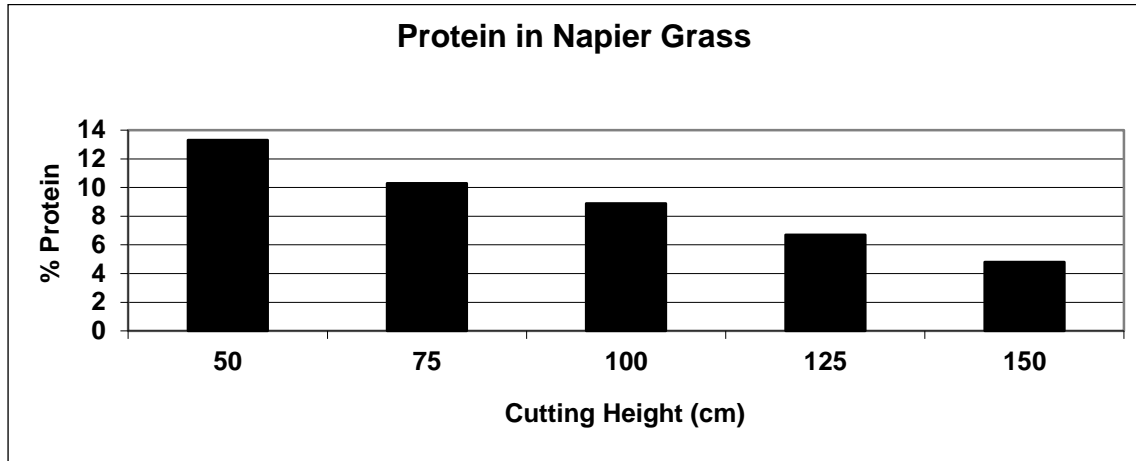
Giving enough protein without enough energy to the rumen will only lead to increased milk in the short-term. However, giving enough energy without enough protein will not increase milk production in the short-term or long-term.

A cow's body can store excess energy (into fat), to be used later, if needed. However, extra protein cannot be stored and used later, but rather is broken down to be used for energy. So making sure protein levels in the diet are adequate (but not excessive) every day is most important. If a cow does not have a high enough energy in her feed then she will become thin and be very difficult to get in calf. Low energy intake in thin cows is the leading cause of no heat signs and poor conception.

Maize silage is one of the best sources of energy for milking cows. See Feeding Maize Silage - Chapter 2.4. The best way to have consistent high quality forage is to make silage of either Napier grass or maize. See Making Silage - Chapter 2.3.

**CUT NAPIER GRASS AT 1.0 to 1.5 METERS TO GET
THE BEST YIELD, PROTEIN AND ENERGY**

The most important source of feed is the feed that you grow on your own farm. The most important and lowest cost source of feed can be Napier grass. It grows well in this climate and uses the manure from cows very well.



The protein and energy of Napier grass is the best when the grass is short. The protein and energy percentage goes down, as the grass gets taller. Cutting Napier grass when it is 1.0 to 1.5 m tall will give the best yield, protein and energy for feeding dairy cows. Taller grass will have a lower percentage of protein and energy, meaning your cattle will produce less milk. The amount of Napier grass that dairy cows eat depends on the maturity (height of the grass) and the size of the cow. Tall Napier grass has more fibre (the plant is woody) which reduces the amount that can be eaten by cattle (it takes longer to digest) and has less energy and protein. Reducing the amount a cow eats, and reducing the quality of what a cow eats both lead to less milk.

For example, a large Holstein cow (600 kg) can eat 60 kg of Napier grass cut at ½ metre height, but only around 40 kg when it is cut at a 2 metre height. Again, this is because of the woody high fibre content of Napier grass. **If cows eat more, then they will milk more.** The protein content of Napier grass is higher when cut at ½ metre height (up to 15%) compared to 2 metre height (3-5%), meaning that cows will get more protein from the Napier grass when it is fed at a shorter height.

NAPIER GRASS CONSUMPTION BY CATTLE AT DIFFERENT HEIGHTS

Type of cow	Napier grass consumption (kg)	
	1 metre height	2 metre height
Large Holstein (600 kg)	60	42
Small Holstein (500 kg)	50	36
Jersey milking cow (400 kg)	40	29

THE TALLER THE NAPIER GRASS HAS GROWN,
THE LOWER THE PERCENTAGE OF PROTEIN AND ENERGY.

Desmodium is a good crop to grow in the lower zones because it is a legume and contains a higher level of protein than grasses. *Desmodium* can be slow to establish but it can provide a large amount of the protein required by milking cows. Growing *Desmodium* will reduce the amount of feeds that must be purchased to produce milk.

Legume tree crops such as *Calliandra* and *Sesbania* can also provide high quality feed. See Growing Fodder Trees - Chapter 2.7 Lucerne is the best forage crop to grow in the higher zones if your farm has deep soil. See Growing Lucerne - Chapter 2.6.

FEEDING VALUE OF COMMON FORAGES (DRY BASIS)

FEED	CRUDE PROTEIN (CP)	NET ENERGY MCAL/KG
Early cut grass hay (fertilized)	18	1.4
Mature cut grass hay	10	1.0
Sweet potato vines	14	1.3
Desmodium	17	1.3
Fodder trees	30	1.0
Maize silage (whole plant)	8	1.5
Maize stover	5	1.1
Maize leaves (green)	15	1.3
Rice hay	5	1.0

Dairy meal is a combination of several grains and minerals, sold in low or high protein concentrations, and the amount of protein is usually printed on the bag label. Usually low protein dairy meal is lower in cost. However, the energy content of dairy meals may vary from very low to high - which is not stated on the bag label because it is not necessary by law. Usually a high priced dairy meal has higher energy, and may also have an additive such as yeast, which may help cattle digest their diets better.

Fish meal is a very high quality source of protein but it should be fed to milking cows in small amounts and after milking so that it does not give the milk a fishy odor. Also, the oils within the fish meal may cause the cows to have a low butter fat content if not fed in small quantities.

Wheat bran has a crude protein of 16 % but the protein is poorly digested. Wheat bran's feeding value is roughly ½ forage and ½ grain, because of its high fibre and low energy content.

Cotton seed cake and sunflower meal have a high content of protein, but a low energy value and should not be used as the only source of protein in a homemade dairy meal (See Chapter 2.5).

Maize silage and Lucerne is an excellent forage combination for milk cows.

FEEDING VALUE OF COMMON GRAINS AND BY PRODUCTS (DRY BASIS)

FEED	CRUDE PROTEIN	NET ENERGY MCAL/KG
Dairy meal	16 to 20	1.6 to 1.9
Fish meal	60	1.9
Soybean meal	54	2.2
Cotton seed cake	43	1.7
Sunflower meal	31	1.5
Maize germ meal	24	2.0
Coconut meal	21	1.7
Pollard (Wheat middlings)	18	1.8
Wheat bran	17	1.7
Rice bran	15	2.0
Molasses	6	1.8

DETERMINING HOW MUCH DAIRY RATION TO FEED

A formula is helpful to know how much to feed a dairy cow. A commonly used formula is to subtract 5 from the kg of milk the cow is producing, and then divide by 2. This tells you the kilograms of dairy ration to feed daily.

For example, if a cow is giving 10 kg of milk then:

$$(10 \text{ kg} - 5 \text{ kg}) \div 2 = 2.5 \text{ kg of dairy ration}$$

AMOUNT OF DAIRY RATION TO FEED

KG of Milk Yield	KG of Dairy Ration to Feed Daily
Less than 10	2.0
15	5.0
20	7.5
25	10.0
30	12.5

Dairy meal should not be fed in amounts higher than 12.5 kg daily, as this will cause a disease called acidosis, which leads to lameness and low butter fat content. High amounts of dairy meal should be split into four equal feedings per day. For example, if a cow receives 10 kg of dairy ration daily,

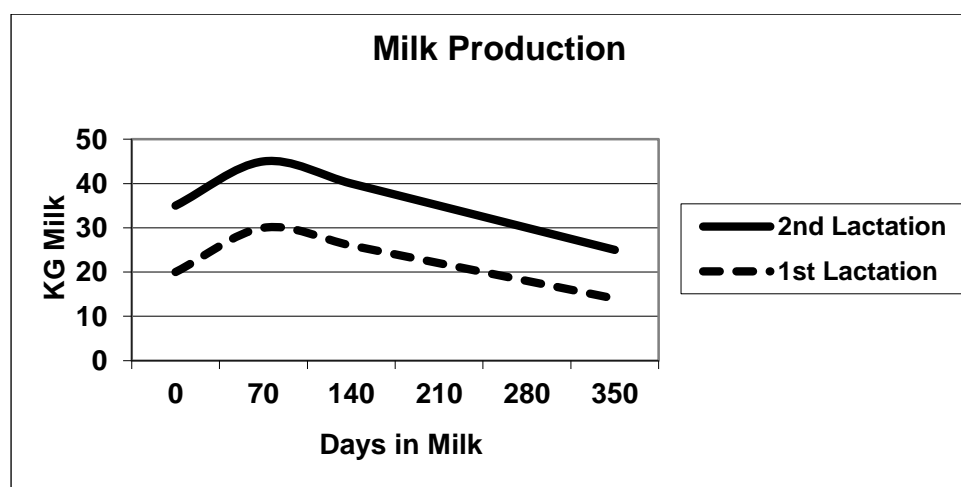
consider feeding 2.5 kg every 4 hours through the day. No more than 4 kg of dairy meal should be fed at one time.

SCALE

USE A SCALE TO WEIGH THE CONTAINER OF DAIRY MEAL FED TO THE COW. A 2 KG FAT CONTAINER DOES NOT HOLD 2 KG OF DAIRY MEAL (MAYBE ONLY 1 ½ KG IF THERE IS A HIGH CONTENT OF WHEAT BRAN)

HIGHER PEAK MILK PRODUCTION LEADS TO MORE TOTAL MILK

We have shown how much protein and energy is needed by a milking cow. The graph below shows how milk production normally goes up after calving, peaking at 2-3 months, but then goes down by 8 to 10% per month. Poor feeding can lead to even larger milk production drops after the peak, especially if production was high.



It is ideal to feed the dairy cow very well during all stages of her dry period and milking period, but especially during the month before calving and the first three months after calving. Why? During the month before calving, the cow's udder grows in size, and the bigger it gets, the more milk it can produce. Feeding the cow very well during this time will make sure that the milk producing part of her udder achieves its maximum potential. More protein and energy soon after calving will push milk production up for a long time afterward (up to 300 days). As the graph shows, a first calf heifer could give 30 kilograms of milk if fed properly, and a very good second lactation cow could give nearly 45 kilograms of milk by 70 days after calving. Note that increasing the dairy ration amount after 90 days in milk will not improve milk production.

THE DRY PERIOD AND 'CLOSE UP' FEEDING

Cows should be dried off two months before calving. A two month dry period allows the cow's body to rest and prepare for the next calving and a productive lactation. When you plan to dry off a cow, begin feeding medium quality Napier grass (10% CP) for a week (no silage and minimal dairy meal) along with 100-150 grams of dairy cattle mineral daily. She should then be ready to dry off.

It is important to change the feeding of the cow before she calves to help her give more milk after calving. A cow which gives more milk at calving can be pushed to higher levels of milk production after calving. Also, she will give more colostrum to feed the calf. This enhanced feeding before

calving is called ‘steaming up’. Start three weeks before calving and give her 1 kg per day of dairy meal and then increase the amount by 1 kg weekly until reaching 3 kg per day at calving. Then feed the amount of dairy meal recommended by the formula given earlier in this chapter.

SCHEDULE FOR “STEAMING UP”

Days Before Calving	KG of Dairy Ration
21 to 15	1
14 to 8	2
7 to calving	3

If the forage is to be changed between the dry period and lactation, the change should be made more than two weeks before calving (not in the last two weeks before calving). Also, any feed change should be made gradually over the period of a week to minimize stomach upsets.

Do not feed Desmodium, Lucerne or fodder trees to dry cows or while steaming up. They can cause Milk Fever (see Chapter 2.9). Maize silage, Napier grass or grass hay can be fed to dry cows and steaming-up cows.

Remember, there are many factors affecting milk production other than nutrition, but none is as important as feeding. Other factors include:

- 1) Cow reproduction (late-lactation cows give less milk than early-lactation cows – rebreed soon)
- 2) Cow health (diseases such as mastitis, uterus and lung infections, lameness, retained afterbirth)
- 3) Cow comfort (bedding area, shade, temperature, hygiene)
- 4) Parasite exposure and treatment (worms and ticks)
- 5) Cow genetics (local breeds give less milk but are hardier to local conditions and diseases)
- 6) Calf and heifer management (well-managed young cattle become bigger cows giving more milk)

WATER

Cows need to have clean water available to them at all times. Any restriction of water will cause a decrease in milk production.

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CHAPTER 2.2



Establishment and Management of Napier Grass (*Pennisetum purpureum*)

Prepared by Mr. Shaad Olingo

The growing of fodder crops is one way of overcoming problems caused by variations in yield and quality of feed resulting from changing weather patterns. Fodders are high yielding plants with high leaf to stem ratio giving abundant herbage yield throughout the year.

Napier grass (*Pennisetum purpureum*) also known as Elephant grass has several benefits for the small scale farmer.

- It gives high herbage yields and can be sold as green fodder
- Controls stock borer by trapping egg-laying moths if planted around maize plot
- Protects maize and other crops from strong winds if planted around maize plot
- Controls run off and soil erosion if planted along contours.

Characteristics of Napier grass

- i. Napier grass is a high yielding perennial grass. It can stand considerable periods of drought. It produces greater dry matter yields than other tropical grasses and is of high nutritive value for dairy cattle.
- ii. Napier grass can be grown from sea level to an altitude of 2100 meters above sea level. It grows well within an annual rainfall range of 750mm to 2500mm.
- iii. It prefers deep well drained and less acidic soils.

Varieties of Napier grass

There are several varieties grown by farmers in Kenya however seven most preferred cultivars are: Bana grass, French Cameroon, Clone 13, Ugandan hairless, Kakamega (i) Kakamega (ii) and Kakamega (iii). Other Napier varieties are: EX- githunguri, Ex-muguga, gold coast, machakos hairless, Ugandan 14, etc...

(i) Bana Grass

- It matures rapidly and is drought tolerant. It is characterized by short succulent stems with broad leaves and is high yielding.
- It grows in a wide range of soils with adequate fertility. Prefers less acidic soils and grows well with an annual rainfall in excess of 1000mm. Performs best in altitudes above 2000 meters above sea level.

- Diseases which attack bana grass are leaf mottle virus, chronic streak and leaf spot. Farmers should control nematodes in these Napier grass fields.

(ii) **French Cameroon**

- High yielding type of Napier grass with thin stems and is less hairy. It grows up to three meters high and has greater tiller numbers than bana grass, kakamega 1 and 2, and ex-githunguri.

(iii) **Clone 13**

- Selected from French Cameroon, it is resistant to snow mold fungal disease and headsmut disease.

(iv) **Ugandan Hairless**

- It is a thin hairless plant with narrow leaves. It is less yielding and highly susceptible to frost and most Napier diseases.

(v) **Kakamega 1**

- It has thin stem and can be used as an alternative to bana grass. It is resistant to headsmut fungal disease. It produces similar yields as kakamega 3. It is as tall as clone 13, kakamega 1, and kakamega 3.

(vi) **Kakamega 2**

- The cultivar is shorter than kakamega 1 and kakamega 3 and produces less than the two cultivars. It is susceptible to Napier stunting disease.

(vii) **Kakamega 3**

- Can be used as an alternative to bana grass. They have similarities in tiller numbers, thickness, height and dry matter yields.

Establishment of Napier grass

- Napier grass can be established from either root splits or cane and can be intercropped with forage legumes like desmodium.
- There are two methods of establishing napier grass

a) **Conventional Method**

Plough and harrow the land before planting. Plant one cane or rootsplit in holes 15cm-30cm deep at a spacing of 0.5m x 0.5m in areas with over 1400mm rainfall and spacing of 1.0m x 0.5m in areas with 920mm to 1400mm rainfall. When canes are used, 2 of the 3 nodes should be buried in to the soil. Weed the plants frequently as they grow and establish.



Cane



planted field



split

Fertilizer application

Plant Napier grass and top dress regularly with fertilizers. There are four fertilizer and manure management practices for Napier grass. Farmers are free to choose the management practice of their choice, depending on the availability of resources.

- i. Use 1 to 2 bags triple superphosphate (TSP) or D.A.P fertilizer per hectare at planting and later apply 5-7 bags of C.A.N (50Kgs each) per hectare in three split applications after harvesting in subsequent years.

or

- ii. Apply 10 tons per hectare of farm yard manure (FYM) at planting. In subsequent years apply same amount in splits after every harvest.

or

- iii. Use 25kgs of T.S.P or D.A.P fertilizers plus 5tones per hectare of farm yard manure at planting. Thereafter, apply 5 tons per hectare of FYM and 100kg to 150kgs of C.A.N fertilizers in 3 splits applications per year in subsequent years.

or

- iv. Apply 60kgs of “slurry” in holes or furrows at planting followed by split application of 60kgs twice in a year or as frequently as you can after every harvest.

Management of Napier grass (conventional method)

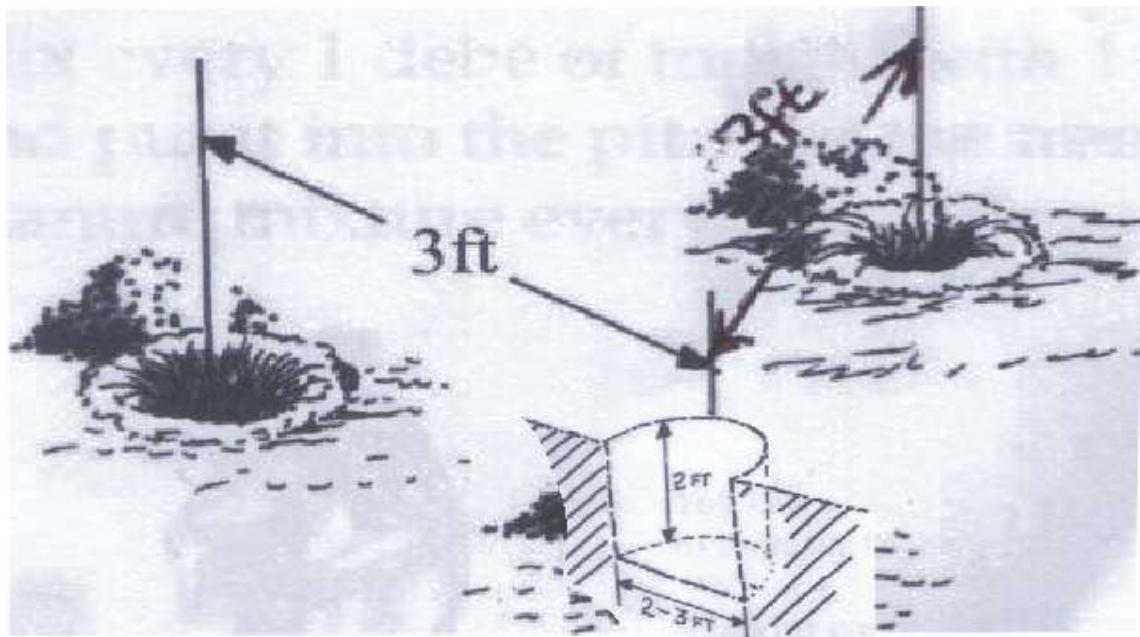
To maintain high productivity you should weed after each harvest. You should harvest Napier when 1.0 metre high or less. Maintain a stubble height of 5cm-10cm from the ground level at each harvest to avoid weakening the rooting system.

During the dry season, you can increase yields through application of nitrogen fertilizers one or two months before the end of rainy season.

b) “TUMBUKIZA” Method

This method of Napier establishment is gaining popularity with small holders since it requires less land to produce high forage volumes, and the fertilization is mostly done during planting. It is similar to the conventional method, but in trenches of a manure/soil/fertilizer mixture. It has faster forage growth and constantly supplies feed even in the dry seasons, due to the organic matter in the manure holding moisture in the ground.

Dig round or rectangular pits of 2 feet (60cm) deep and 2-3 feet (60cm-90cm) wide. Separate topsoil from subsoil as you dig. Mix every one tin (debe) of top soil with one to two tins (debes) of farm yard manure (FYM) and put in to the pit. Leave about 6 inches (15cm) unfilled space on top of each pit. Plant 5 to 10 cane cuttings or one root split in the round pit. You may mix the soil in the pit with one or two handfuls of T.S.P or D.A.P fertilizers at planting. Water the canes or splits planted generously. You can plant sweet potatoes or forage legumes between the pits to increase the quality of forage and to control weeds.



Management of Tumbukiza method napier

The management systems are similar to those of Napier establishment under conventional methods.

Intercropping Napier with Desmodium.

Make furrows between the Napier rows and apply TSP or D.A.P fertilizer. Mix 2 bags per acre TSP or NPK fertilizers with the soil before drilling desmodium seeds. For vegetative propagation you should use mature parts of desmodium vines cut in pieces with four nodes. Bury two nodes in between Napier lines leaving one or two nodes above the ground. Space at 15 – 30cms from vine to vine. Use same fertilizer rates as for establishment by seed. The fertilizer in this case should be placed in the planting holes.

Diseases and pests:-

- In central Kenya cultivars, bana grass, French Cameroon and clone-13 are attacked by a fungal headsmut caused by *Ustilago camerumensis*. Kakamega1 is resistant to this disease.
- In western Kenya, especially Bungoma, Busia and Migori counties, Napier grass is attacked by a fungus *helminthosporium* species. There are new resistant varieties being developed.
- Snow mold fungal disease attacks all Napier grass varieties except clone-13 and to a lesser extent kakamega (iii) and bana grass. However the disease is not a threat to herbage production.
- Other diseases are leaf mottle virus, chronic streak and leaf spot. Farmers are advised to grow disease resistant varieties.
- The control of nematodes in soils where Napier is grown is necessary, however pests are not typically a problem to Napier.

Harvesting and utilization

Napier grass is ready for harvesting 3 to 4 months after planting. Harvesting can continue at an interval of 6 to 8 weeks for up to 3 to 5 years. Yields depend on agroecological zones and an average Napier crop can give 12 to 25 tons per hectare of dry matter (DM) yield. Chop harvested Napier or Napier desmodium mixture to reduce waste at feeding. Do not graze animals directly on Napier.

- 1.0 acre of Napier grass planted by conventional method can give enough feed for 1 to 2 dairy cows per year.
- 1.0 acre of Napier grass planted by “TUMBUKIZA” method can give enough feed for 2 to 3 dairy cows per year.

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CHAPTER 2.3



SAVING FORAGE AS SILAGE

Prepared by Ken Mellish and B.M. Karinga

The rainy season brings an abundance of Napier grass, and cows milk well when fed good quality grass. Storing grass as silage allows the feed be kept in top quality for feeding in the dry season.

The most common grass stored as silage is Napier grass but green maize stalks and other grasses can be stored as silage.

The easiest way to make silage is to store it in plastic bags specially made for silage. These bags can hold up to 200 kg of silage and each one provide total forage for ten days for a cow.

There are some rules which must be followed to make good silage.

MAKING GOOD SILAGE IS ALL ABOUT KEEPING THE AIR OUT OF THE SILAGE BAG

1. Napier grass should be harvested before it is too tall. About one meter is the best.
2. Chop the forage to lengths of about 1 inch using a panga or chaff-cutter. Spread about 50-70kg of chopped material (about 1 ordinary bag) in a thin layer on a flat surface such as a polythene sheet, chadarua or canvass.
3. Dilute 1 litre of molasses (about 1kg of kasuku tin full) with 1-3 litres of water (enough water to spread the 1 litre molasses onto the 50-70kg of chopped forage).
4. Sprinkle the diluted molasses onto the chopped forage as evenly as possible. Turn/mix the forage repeatedly to ensure an even spread.
5. Tie one end of a 2.5m long plastic tubing (1.5m width, 1000 gauge) to make a large plastic bag. Place the 50-70kg of forage already mixed with molasses into the 'plastic bag' and compact as much as possible.
6. Repeat steps 1-3 twice, each time compacting thoroughly after adding the forage into the plastic bag.
7. Tie the top of the plastic bag tightly ensuring as little air as possible remains above the forage-molasses mix.
8. Store away from direct sunlight or rain. It may be useful to place some weight on the tied sack to maintain the compacting. Store the bag of silage where it will not get torn or punctured. If there is a tear then air will go in and spoil the storage.

Similar silage-making methods can be used for making maize silage.

Notes:

- The filled silage bag is very heavy and it is recommended that it is filled at the place of storage. Alternatively use tubes of 1.5m length but fill with less material.
- Only use the forage in times of shortage of green forage.
- Silage is conserved forage and cannot replace concentrates. Therefore, supplement your dairy cows with concentrates even when using silage.
- A dairy cow may consume more than 20kg of silage per day. Feed at least 2 hours before milking or immediately after milking to avoid tainting.
- Each time after you open a silage bag and remove some silage, expel air from the bag and then tie the remaining silage tightly to avoid spoilage.
- Plastic tubes and molasses are available in hardware and feed stores.
- When the bag is empty wash it and store it carefully for reuse the next season.

ADVANTAGES OF STORING GRASS AS SILAGE

1. Saves feed for the dry season.
2. Allows cutting of grass at a good maturity for high feed value.
3. Silage will not carry ticks to cows.
4. Reduces the cost of purchased feed.
5. Keeps milk production up in the dry season.

DISADVANTAGES OF STORING GRASS AS SILAGE

1. Cost of silage bags.
2. Grass must be cut and harvested in one day.
3. Forage can be lost if the bags are torn.

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CHAPTER 2.4



Feeding Maize Silage to Dairy Cattle

Written by Mr. Ken Mellish, Mr. Daniel Scothorn, and Drs. John VanLeeuwen and Shauna Richards

Maize silage has several advantages in feeding dairy cows:

1. High growth and yield of forage per acre.
2. Dairy cattle need high energy food; maize is high energy food
3. An efficient way to store high quality feed for feeding during the dry season.

The disadvantages are:

1. You must be very careful when keeping the stored maize silage
2. You must buy plastic (& molasses or some other energy or additive) to store the feed
3. You must chop (cut) and store (seal in pit/tube) the maize in a short amount of time.

When to consider growing and feeding maize silage:

1. When you have good amount of manure or fertilizer
2. If you own or can rent land to plant maize
3. When cattle have a low body condition (skinny)
4. If you want to spend less money buying dairy meal or other grains for energy
5. If you want to enhance your crop (plant) growth per hectare/acre and/or milk production

Maize silage is high in energy, moderate in protein and low in minerals such as calcium, phosphorus and magnesium, relative to other forages such as Napier or Lucerne. All of these things should be taken into account when feeding maize silage to dairy cows. Typical good maize silage, with lots of kernels, is 8% protein, 70% TDN (energy) and Calcium and Phosphorus of 0.2%, on a dry matter basis.

The high energy of maize silage will help meet the increased demands of a lactating dairy cow for energy to produce milk. The high starch content of the maize silage will help prevent energy shortages in the cow after calving.

How much maize silage should you feed?

If you are going to do an accurate job of feeding your cow, then you should have an estimate of the cow's weight. The easiest way to get a cow's weight is using a weigh tape and the conversion table in this dairy handbook (Chapter 2.3-2.4).

A. *If you have a limited (small) amount of silage:*

1. Start feeding a cow 1-2 kg of maize silage during her first week after calving
2. Slowly increase the amount of silage feed as her milk production increases
3. Try to feed the maize silage for the whole time during the first 200 days after calving
4. Continue this until you know that she is pregnant again
5. Feed more silage early in the milking period; when milk production is highest
6. A good plan is to feed 10kg per day. This will improve milk production and one bag of silage should last one month.

B. If you have unlimited (a lot) of silage:

1. Start with small amounts of silage, slowly increase the amount of feed over 1-2 weeks
 - a. Start with 1-2 kg of silage on the first day
 - b. Increase by 1-2 kg per day for 1-2 weeks
2. Then, feed the milking cow all she wants to eat, up to a calculated maximum
 - a. Cows can eat up to 6% of their body weight in wet maize silage each day
 - b. Example: 500kg cow will eat 30kg (6%) of wet silage per day
 - c. They eat this amount when they are producing the most milk at 60 days after calving

When you feed maize silage make sure:

1. You clean the feed box of any uneaten silage - it will get moldy and can make a cow sick
2. You add new silage many times a day
3. You give a similar amount as yesterday - cows like to eat the same amount every day

What should you feed with maize silage?

1. Maize silage can be fed as the only forage. In Kenya it is usually long-chopped so it should not cause the problems you read about with fine-chopped silage in other countries.
2. Good quality Napier grass or Napier grass silage is an excellent feed to go with maize silage as it adds protein that may be lacking in maize silage.
3. Calliandra leaves or other high protein feeds (see list in Chapter 2.1) also can be fed with maize silage as these also add protein.
4. If the maize silage is good quality with lots of kernels (high energy), you should feed a high yield dairy meal (20% protein). It is important to balance the energy and protein in the diet. Although the high yield dairy meal costs more, cows fed good quality maize silage can actually be fed 20% less high yield dairy meal than calculated by the formula, saving you money. For example, if 5 kg of dairy meal is calculated to be required, you can feed just 4 kg of 20% dairy meal with the maize silage.
5. Feed a mineral mix that has 2:1 or 3:1 Calcium to phosphorus ratio to milking cows, in amounts according to the level of milk production.

What can you expect when you feed maize silage?

1. Cows giving more milk. Maize silage will supply the necessary energy to produce higher levels of milk.
2. Easier to get cows pregnant again. Cows with adequate energy in their feed will show heat and get in calf earlier than cows that are fed less energy.
3. Cows will maintain their weight while milking well and not get skinny. Cows will give higher volumes of milk longer and will have good weight when they are dried off for the next calf.
4. Cows will have a stronger immune system and appear healthier and more active

What if a cow gets fat when eating only maize silage and dairy meal?

1. If it is soon after calving, less than 200 days, then not enough protein is being fed. See above for good feeds to feed with maize silage.
2. If it is later after calving, more than 200 days, the cow may be receiving more energy than required for her milk production. Then replace some of the silage with good quality Napier grass.

Should you feed maize silage to dry cows or pregnant heifers?

1. If you have limited amount of silage, the best cows to feed the silage to are the cows making milk that are not yet confirmed pregnant.
2. If you have a lot of silage, you can also feed small amounts of maize silage to cows that are about to calve (steaming up) - 3 weeks before calving, start feeding 1-2 kg of silage per day. However, do not open the silage bag/pit if you are only feeding one cow a small amount of silage as the silage will get moldy if it is not used fast enough
3. When the cow calves, you can increase the amount of silage being fed to 6% of the body weight
4. Feeding good quality maize silage will reduce the amount of dairy meal you need to feed. If a cow without maize silage need 2.5kg of dairy meal per day, based on the formula mentioned in Chapter 2.1, then that same cow eating maize silage would only need 1.6kg of dairy meal per day

Should I feed maize silage to calves or unbred heifers?

1. Do not feed maize silage to calves younger than 6 months old because their rumen (stomach) is not fully developed
2. You can feed unbred heifers maize silage if you also give high protein feed. If you don't give high protein with the maize silage, you may get fat in the udder, which will decrease the milk production.

Photo of long-chopped maize silage in a manger



SUGGESTIONS FOR FEEDING MAIZE SILAGE TO MILKING COWS

Table #1 Limited silage available.

Cow size	Small-framed cow (less than 400 kg)	Medium-framed cow. (400-500 kg)	Large-framed cow (500 kg and larger)
Limited Silage Available	10 kg /day	15 kg/day	20 kg /day
Supplement with	Good quality napier grass or napier silage	Good quality napier grass or napier silage	Good quality napier grass or napier silage
Dairy meal	Feed a 16% protein dairy meal according to milk production plus 2:1 Ca:P minerals.	Feed a 16% protein dairy meal according to milk production plus 2:1 Ca:P minerals.	Feed a 16% protein dairy meal according to milk production plus 2:1 Ca:P minerals.

Table # 2 Enough silage to full-feed milking cows.

Cow size	Small-framed cow (less than 400 kg)	Medium-framed cow. (400 - 500 kg)	Large-framed cow (500 kg and larger)
Feed to what cows will eat.	20 kg /day	25 kg /day	30 kg /day
Dairy meal	Feed a 20% protein dairy meal according to milk production plus 3:1 Ca:P minerals.	Feed a 20% protein dairy meal according to milk production plus 3:1 Ca:P minerals.	Feed a 20% protein dairy meal according to milk production plus 3:1 Ca:P minerals.

Note: always make day-to-day changes to cow feed gradually. If you don't cows will go "off feed"

Note: Similar methods can be used for feeding grass silage.

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CHAPTER 2.5

Dairy Meal Recipes in Kenya



Written by Mr. Ken Mellish and Dr. John VanLeeuwen

Dairy Meal is expensive to purchase but important to feed. The main reason for dairy meal mixing is to assure that cows receive all of its concentrate requirements including energy, protein, minerals and vitamins. You can make your own dairy meal if you are willing to put in the effort to find the base ingredients and mix it properly. Ensure you have an accurate scale that weighs in 0.5 kg increments. Here are some recipes that you can use.

Recipe #1: This is a recipe that does not include minerals, so you need to add minerals on top. You could mix a 2.5 kg bag of Maklik Super to this mix for easier feeding but that gives you less control over how much mineral each cow gets (they get the amount of mineral related to the amount of dairy meal they get, which may not be enough if you are giving a small amount of dairy meal per day).

Ingredient	KG per batch
Maize bran	49.5
Sunflower/ cotton seed	25.0
Rice polishing	20.0
Fish meal	5.0
Common salt	0.5
Total	100.0

The mix will be 100 kg. Source: from a local Meru farmer.

Recipe #2:

Ingredient	KG per batch
Wheat bran	18.0
Rice bran	15.0
Maize germ	15.0
Rice bran	15.0
Maize flour	10.0
Cotton seed cake	5.0
Wheat pollard	5.0
Stock Lime	1.0
Unga High Phosphorus	1.0
Total	70

The mix will be 70 kg. Source from: <http://graduatefarmer.co.ke/2015/03/15/how-to-make-affordable-dairy-feeds/>

Recipe #3:

Ingredient	KG per batch
Maize germ	44.0
Wheat bran	27.0
Wheat pollard	17.0
Cottonseed meal	6.5
Sunflower meal	5.5
Total	100.0

The mix will be 100 kg. Source: from a dairy cattle feeding book, and suggests that this recipe produces a dairy meal with 10.5 ME/Kg (Energy), CP=14-16% (Protein).

Dairy Meal mixing tips:

- Weigh ingredients accurately using a scale that measures in ½ kg increments, but ideally 100 g increments.
- Many of the problems of mixing dairy meal are separation of larger particles (like bran and germ) from finer particles like minerals and flour after the batch has been mixed. To fix this, use a binder such as vegetable oil, grease or molasses at a level of about 2% of the final batch total.
- The order of mixing is important too. Mix the larger volumes and larger particle size ingredients well first. Then add the binder (oil, grease or molasses) and mix well. Pre-mix the small volumes of ingredients (mineral and salt) and then mix them with the rest.
- Tools for mixing: use a large bucket with a paddle or stick, a barrel, or a barrel mounted horizontally on a shaft that can rotate. Best to mix is with a cement mixer.

Certain ingredients can be a problem if fed above a certain level. Maximum levels for the following raw materials in dairy meals are: Fish meal 5%, Cottonseed 25%, and Urea 1.5%

If you want to substitute high protein fodders for dairy meal, do so for up to 40% the dairy meal requirement. The reason you should not exceed 40% is because dairy meal has more energy than high protein fodders, and if you substitute more than 40%, your cows will be deficient in energy. For example, if a cow is milking 20 kg per day, the dairy meal requirement is 7.5 kg/day (because 20-5 is 15, divided by 2 is 7.5). Then, 40% of 7.5 kg is 3 kg. So you should still feed 4.5 kg of dairy meal (either purchased or home-made), while feeding 3 kg dry matter of Leucaena or Calliandra, which is equivalent to about 9 kg of fresh leaves (assuming the fresh leaves are 45% water instead of 15% water when it is completely dry).

Other information sources: <https://www.livestock1.com/animal-feed-suppliers/kenya>

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CHAPTER 2.6

Lucerne (Alfalfa) – an Excellent Protein Source

Written by Mr. Ken Mellish and Drs. Winston Johnston & John VanLeeuwen

INTRODUCTION

Lucerne is the best home-grown protein feed for milking cows in any area where it can be grown. Its high protein content, rapid growth and long life of well-managed crops makes Lucerne a highly rated feed for dairy cows. Lucerne provides more protein per ton than purchased dairy meal. To get a productive crop of Lucerne, the farmer must take care in establishment of a plot, and some irrigation in dry season is needed for best production. Soil should be deep, alkaline and fertile. Expect better growth in the higher zones.

Farmers Helping Farmers has demonstrated a number of crops of Lucerne with farmers in Meru County. These recommendations are based on these plots and members' experiences.



Lucerne crop ready to harvest in Meru County Kenya

1. Why grow Lucerne ?

- Lucerne produces a very high quality feed for milking cows and can give high yield per acre of land.
- As a legume, Lucerne makes its own nitrogen fertilizer. Nitrogen is made on the plant roots by bacteria from the inoculant applied at planting (see photo later).
- With this nitrogen, Lucerne can have up to 20% protein on a dry matter basis.
- With this protein, farmers who have experience with Lucerne report an increase in milk when they feed Lucerne to milking cows.
- Good Lucerne can even replace some of purchased dairy meal.
- The Lucerne yield per acre can be very high if some irrigation water is available and applied.
- Lucerne production is continuous and can be cut every four to five weeks if there is irrigation water.
- Once established, a well-managed crop of Lucerne will last many years without reseeding. This reduces seeding costs.

2. Where to grow Lucerne.

- Lucerne grows best in cooler areas. With a good supply of water Lucerne can be grown in lower zones but it grows best in the higher cooler areas.
- **LUCERNE REQUIRES DEEP SOIL.** If you have shallow stony soil Lucerne will not do well.
- Lucerne will not grow well in acid soils. Lucerne is the opposite of tea for soil pH requirements. If Lucerne is to be grown in tea producing zones, it will require high levels of agricultural lime to be applied to the soil prior to planting. If you are soil testing then a pH of 6.0 to 6.4 is needed.
- Lucerne requires high levels of phosphorous (P) and potassium (K) to grow well. Land which has had good applications of cow manure over the years should be adequate in these soil nutrients. Do not apply fresh manure before planting Lucerne but build up the soil in the years prior to seeding.

3. How to plant Lucerne.

- **SEED BED PREPERATION IS CRITICAL TO ESTABLISHING A LONG LASTING CROP.** The area should be free from perennial weeds. Round Up should be applied if there are perennial weeds. The soil should be ploughed and left to allow the annual weeds to die. The soil should be worked very fine. This can be with a harrow or the back of a jambe can be used to break up lumps. The soil should be made firm. When you step on it your foot print should be less than a half an inch. A fine, firm seedbed will allow contact between the seeds and the soil. This will promote good germination and the seedling roots will not dry out.
- Use seed from a good source and if possible varieties which have been developed for your growing area. Do a germination test on the seed. Germination can be tested by counting a number of seeds onto some wet newspaper. Add another layer of newspaper, roll it up and keep in a warm area for a week. Check that the paper does not dry out and count the seeds that have grown. Adjust seeding rate upwards for a low germination rate.
- **MIX A LUCERNE INNOCULANT WITH THE SEED.** This will provide bacteria which help the plants fix nitrogen from the air. Inoculant does not keep well as it is a live bacteria. It should be kept cool and used as soon as possible.

- **SEED AT 2 KG of seed PER ACRE.**



- We have been using a small Earthway hand-pushed seeder for planting Lucerne. This seeder packs the soil, plants the seed at the correct spacing and depth, and packs the soil after the seed is placed. It is highly recommended that a seeder is used but if you do not have a seeder, the seed can be placed by hand. Seeds should be placed every 2 inches in ROWS THAT ARE ONE FOOT APART. The space between the rows will allow for weeding and incorporating manure. After placing the seed, it should be covered and packed down.
- Fields are very susceptible to erosion before the crop covers the ground. If there is enough soil moisture, the crop should be established before the heavy rains start. The established crop will protect from erosion.

4. Harvesting Lucerne.

- The first cutting should be delayed until some of the plants are flowering. Then, the plants and the weeds growing with the plants should be cut. The Lucerne will grow back and the weeds should not regrow. The time between cuts will depend on the amount of water and how warm the weather is in the field. Cutting should take place when the plants have flower buds and a few flowers. Expect a four to five week cutting cycle on established fields.
- Do not cut the plants too close to the ground. Leave one or two inches as the new plants grow from the buds low on the plants
- Normally a farmer would cut enough each day to allow a continuous supply. About 1/30 of the plot could be cut each day and this would allow for a continuous supply.
 - a. Cutting too early, before the first flowers form, will not allow for the roots to store nutrients for regrowth and shorten the life of the crop.
 - b. Allowing the plants to become too mature will lower the protein level of the feed.
 - c. Cut one day and feed the next. This will reduce bloat and the number of ticks brought to the cows.

Maturity	total digestible nutrients(%)	Protein (%)
Bud	62	20
1/2 bloom	56	16
Full bloom	54	15
Mature	52	13

*Expressed on dry matter basis.

5. Crop maintenance

- Perennial weeds should be removed if they compete with the Lucerne. Usually the Lucerne will regrow fast enough to outgrow any weeds.
- Irrigation water should be applied often enough to keep the plants growing. This will depend on rainfall, soil type and how soon another crop is required.
- Fertility. Well-rotted manure or compost should be worked into the soil between the rows of plants. Do not use fresh manure or put manure on top of plants. This will keep up the levels of P and K in the soil. How often will depend on the soil. Add fertility when the crop is not regrowing fast enough.
- A well maintained stand can last for many years.

6. Feeding Lucerne

- The high protein content of the forage will boost milk production. This will be seen mostly in fresh cows but all milking cows will benefit.
- Lucerne fits with maize silage for cow-feeding. Lucerne is high protein with medium energy and maize silage is lower protein and higher energy. Together they can make the perfect feed for milking cows. Lucerne also fits well with good quality grasses.
- **Do not feed Lucerne to dry cows.** This is particularly important in the “steaming up” period. If fed in the dry period, the high calcium in Lucerne will cause cows to have milk fever (a treatable disease where the cow is unable to stand). The high calcium is a benefit during milking, so introduce Lucerne gradually after the cow calves.
- If Lucerne is available, cows can be fed wilted Lucerne as their only forage. In most cases, there will not be enough to feed only Lucerne forage, and it is best to feed the amount that will allow the cow to have a continuous supply of about the same amount every day. If cows are fed only high quality Lucerne there can be problems getting them in calf.
- Continue to feed dairy meal but the amount may be reduced without reducing the amount of milk produced.
- Lucerne is an excellent feed to boost protein for growing heifers as well.

Excellent crop of Lucerne in Meru County, Kenya



Lucerne plant showing nitrogen producing nodules

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Fodder Shrubs:

An Excellent Protein Source

Prepared by Drs. Dennis Makau, Melissa Moggy and John VanLeeuwen

Milk production depends on a balance of energy and protein. Common feed stuffs such as tall Napier grass are lower in protein. Fodder shrubs are an excellent source of protein (20 - 30%) that can be fed in combination with high energy foods. Table 1 has the nutritional value of common Kenyan cattle fodder.

Benefits of Fodder Shrubs:

- Research shows average milk increases of 1 kg/cow/day or 10,000 ksh/year in Kenya
- Less likely to get rejected milk on lactometer test because milk is “thicker”, especially Friesians
- Cost to establish 500 Calliandra/Sesbania shrubs (labour included) is 700 to 1000 ksh (see photo with Calliandra on left and Sesbania on right)
- Decrease the need to purchase additional protein sources, especially during the dry season
- When fed to cattle, the manure produced is higher quality and can contribute nutrients to the soil.
- Take up little space and can be planted in areas cash crops are not planted such as, along farm boundaries, along paths, across slopes and in Napier grass plots. They can replace existing hedges.
- Roots extend deep into the soil (still grows when dry), and by planting across slopes, they can prevent soil erosion. Most fodder shrubs are “nitrogen fixers”, contributing nitrogen to the soil.
- Grown on farm, reducing the need to collect forage far from home, especially for zero-grazing farms. Also provide stakes & fuel wood.



How to Feed Fodder Shrubs:

- Can be fed freshly cut or it can be dried and stored for the dry season.
- 500 Calliandra/Sesbania make 6 kg/day of leaves - equal to 2 kg/day dairy meal
- Feed 3 parts Napier grass to 1 part fodder shrubs
- Remember to feed enough energy to match the protein in the Calliandra/Sesbania – increase energy feed (eg. maize germ or dairy meal) as cow milk production increases after calving, and to help improve body condition and improve conception (See Chapter 2.1)

How to Plant Fodder Shrubs:

- Selecting the appropriate types of fodder shrubs for your shamba can be difficult. It is important to plant a few varieties in case one variety fails. Table 2 can help you select the best fodder shrubs for your shamba.

For shrubs from seeds:

- Seeds should be planted in a nursery 2-4 months before the rainy season.
- If possible, set the nursery's length from north to south - this allows appropriate sunlight exposure to the nursery. The nursery should be located in a secure place (so animals cannot eat them) with a reliable water source.
- Prior to planting the seeds, the soil should be mixed with high quality manure, with 1 part manure to 4 parts soil.
- When first planted, the seeds can be covered with dry grass until the seeds germinate.
- The seeds should be watered twice a day, early in the morning and late in the evening. Once the seedlings have reached 15cm tall, watering can be decreased to once a day, late in the evening.
- Transplant the seedlings at the onset of the rainy season, when the seedlings are 25-50cm tall.

For shrubs from cuttings:

- Mulberry (photo on right) can be planted from seeds or cuttings.
- The cuttings should be 4 nodes long, planted on a 45 degree angle, with 2 nodes covered in soil
- Mulberry can compete with other crops as it has a shallow root system. It should not be planted nearby other food crops.



Fodder Shrub Management:

- Manure should be applied to the soil at the beginning of every rainy season.
- Shrubs can start to be harvested at 1-2 meter high, and continue to be harvested every 8-12 weeks, cutting them down to 1 meter high.
- Use a sharp edge to harvest the fodder shrubs. Tearing the forage by hand can damage the shrub resulting in poor regrowth
- Every 6-7 years the shrubs can be cut back to promote new growth.
- To collect seeds, leave every 5th shrub uncut and allow it to grow up to 2-3 meters.

Where to get fodder shrubs:

- Agroforestry Research Center; they will send seeds upon request (small amount)
- Specialized nurseries can provide seeds and seedlings
- Your Dairy Group can help you find sources

Table 1: Nutritional Values of Fodder Crops Available in Kenya

Species	% Crude Protein	Potential Leaf Yield (tons/ha/year)	Limitations/Advantages
Grasses			
Napier Grass*	5 - 15	17 – 30	Low Protein
Maize Leaves	9 - 15	1 - 2.7	Low Protein
Herbaceous Legumes			
Desmodium	16 - 24	4 – 7	Does Poorly in Dry Season
Ground Lucerne	17 - 22	7 – 11	Low Tolerance to Acidic Soil & Drought
Fodder Shrubs			
Calliandra	22 - 28	6 - 16	No limitations (see photo above)
Trichandra	17 - 33	6 - 16	Cool climate. Some are psyllid resistant
Pallida	29 - 35	6 - 16	No limitations. Drought tolerant, highly psyllid resistant
Sesbania	15 – 25	Up to 20	Plants need replacing within 10 years Only one to tolerate water-logged soil
Tree Lucerne	20 - 30	Up to 10	No limitations. Drought tolerant. Act as a fire break.
Mulberry	15 - 25	5 - 11	Competes with crops; only non-N fixer. Highly palatable.
Others			
Sweet Potato Vines	11 - 18	15 - 18	High Water Content

* Tall Napier grass (2 metres high) has 5% protein. Short Napier grass (below 1 metre) is 15%.

Table 2: How to Select the Right Fodder Shrubs for your Shamba

Species	Rainfall (mm)	Altitude (m)	Max (m) Height	Frost Tolerant	Soil Drainage	Nitrogen fixers
<i>Calliandra calothyrsus</i>	>800	0-2200	4 - 6	No frost	Well drained	Yes
<i>Leucaena trichandra</i> (“Trichandra”)	1100-1800	700-2000	5 - 18	No frost	Well drained	Yes
<i>Leucaena pallida</i> (“Pallida”)	500-2000	1000-2000	4 - 6	Light frost	Well drained	Yes
<i>Sesbania sesban</i>	500-2000	100-2500	6 - 8	Light frost	Tolerates wet	Yes
<i>Chamaecytisus tagasaste</i> (“Tree Lucerne”)	600-1600	1500-2500	5 - 6	Frost	Well drained	Yes
<i>Morus alba</i> (Mulberry)	1500-2500	1000-3000	25	Frost	Well drained	No

Acknowledgement: Thank you to World Agroforestry Center for providing information for this chapter.

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CHAPTER 2.8

Mineral and Vitamin



Feeding for Cows

Prepared by Dr. Shauna Richards, Dr. John VanLeeuwen and Ken Mellish

Part 1: Introduction

Why are minerals and vitamins important to give to cows and calves?

- required for good growth, reproduction, milk production and milk quality
- prevent diseases such as blindness, retained placenta, mastitis, down cow/calf



Feeding supplemental minerals and/or vitamins is especially important when:

- cattle have high mineral/vitamin needs (growing, breeding or milking lots); and
- cattle receive poor quality feed (weeds, crop residue, tall grass, or poor silage)

There are different types of minerals and vitamins:

- macro-minerals - calcium, phosphorus, magnesium, sodium, chlorine, potassium, sulfur - required in larger quantities – found in powders or blue blocks (usually)
- micro-minerals - cobalt, copper, iodine, iron, manganese, molybdenum, selenium, zinc - required in smaller quantities – found in powders or brown blocks (usually)
- fat-soluble vitamins – Vitamin A, D, and E – required in feeds given; found in powders
- water-soluble vitamins – Vitamin B, C and K - made by rumen germs (usually)

The type and amount of mineral to give depends on needs and supplies related to:

- age (calf, heifer, and cow);
- desire to get a heifer/cow pregnant (waiting to breed, breeding, confirmed pregnant);
- level of milk production (high production, low production, dry cow);
- different concentrations of minerals in grown and purchased feeds provided;
- different concentrations of minerals in different brands of purchased mineral.

It is impossible to know exactly how much each animal needs and what they are getting from the feeds. Therefore, it is also impossible to exactly match their mineral intake with their needs. A best management practice is to feed the right type and amount of minerals, mixed into the dairy meal or other grain so that they eat it, based on approximate expected needs (see below), and then provide access to “free-choice” mineral. “Free-choice” means the minerals are put in a box (powder or block) or on a rope (block) so that animals not getting enough minerals in the feed for their needs can get more to meet their needs. When free choice minerals are introduced, they should be done gradually to avoid over eating. “Free-choice” only is not recommended for high-producing cows as they will likely not eat enough mineral.

There are 5 general categories of minerals available in the markets for dairy cows (and calves):

1. **Dry cow mineral powder** – has equal or less calcium (Ca) compared to phosphorus (P). For example, “Vital Dry Cow” has 0% Ca and 6% P. It also has other macro and microminerals (eg. selenium) and vitamins, for a complete dry cow mineral. Do **not** feed to dry cows a mineral with more Ca than P in it, even if it says it is for dry cows. Check the Ca and P amounts in the minerals you give to dry cows.
2. **General mineral powder** - has a bit more Ca than P (ratio is 1.2:1 to 1.5:1). For example, “Unga High Phosphorus” has 18% Ca and 12% P for a ratio of 1.5:1. It also has other macro and microminerals (and vitamins sometimes).
3. **High-milking mineral powder** – has much more Ca than P (ratio is 1.8:1 to 2.8:1). For example, “Vitaphos Maziwa” has 22% Ca and 8% P for a ratio of 2.7:1. It also has other macro and microminerals and vitamins.
4. **Trace mineral block or powder**. For example, “Maklik Mineral Brick” (brown block) has microminerals Cu, Mn, Zn, Co, I, Se & Mo, and macrominerals Mg, Na, S, Ca, & P.
5. **Salt block or powder** - to replenish sweat minerals. For example, common salt has sodium and chloride, and sometimes iodine.



Part 2: Recommendations

Feeding Minerals to Low-Producing Pregnant Cows (< 10 kg/day)

Giving 1-2 kg/day of dairy meal (pregnant cows) and free-choice short Napier grass will likely meet mineral needs when no breeding is needed. Provide 3 level tablespoons (45 grams) of **general mineral** if feeding pollard or maize germ (1-2 kg/day) instead of dairy meal. Provide **trace mineral and salt block or powder**.

Feeding Minerals to Low-Producing Open Cows (< 10 kg/day)

If breeding is needed, mineral needs increase. Dairy meal (1-2 kg/day) and free-choice short Napier grass will **not** meet mineral needs. Provide 3 level tablespoons (45 grams) of **general mineral**, and double if feeding pollard or maize germ (1-2 kg/day) instead of dairy meal. Provide access to a **trace mineral and salt block or powder**.

Feeding Minerals to High-Producing Cows (milking > 10 kg/day - Open or Pregnant)

Dairy meal (required amount depends on milk production – see Chapter 2.1) and free-choice short Napier grass will **not** meet expected mineral needs. Provide at least 6 ½ level tablespoons (100 grams) of **high-milking mineral** if feeding pollard or maize germ (1-2 kg/day) instead of dairy meal, and half that amount if feeding required amounts of dairy meal. Increase amounts based on kg of milk production & bag instructions. Provide access to a **trace mineral and salt block or powder**.

High-producing milking cows require higher levels of Ca & P. However, if you feed lots of legumes like Desmodium or Lucerne, you can switch to a **general mineral**, or provide less high-yield mineral.

Daily Feeding of Minerals to Dry Cows

Give 4-6 level tablespoons (60-100 grams) of **dry cow powder** (low calcium) mixed in some dairy meal or pollard or maize germ, even during steam-up (see chapter 2.1). Provide access to a **trace mineral and salt block or powder**.

Also, feed low Ca forages (Napier grass) to dry cows to prevent down cows. Do not give legume forages (Desmodium, Lucerne, Leucana, Calliandra) to dry cows - they have high Ca.

Dry cows must be fed a low Ca diet (both mineral and feed). If cows are fed a high Ca diet when dry (when they do not need much Ca), their body systems managing Ca levels become inefficient. When their udders start making milk around calving time, their inefficient body cannot get enough Ca to meet their needs – leading to a down cow. When milk production is low, the body needs for Ca are low and so down cows are uncommon, but as milk production increases in your improved cows, the possibility of down cows increases. Cows which have had several calves are more likely giving more milk and so more likely to become a down cow. Older dry cows require special attention for feeding and mineral supplementation. See Chapter 2.9 on “Down cow”. On the day of calving, you should switch the mineral to a high-producing mineral and considering giving a calcium bolus (“Transition” or “Bovikalc”), solution (“Animator”) or powder supplement.



Part 3: General Tips and Specific Minerals

General Tips on Feeding Minerals

- Always buy mineral supplements from a reliable supplier in a bag with a label.
- Lower cost minerals may not contain all the minerals needed. Read the label.
- Read and adapt the recommended feeding rates on the package to your farm.
- Get a measuring spoon/container that identifies tablespoons or grams
- One level tablespoon equals 15 grams
- Minerals must be kept dry and fresh. If powder minerals get wet, they will become hard and not absorbed in the cow’s stomach.



Specific Minerals That Are Important

- Calcium and phosphorus deficiency can lead to muscle weakness (down cow) and poor fertility. Milk contains a lot of Ca and P, therefore cows producing milk usually require additional Ca and P for good milk production and fertility.
- Selenium (Se) deficiency can lead to low fertility, increased mastitis, retained afterbirth and weak calves. It is not included in all minerals, so read the label. All mineral mixes for cows and calves should contain selenium. Due to high rainfall amounts during the rainy season in Kenya, selenium is washed out of the ground, making forages selenium deficient. Cows should receive but not exceed 3 mg of Se per day, which can be provided by 100 g of a mineral with 15 mg/kg Se, or 50 g of a mineral with 30 mg/kg Se, assuming cows get 1.5 mg from fodders and dairy meal.

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CHAPTER 2.9

Down Cow Management



Prepared by Drs. Alexander Burrows, Marianne Parent, Michael Walker, John VanLeeuwen

WHEN DOES A DOWN COW OCCUR?

A cow that is lying down for a prolonged period of time and cannot stand is known as a down cow. Down cows can occur at any time, but most commonly occur in the days before or after calving. It is important to identify down cows quickly and to treat the cause so that she can stand again and prevent further injury to the muscles because the weight of the cow can cause muscle damage when she is down for prolonged periods (more than 4 hours on one leg).

CAUSES AND PREVENTION OF DOWN COWS AROUND CALVING

Injury (around calving):

- **Causes:**

Injury usually occurs to the nerves and can lead to temporary or permanent loss of feeling and use of one or both hind limbs. Nerve injury most commonly occurs as the calf is being delivered, particularly if it is a large calf or complicated calving, and will result in the cow being unable to stand after the calf is born.

- **Treatment:**

Because there is physical damage to the nerves, an anti-inflammatory medicine should be given to reduce the swelling during the first few days after calving. However it takes time for nerves to heal, therefore it is important to manage the cow well until she is able to stand on her own. Management of a down cow involves rolling her every 4 hours from the side the cow was lying on. Using feedbags under her belly, the down cow can also be assisted to stand for ½ hour twice or thrice per day to reduce time to recovery by increasing blood circulation to the muscles of the hind legs. Bedding is also important for the cow's comfort. Bedding should be clean, dry and about 15 cm in depth, preferably on top of soil and not hard cement or stones (you can add dirt and bedding to cement). Since the cow is unable to reach the feed and water troughs, keep her in a separated area away from other cows & provide food and water buckets (tied to a post if possible).

- **Prevention:**

Using bulls with a high rating for calving ease, and waiting to breed heifers until they are at least 60% of mature cow's weight should prevent most difficult calvings. Provide assistance quickly if the calving is taking more than an hour after the water breaks.



Severe Infections (around calving):

- **Causes:**

Severe infections can result in down cows because they are too weak and sick to have the energy to stand. In the days following calving, the most common infections are uterus and udder. If a cow is down and not interested in eating, particularly if there is evidence of mastitis or retained placenta, it is important to call a veterinarian or vet tech immediately because the cow can die from these infections quickly.

- **Treatment:**

Medicines are given to treat the infection. Please see “Injury” section for management of a down cow.

- **Prevention:**

A cow is less likely to develop severe udder infections by maintaining a clean dry environment in the sleeping stalls around calving and in the days afterwards (Chapter 4.4). Poor nutrition during the dry period reduces immunity and increases the risk of severe infections, therefore a proper steam-up is important (Chapter 2.1). Also, see retained placenta prevention (Chapter 3.5) and mastitis prevention. (4.2)

Nutritional (around calving):

Nutritional imbalances causing down cows can be divided into 4 groups.

1. **Calcium deficiency (shortage – also called “milk fever”):**

- **Causes:**

The most common nutritional cause of down cows is calcium deficiency. Cows need calcium for proper muscle function. At the time of calving, a large proportion of a cow’s calcium is shifted to producing milk. Some cows don’t have enough calcium for muscle function, so they are weak and not eating or standing.

- **Treatment:**

Luckily, milk fevers are easy to treat. You should call the veterinarian or vet tech and he/she will give the cow a calcium solution in the vein, and the cow usually stands up within 3 hours. Usually one treatment is enough but sometimes cows will need to be treated more than once. Please see “Injury” section for management of a down cow. Only intravenous (not oral) treatment will make these cows stand.

- **Prevention:**

We can prevent some milk fevers by properly feeding the cow during the dry period. It is crucial that we feed cows a mineral supplement that has equal or less calcium compared to phosphorus during the dry period. We should also not feed dry cows legumes (Desmodium, Leucaena, Lucerne, Calliandra) because they are usually high in calcium. Good quality Napier grass and/or corn stalks are good for dry cows, especially if they did not receive much manure fertilizer. On the day of calving, once you start removing milk from a cow, it is important to switch minerals to a milking cow mineral with a calcium to phosphorus ratio of 2:1 or 3:1 (twice or thrice as much calcium as phosphorus). If a cow has had milk fever before, you can also give an oral calcium bolus (“Transition” or “Bovikalc”) or solution (“Animator”) after calving. Pay attention to older cows - more likely to develop milk fever than first calf heifers.



2. Magnesium deficiency:

- **Causes:**

Magnesium deficiency, also called grass staggers or grass tetany, occurs after cows have been grazing very lush grass during the rainy season. This is very rare in zero-grazing systems but could occur if cows are being fed very lush, freshly cut grass. These cows are usually anxious and very sensitive to noises and movement.

- **Treatment:**

Like milk fever, cows will usually recover quickly after the veterinarian gives some intravenous magnesium. Please see “Injury” section for management of a down cow.

- **Prevention:**

If feeding lush grass during the rainy season, introduce it slowly to the diet by mixing with some dried fodder, and ensure the cow is receiving adequate mineral supplement. See Chapter 2.8 on mineral feeding.

3. Phosphorous deficiency:

- **Causes:**

Phosphorous deficiency is another cause of down cows, with little known on exactly why some cows develop it and not others. These down cows are usually still eating.

- **Treatment:**

A veterinarian can administer an intravenous injection of a phosphorous solution. After treatment, the cow should stand within 6-24 hours (not quickly like with magnesium or calcium). Please see “Injury” section for management of a down cow.

- **Prevention:**

Ensure the cow receives a proper mineral supplement with a 1:1 ratio of calcium to phosphorous during the dry period.

4. Ketosis (Also see Chapter 2.10):

- **Causes:**

Ketosis most commonly occurs in the weeks after calving when a cow’s body is still adjusting to putting large amounts of energy into milk production and her diet is unable to meet the energy needs. The breath of these cows smells different (sweet).

- **Treatment:**

The veterinarian can administer an intravenous injection that will boost her energy, however this is only a short term treatment and the cow will need further oral treatments with glycol or molasses and higher amounts of high energy feeds (e.g. dairy meal or maize germ). Please see “Injury” for management of a down cow.

- **Prevention:**

Prevention of ketosis starts with proper steaming up before calving and continues with feeding a diet that meets a cow’s rising energy requirements after calving. Please refer to the nutrition chapters of this handbook (2.1-2.8) for more information on steaming up and calculating the dairy meal requirements of a cow that is milking.

CAUSES AND PREVENTION OF DOWN COWS AT ANY TIME

Injury (any time):

- **Causes:**

Injuries can occur at any time and in any animal. However, they most commonly occur during mounting activity, on slippery/hilly ground or in poorly designed stalls. The most common down cow injuries include dislocated hips and broken bones.

- **Treatment:**

Unfortunately, these down cow injuries are often difficult to treat. However, it is still important to have a veterinarian or vet tech examine the animal to check for treatable causes. Please see “Injury (around calving)” above for management of a down cow.

- **Prevention:**

Housing with proper footing that is even and allows good traction is important in preventing injuries. Well-designed stalls with a soft, even surface will decrease risk of injury while lying down (Chapter 4.4).

Nutritional (any time): While the nutritional causes of down cows discussed above most commonly occur during the days around calving, they can occasionally occur at other times. Causes, treatment and prevention are as mentioned above.

Figure on right shows a down cow with feed in shade



Severe disease (any time):

- **Causes:**

Any disease causing severe illness in a cow can result in her being unable to rise. Severe disease causes severe weakness and exhaustion in cattle and they are focussing all of their energy reserves on recovering.

- **Treatment:**

It is important to treat the animal for the underlying disease as soon as possible. By the time an animal is unable to rise due to severe disease; they are very ill and may not recover if not immediately treated by a veterinarian or vet tech. Please see “Injury (around calving)” section for management of a down cow. In some cases, it may take these cows a few days to recover to the point of rising on their own following treatment, so proper management is very important during this time.

- **Prevention:**

Clean, dry, well-ventilated environment with proper nutrition will provide cattle with the best ability to fight off serious illness. See Chapters 4.2 and 6.1 - 6.3 on preventing mastitis and tick-borne diseases, and Chapter 2.1 on good feeding.

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CHAPTER 2.10

Ketosis: Causes, Prevention and Treatment

Prepared by Drs. Katie Gottlieb, Samantha Pomroy, Jolene Vermeulen & John VanLeeuwen

What is ketosis and when does it occur?

Ketosis is an energy deficiency disease of high producing dairy cows usually starting shortly after calving when the cow changes from giving no milk to giving milk. Producing milk requires lots of energy and if that energy is not replaced by the right amounts of good quality feed, a cow will start to take fat from her body to make energy. **If the cow takes too much fat from her body too fast (making her liver too fat and sick – depressing appetite), ketosis develops.** With ketosis, the fat is not completely broken down and produces a chemical called ketone. Ketones can also depress the cow's appetite (block the cow wanting to eat the correct foods – like dairy meal). This disease is not good for your cow because it leads to lower milk production and delayed conception.

There will be more ketosis in Kenyan cows as farmers continue to use good bulls when breeding their cows. We describe here what a dairy farmer can do to prevent, identify and treat ketosis.

Causes of Ketosis (any combination of the factors below)

- High milk production (especially when cows are giving over 10 kg/day)
- Excessive body condition score (fat cow becoming thinner – see below)
- Low body condition score (thin cow becoming thinner – see below)
- Poor quality diet that is low in energy (such as insufficient dairy meal or poor forages)
- Feeding higher protein, lower energy feeds (such as fodder trees and Lucerne) without feeding more energy can push up milk production and open the door to ketosis.
- Stresses: sudden feed changes, environmental stress (excessive heat/cold due to poor housing) or social stress (getting bullied)
- Any problem occurring around calving (such as milk fever, difficult calving, retained placenta)
- Any disease that causes a cow to eat less (such as anaplasma, severe mastitis, pneumonia)

GENERAL RULE: you can expect a cow to lose a bit of weight during the first 2 months after calving because milk production typically peaks at 2 months after calving. Therefore it is a good idea to make sure cows have some fat at the time of calving – you can think of it as money in the bank for when you need it later – you will get it back in milk production.



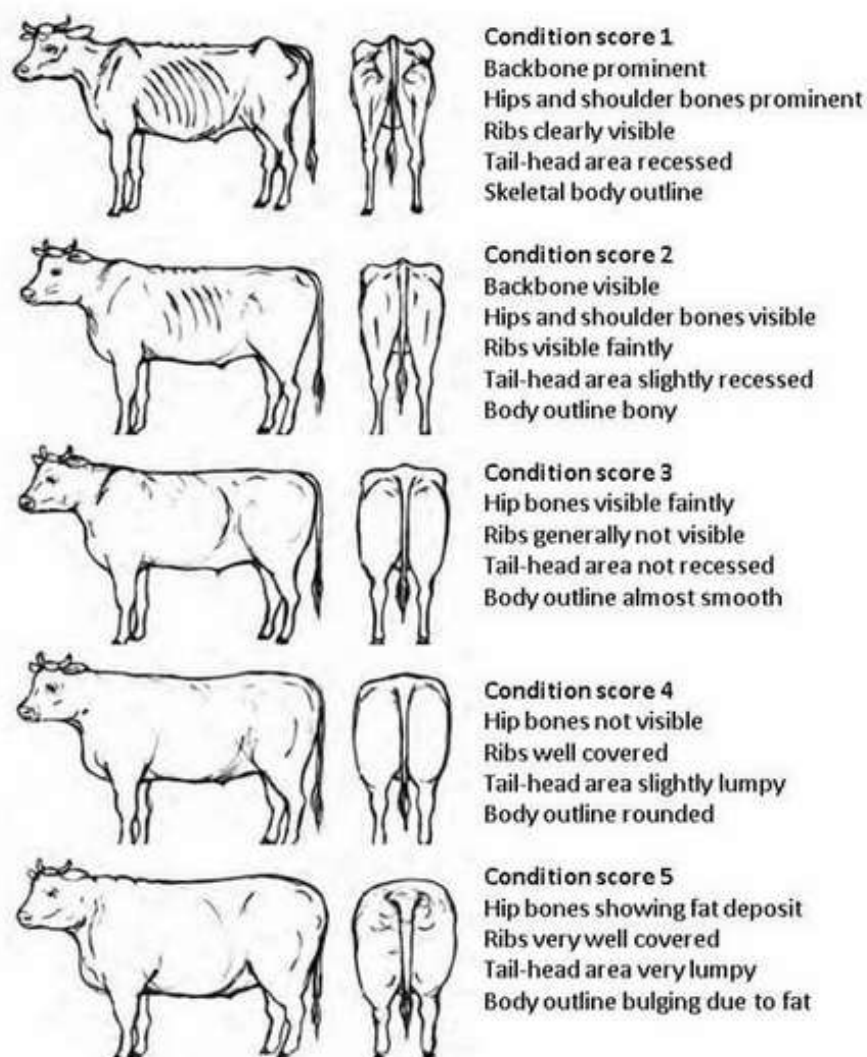
The photo on the right showing good shade over stalls and manger, and rubber mats for soft lying surface, but poor air circulation in the stalls due to the solid wall at the end of the stalls.

Things you can do to prevent ketosis:

You can prevent ketosis by ensuring the above causes do not happen in high producing cows.

- Make sure your cows have a good amount of fat at calving for a body condition score of 3 to 3.5
- Make sure you steam up your cow with dairy meal and dry cow mineral during the month prior to calving so her stomach is used to getting dairy meal at the time of calving so there is no feed adjustment is needed at that stressful time
- Make sure the diet after calving has enough energy.
 - Follow the formula for amount of dairy meal to feed based on amount of milk the cow gives, which is: $(\text{Kg of milk production}) - 5 \text{ then } \div 2 = \text{kg dairy meal to feed per day}$.
 - Feeding good quality forages such as short Napier grass, maize silage, desmodium, sweet potato vines, Lucerne, Leucana, Mulberry, Sesbania, Calliandra, etc..
- Minimize stresses: make gradual feed changes over 3-5 days, prevent environmental stress (provide good shade and wind protection), and prevent bullying by separating bullies
- Prevent diseases that will cause a cow to eat less: for infections and tick-borne diseases, zero-graze, minimize contact with other cattle from other farms, and spray for ticks regularly, ensure the cow has a clean dry place to lie down, provide assistance at calving quickly when needed, feed mineral that has selenium to prevent retained placenta, etc. (See other book chapters).

Below is a figure of things to look at to determine body condition score (BCS).



The best time for a cow to add fat to her body is after she is confirmed pregnant. Remember that you want her to be around a BCS of 3.5 (half way between 3 and 4) when she is **DRIED OFF**. You do not want the cow to be BCS of 4 or higher at calving or else the cow will likely develop ketosis.

How do you identify a cow that has ketosis?

- recently calved (in the last 2 months) or sometimes in the last month of pregnancy
- thin and/or recent weight loss with dull hair coat
- reduced appetite - does not want to eat dairy meal
- some people can notice a strange sweet smell to the cow's breath or milk
- sudden decrease in milk production. It is VERY useful to keep a record of what your cow makes each day so you can pick up on small changes and fix the problem before it becomes bad
- sometimes the cow can be nervous, aggressive, or show excessive licking or saliva
- note that reduced milk production and appetite for dairy meal can happen with many diseases so it is good to have a daktari check for and treat other diseases along with the ketosis

Treatment options for ketosis:

If you suspect ketosis, the treatment is easy and can be given by **YOU**, the farmer, without the help of a technician or veterinarian.

Propylene glycol, if available, is the best treatment for the cow. Give 300ml by mouth twice daily for 3-4 days until the cow's appetite for dairy meal returns.

If propylene glycol is not available, make diluted molasses (EQUAL parts water and molasses, shaken together to allow it to pour out). Give 300ml of diluted molasses by mouth 3-4X daily for 3-4 days using a CLEAN wine or soda bottle

Make sure your cow is swallowing the liquid and it is not going into her lungs (it can kill cow lungs).

If her milk production increases after treatment, it was likely ketosis. If you do not see an improvement in her milk production or she develops any other problems as a result of the ketosis, she may have some other disease problem and you should have a veterinarian examine her.

If a cow has ketosis and she does not get treatment, eventually her milk production drops to a volume that can be supported by the amount of energy the cow is eating.

If you give her the molasses when she does not have ketosis, there is no problem. She will still be able to use the molasses.



What is the success of the treatment?

Treatment is usually successful when the problem is detected and treated early. A cow can fully recover to her expected milk production. Without treatment, your cow will be more likely to develop other diseases or problems, so it is important to treat ketosis if you suspect it. Any sickness should also be treated as soon as possible because sick cows can easily develop ketosis.

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SECTION 3:

COW REPRODUCTION AND REPRODUCTIVE DISEASES



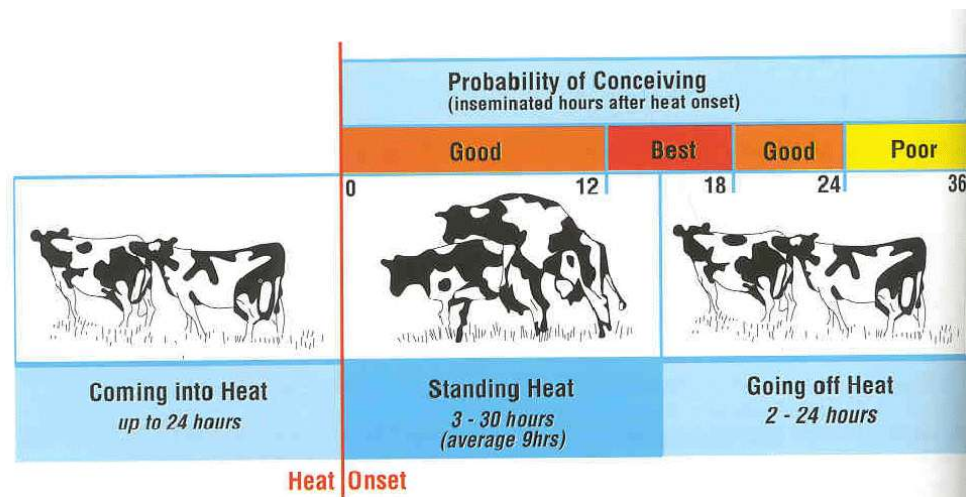
CHAPTER 3.1

BREEDING MANAGEMENT

Prepared by Dr. John VanLeeuwen, Ken Mellish and Dr. Ayub Kaniaru

SIGNS THAT A COW IS IN HEAT AND SHOULD BE BRED

- A cow in heat looks agitated or interested in the bull or looks at you in a “friendly” manner
- A cow in heat sometimes shows a decline in milk yield or will not let down her milk.
- A cow in heat usually has mucous discharge from her swollen vulva & rub marks on her tailhead and pin bones, from other cows rubbing her (which can be detected easier when tail paint/chalk is rubbed off)
- If multiple cows are in a herd, a cow in heat will be observed mounting other cattle, AND "standing" to be mounted (standing to be mounted is the **best sign** of true heat). If a cow does not stand to be mounted, she likely is not in heat. Cows that are not in heat (even pregnant cows) will mount other cows that are in heat. **Only breed cows standing to be mounted.**
- If you only have one cow, write down how long your cow shows heats (24, 36, 48 hours). If only 24 hours, then call to breed when you first see the mucus and swollen vulva. If 48 hours, wait until the second day to call to breed her so you do not breed her too early.



TIMING OF INSEMINATION

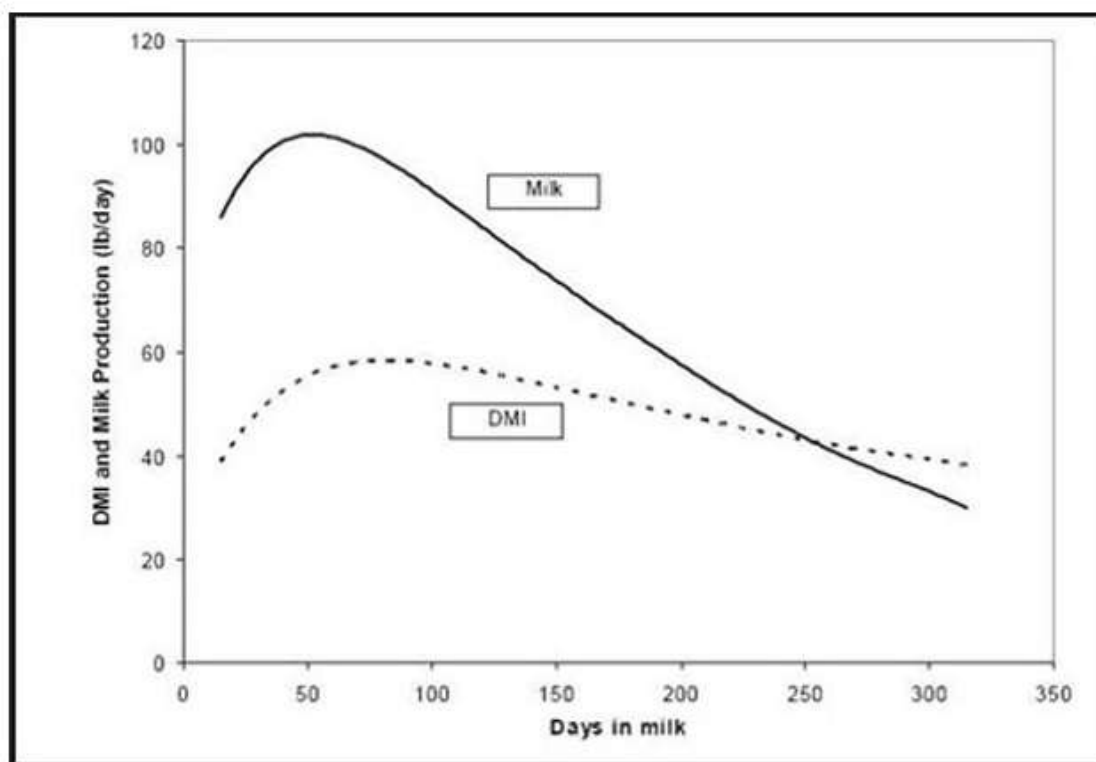
Best time for breeding is middle of heat (12 hrs after the onset of standing heat, as shown in the above diagram). Cows can be inseminated a second time if they are still in standing heat the next day but that costs extra money. It is better to not breed too early.

If a cow is in standing heat **late** in the day, breed her the **next morning**.

If a cow is in standing heat **early** in the day, breed her **later that day**.

STEPS TO FOLLOW TO IMPROVE REPRODUCTION IN DAIRY COWS

- Keep good records of dates and reproductive events for each cow (calvings, heats, breedings, pregnancy test result, abortions, abnormal events (eg. pus, mucus or blood on the vulva or tail).
- Watch and record all heats to determine patterns and when to expect heats. If you have a record of a previous heat (mucous, blood), you have an idea of when to look for the next heat signs (on average, heats occur every 21 days, but can be 18 to 24 days later).
- If abnormal discharges are coming from the uterus (placenta, pus), seek veterinary treatment.
- At 90 days post-calving, begin breeding on observed heats because before this time, the cow is usually not eating enough to replace the energy and protein needed for the high milk production occurring during the first 90 days (see graph showing dry matter intake (DMI) peaking at 90 days but milk peaking at 50-60 days).



- If no heats are seen, seek veterinary examination and treatment.
- If a cow is bred, seek veterinary examination for pregnancy diagnosis at 45 days post-breeding.
- Ensure good nutrition from the month prior to calving until positive pregnancy diagnosis (see Chapter 2.1)
- If a cow aborts, observe for heats and abnormal discharge and rebreed if in heat after 25 days
- Two medicines can be used to help bring a cow into heat, PG and GnRH. See treatment options for getting cows pregnant faster (below). They work best in cows in good body condition.
- Only use natural breeding when AI is been unsuccessful twice in a row.

WHY SHOULD YOU TRY TO IMPROVE REPRODUCTION?

1. Healthy cows produce the most milk around 60 days after calving, and after that, continue to reduce in milk production, no matter what you do. This is how God made them because a calf relies less on milk after this and more on grass and grain. More days with good milk production means more money for the owner. Therefore, most dairy farmers try to make sure that their cows calve for the first time at 24 to 28 months and have a calf every 12 to 14 months.
2. Based on the information obtained from research we did on dairy farms in Mukurwe-ini and in Naari, there is a need for improving reproduction. The average interval between calvings was over 17 months. Some cows were milking for more than two years without having another calf. Average age at first calving was also quite old, at 33 months, meaning that the heifers were consuming many resources for nearly three years before they started producing any milk and making any money for the farmer.
3. With a pregnancy taking about 9 months, it is important to breed cows starting 3 months after calving. A cow is more likely to become pregnant if she is starting to gain weight after calving and less likely to become pregnant if she is too thin or fat. At 3 months, cows are eating to their maximum potential and they are no longer at peak milk production so they should be starting to gain weight again.
4. Breed heifers starting at 16 months (but only if heifers are big enough to breed to avoid calving problems (240kg if your mature cows are 400 kg, because 240 kg is 60% of 400kg) - if not, you need to improve nutrition to help the calf grow faster).

Treatment Options to Get Cows Pregnant Faster:

A veterinarian or vet tech can use injectable hormones to get cows pregnant faster:

1. to help a cow start cycling (GnRH);
2. to bring a cow into heat (PG); and/or
3. to treat a cystic ovary (GnRH and PG). Ask them about when to these.

Breeding Options: Natural Insemination versus Artificial Insemination

The main advantage of artificial insemination (AI) is that farmers obtain the out-breeding and good quality genetic gain for milk production without having to invest in purchasing bulls. Also, bulls can also carry sexually transmitted diseases on their penis that only get spread through natural breeding, not artificial insemination. The main disadvantage of AI is that the conception rate is somewhat lower due to the smaller volume of semen used with AI, and the necessity to be precisely accurate with respect to heat detection and timing of breeding. The advantages of AI usually outweigh the disadvantages and therefore, use good and frequent observation for accurate heat detection and successful AI.

REMEMBER, FOR BETTER FERTILITY IN COWS:

- Good nutrition from one month before calving to pregnancy confirmation.
- Good and frequent observation and records for accurate heat detection.
- Use veterinary exams to check problem cows and confirm pregnancy. Most cows that are of improved breeding will produce more milk if they are fed better. If cows give more milk then more profit can be made. To get high production from milk cows, many things must be considered.

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CHAPTER 3.2

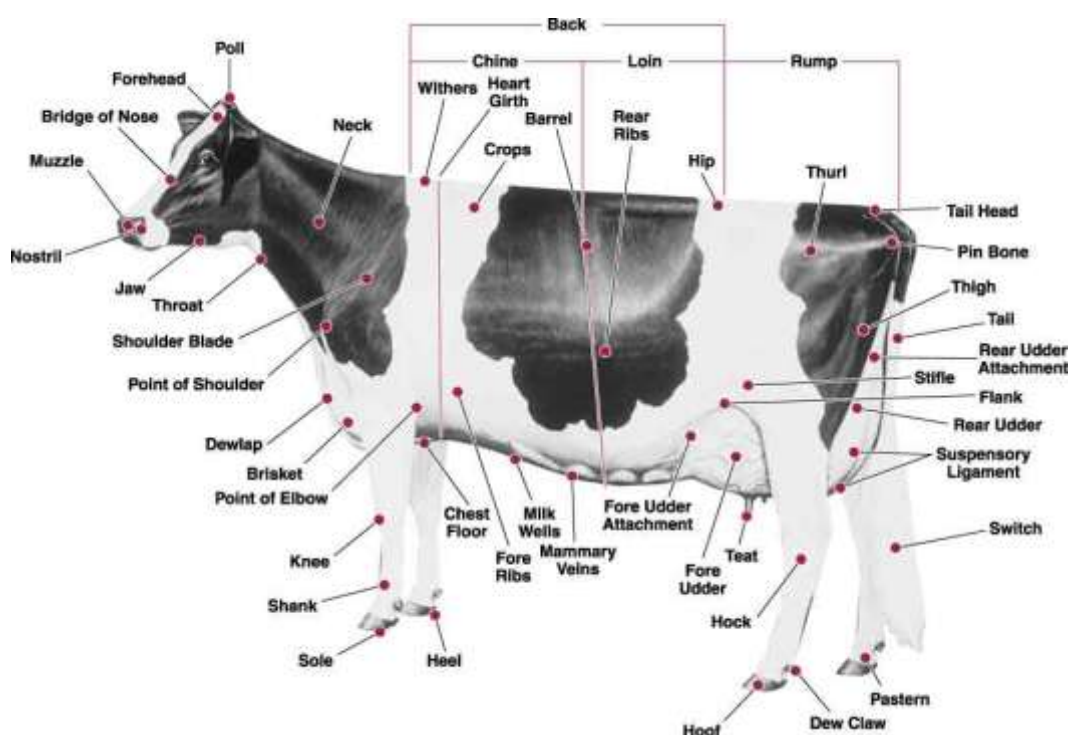
IMPROVING GENETICS OF DAIRY COWS

Prepared by Dr. John VanLeeuwen, Dr. Andrea Dubé and Dr. Ayub Kaniaru

Milk production can be improved over time by paying attention to bull traits when selecting semen for artificial insemination. However, these improvements can take generations, whereas better feeding and management of cattle can make improvements quickly. Good genetics cannot compensate for poor management and feeding. While it is important to use good bulls, it is seldom wise to pay a high price on bull semen unless management is at a high level. No sire can be expected to fix all problems in one generation. This chapter explains how to select the right bull for your cows at a reasonable price.

CHOOSING SEMEN APPROPRIATE FOR YOUR COW

- * The cow and bull each provide 50% of the genetic make-up of the resulting calf.
- * Breeding your cows to superior bulls for specific traits will add superior genetics to your herd.
- * Recognize the strengths and weaknesses of your cows to determine how to get a better calf.
- * Match a bull's strengths with a cow's weaknesses to get an ideal calf.
- * For example, for a cow with weak legs, select a bull that is "positive" for leg traits.







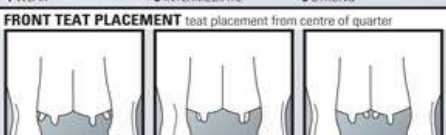


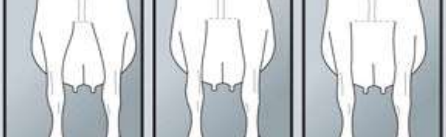
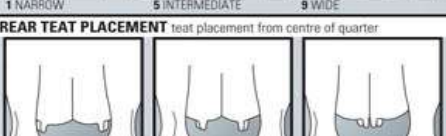
Identifying Strong and Weak Characteristics:

For each characteristic listed below, scores are recorded for the above characteristics, with the ideal score for some characteristic being 9, in others 1, and again in other cases it is somewhere in the middle.

CHOOSING GOOD UDDER TRAITS

You can improve your cow's milk-producing capacity by selecting bulls who rank highly for udder characteristics.

- Udder depth: a characteristic which if appropriate will help a cow live out a long productive life. Ideally depth should not go beyond the hocks, as these cows tend to be predisposed to mastitis and stepping on their teats. Too shallow an udder however does not produce much milk therefore ideally depth should be somewhere in-between.
- Udder texture: a characteristic which, when present, is representative of a superior production animal. Cows with lots of texture tend to be high producers. These udders are soft, pliable and elastic, and well collapsed after milking.
- Median suspensory: the ligament which suspends the udder between the teats. In order for a cow to carry a large volume of milk, her median suspensory must be strong. Weak median suspensory ligaments can cause the teats to face outward and rupture can be the end of a cow's productive life.
- Fore udder attachment: should be strong to avoid teats becoming too close to the ground (and lead to mastitis) and to prevent teats from getting stepped on.
- Teat placement: ideally teats will be at the centre of the quarter, and at the most dependant part of the udder. This is to prevent difficulties milking.
- Rear udder attachments: should ideally be high and wide, as both provide more strength for milk carrying capacity and provide structural longevity for the cows udder
- Teat length: in Canada, ideal teat length is a function of milking ease, therefore ideal Kenyan teat length may be longer than ideal Canadian teat length due to the differences in hand versus machine milking. Ideally teats should be long enough to milk properly without causing teat sphincter muscle strain, yet short enough to prevent stepping on teats and related mastitis.
- The four quarters should be even-looking.

MAMMARY SYSTEM		40%																														
UDDER DEPTH from hock to floor of udder 		IDEAL 5-6 WEIGHT 14%																														
UDDER TEXTURE softness and expandability 		IDEAL 9 WEIGHT 16%																														
MEDIAN SUSPENSORY depth of cleft (fore/rear) 		IDEAL 9 WEIGHT 14%																														
FORE ATTACHMENT attachment to abdominal wall 		IDEAL 9 WEIGHT 16%																														
FRONT TEAT PLACEMENT teat placement from centre of quarter 		IDEAL 6 WEIGHT 8%																														
REAR ATTACHMENT HEIGHT milk secreting tissue to base of vulva 		IDEAL 9 WEIGHT 13%																														
REAR ATTACHMENT WIDTH width at milk secreting tissue 		IDEAL 9 WEIGHT 11%																														
REAR TEAT PLACEMENT teat placement from centre of quarter 		IDEAL 5 WEIGHT 6%																														
TEAT LENGTH average length of rear teats 		IDEAL 5 WEIGHT 2%																														
DEFECTIVE CHARACTERISTICS if double-ticked severe, receives double deduction																																
<table border="0"> <tr> <td>DEFECT</td> <td>DEDUCTION</td> <td>DEFECT</td> <td>DEDUCTION</td> <td>DEFECT</td> <td>DEDUCTION</td> </tr> <tr> <td>✓ tilt</td> <td>1.0</td> <td>✓ lacks udder shape</td> <td>1.0</td> <td>✓ front teats back</td> <td>1.0</td> </tr> <tr> <td>✓ reverse tilt</td> <td>0.5</td> <td>✓ unbalanced quarter</td> <td>1.0</td> <td>✓ rear teats back</td> <td>1.0</td> </tr> <tr> <td>✓ short fore</td> <td>1.0</td> <td>✓ blind quarter</td> <td>5.0</td> <td></td> <td></td> </tr> <tr> <td>✓ short rear</td> <td>1.0</td> <td>✓ webbed teat</td> <td>2.0</td> <td></td> <td></td> </tr> </table>	DEFECT	DEDUCTION	DEFECT	DEDUCTION	DEFECT	DEDUCTION	✓ tilt	1.0	✓ lacks udder shape	1.0	✓ front teats back	1.0	✓ reverse tilt	0.5	✓ unbalanced quarter	1.0	✓ rear teats back	1.0	✓ short fore	1.0	✓ blind quarter	5.0			✓ short rear	1.0	✓ webbed teat	2.0				
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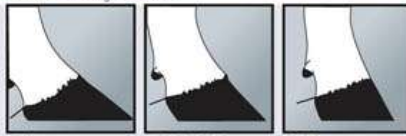
CHOOSING STRONG FEET AND LEG TRAITS

If a cow has sore feet, or is lame, she will produce less milk. Choosing cattle with strong, well-built feet and legs will lead to less lameness and a longer life of your milking cow.

- Foot angle and heel depth: both angle and depth are important to the cow's longevity. Well-built feet will hold up better through the rainy season with a reduced incidence of foot-rot which is a major cause of lameness of cattle. Feet should be short, well-rounded and have slightly-spaced toes. Spacing of the toes (claws) allows for air circulation and reduction of bacterial disease.
- Bone quality: more of a show cow trait, and will be omitted from this discussion.
- Legs: pasterns (between the fetlock and hoof) should be strong, of medium length, and flexible. Forelimbs should be straight, wide set and squarely placed. Hind legs should be nearly perpendicular to the ground from hock to pastern from the side view, straight and wide apart from the rear view.

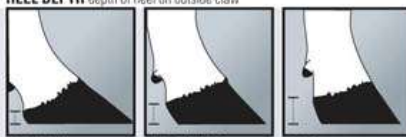
FEET & LEGS
25%

FOOT ANGLE angle of hairline




7
IDEAL
25%
WEIGHT

HEEL DEPTH depth of heel on outside claw



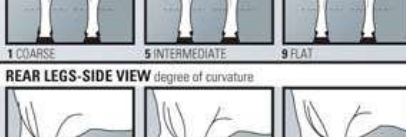
9
IDEAL
22%
WEIGHT

BONE QUALITY flatness of bone




9
IDEAL
10%
WEIGHT

REAR LEGS-SIDE VIEW degree of curvature



5
IDEAL
17%
WEIGHT

REAR LEGS-REAR VIEW turn of hock when viewed from the rear



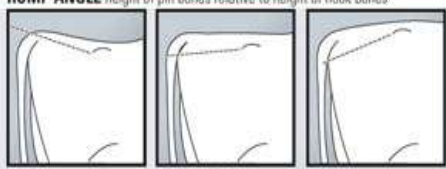
9
IDEAL
26%
WEIGHT

DEFECTIVE CHARACTERISTICS if double-ticked severe, receives double deduction

✓ corkscrew claw	1.5	✓ lacks bone	0.5	✓ thurls back/low	1.5
✓ weak pasterns	1.5	✓ cramped	3.0	✓ toes out front	1.5
✓ boggy hocks	1.0				

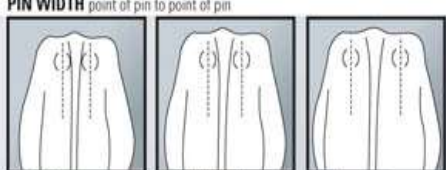
RUMP
10%

RUMP ANGLE height of pin bones relative to height of hook bones



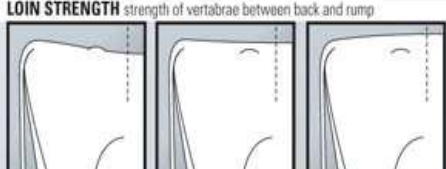
5
IDEAL
42%
WEIGHT

PIN WIDTH point of pin to point of pin



9
IDEAL
26%
WEIGHT

LOIN STRENGTH strength of vertebrae between back and rump



9
IDEAL
32%
WEIGHT

DEFECTIVE CHARACTERISTICS if double-ticked severe, receives double deduction

✓ advanced anus	2.5	✓ recessed tailhead	1.0	✓ wry tail	1.0
✓ advanced tailhead	1.5	✓ high tailhead	0.5		

CHOOSING FOR CALVING EASE AND GOOD REPRODUCTION

A cow produces the most milk during the few months after calving. Calving every year will increase milk production. Selection traits can enhance fertility.

- Rump angle: appropriate rump angle is likely associated with uterus placement, and thus good rump angle may reduce instance of urine pooling, prolapsed uterus and thus difficulty rebreeding
- Pin width: Wide pins (bones beside the tail) allow for large calves to be passed easily, and thus resulting in less wear and tear on the cow, and likely fewer serious calving injuries.

CHOOSING FOR A STRONG BODY

A strong body will last longer and therefore produce more milk.

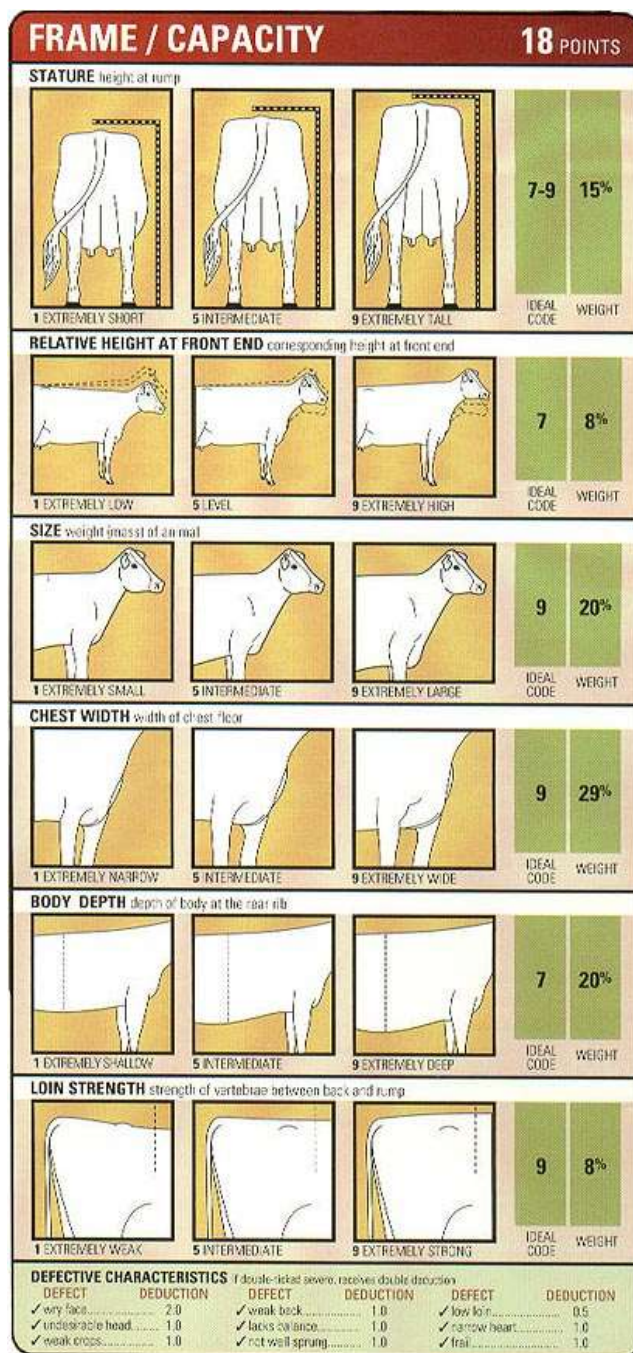
- Height: larger cows tend to have more capacity to eat and drink (larger rumen and intestinal tract) and produce milk. They can also produce larger offspring and for these reasons taller cattle may be of benefit. However they also require more to eat and according to some, for the same quantity of milk, a smaller cow can produce more milk. Height is also a function of how an animal was fed while it was young, so this characteristic becomes very difficult to assess on Kenyan dairy farms.
- Medium sized cows may be more heat tolerant and be desirable for Kenyan conditions.
- Body depth: a cow with a large barrel and lot of size can, under the right circumstances, be a very productive cow.
- Size, relative height at front end, chest width and back strength (loin strength): The loin is the portion of the body specifically important to bearing the weight of the udder, stomach and fetus. A strong loin will carry a large volume of milk, food and fetus for many years comfortably, while cows with weaker loins will tend to “wear-out” at a younger age and have a shorter productive lifespan.

Bulls are classified as being “strong” (or positive +) or “weak” (or negative -) for a certain characteristic based on whether their progeny are excellent or poor for the characteristic. In addition to the body traits indicated above, bulls can also be rated as “+” or above average for milk production, protein, and fat, somatic cell score and productive life.

For more information on the Canadian Holstein Classification program, visit www.holstein.ca. This website is also the source of the figures in this chapter.

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CHAPTER 3.3

Sexed Semen in Kenyan Dairy Cattle



Prepared by Drs. Joan Muraya and John VanLeeuwen

In 2016-18, we conducted research projects in Meru County of Kenya with the following objectives: 1) to gain a better understanding of the milk production and reproduction of smallholder dairy farms (SDF); 2) to determine the factors and prevalence of selected reproductive diseases potentially affecting reproduction; and 3) to assess the use of sexed semen and reproductive hormones in improving reproductive efficiency of these cows. The study for each objective is described below.

In study 1, 200 SDF were randomly selected from 550 active members of Naari Dairy Farmers Co-operative Society. During a farm visit, a questionnaire was used to collect data on factors affecting milk production, and animals were examined for physical and reproductive health. The average body condition score and milk produced by the 314 cows were 2.4 and 6.7 kg/cow/day, respectively, with 43.4% of the cows having been bred or pregnant at the time of the visit (these should be higher). A third of milking cows were not cycling (should be 10%), and the average days in milk was 300 (should be 150). Milk yield was higher with bigger animals, feeding concentrates (dairy meal) during the last month of pregnancy, and increasing percentage of land allocated for growing fodder for dairy cows. Milk production was lower in indigenous breed cows. Cycling and confirmed pregnant cows both had higher milk production than anestrus cows because they were fed better. Poor breeding, feeding & body condition were leading to poor milk production and reproduction. Sexed semen could help with getting more heifers and cows in the Naari Dairy area.

In study 2, we investigated the prevalence of two common infections in cows, *Neospora caninum* and bovine viral diarrhoea virus (BVDV), and factors contributing to their infection. Blood from 470 cows and heifers over 6 months of age from the same 200 farms described in the first study was collected and tested. A questionnaire was used to collect data on risk factors of infection, and the cattle were examined. There was no history of vaccination of the two diseases in this area of Kenya.

- **35% were infected with Neospora (see Chapter 3.4 Abortions)**
- **47% & 36% showed previous & current infection with BVDV (see Chapter 3.4)**
- **18% had previous or current BVDV infection and Neospora infection**

Farm management factors contributing to cows being infected with *Neospora* were: 1) purchasing milking cows often (better to raise your own cows, if possible; farmers may sell a cow that aborts more than once, selling the problem to another farmer); 2) lending cattle between farms (better to not lend cattle to reduce exposure to germs on other farms); 3) allowing farm dogs to eat aborted bovine fetuses; and 4) having female dogs giving birth on the farm compound. **We know dogs can spread Neospora, especially pregnant dogs.**

Farm management factors contributing to cows being infected with BVDV were: purchasing cattle (**better to not purchase cattle to prevent spread of germs to your farms**); and allowing other dairy farmers to handle your cattle (**spreading germs from farm to farm**).

Sexed semen is not recommended in cows that have a history of abortion because they could be positive for BVDV or *Neospora* and could abort again.

In study 3, we enrolled 100 randomly selected farms from the farms used in the previous two studies. The farms were randomly assigned to 1 of 5 groups:

- 1) receiving reproduction resources and education;
- 2) receiving nutrition resources and education;
- 3) receiving reproduction and nutrition resources and education;
- 4) receiving education only; or
- 5) receiving cooking oil only.

- Reproductive resources included antibiotics for uterus infections and/or hormone treatment to help cows come in heat (if needed) and education on reproduction.
- Nutritional resources included Calliandra and Sesbania fodder shrubs to plant on their farms and education on shrub management and feeding, along with other nutrition advice.

In groups 1 and 3, breeding using sexed semen was allowed up to two times per cow, once certain breeding criteria related to body condition score (above 2.25), days in milk (60 to 300 days), normal ovary function and clear vulva mucus were achieved. In groups 2, 4 and 5, farmers were given one dose of sexed semen to use on any cow they wished.

Group 5 had the lowest service percentage at 8.5% of eligible cows getting bred. Group 1 (reproduction) had the highest service percentage at 35%

Conception was slower with:

- Conception was lower with
- Lower body condition score
- When farmers did not attend dairy related training
- In cows receiving hormone therapy

Conception was faster with:

- Dairy meal (or maize germ) fed during the last month of gestation
- Fodder shrubs (Calliandra) were fed
- Sexed semen

Sexed semen conception was faster than conventional semen because cows were bred sooner with sexed semen and only when they met the breeding criteria to enhance chances of breeding success, considering the higher cost of the sexed semen. Conversely, cows bred with conventional semen were often bred later and sometimes without fulfilling the criteria.

Conception success for all inseminations:

- 44% of cows and 54% in heifers conceived with sexed semen (lower than conventional semen)
- 57% of cows receiving GnRH hormone treatment conceived with sexed semen
- 79% of cows receiving PG hormone treatment conceived with sexed semen

Farmer education on nutritional and reproductive management (e.g. use of fodder shrubs, sexed semen and hormone therapy), and biosecurity measures and BVDV vaccination may assist farmers in addressing low milk production, poor reproduction and infectious diseases of smallholder dairy farms in Kenya.

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CHAPTER 3.4

Preventing Abortion in Kenyan Dairy Cattle



Written by Drs. John VanLeeuwen, Alden West, Amanda Alexandre, and Jessie MacQuarrie

INTRODUCTION

Abortions can be a serious problem for smallholder dairy farmers. They cause losses in several ways: treatment costs if the animal is sick, increased time between calvings, loss of money invested into breeding the cow, and loss of income when milk production drops.

Sometimes abortions happen because the cow is pregnant with twins or there is a genetic defect of the calf. We have no way of preventing these types of abortions from happening. Other times, abortions happen because the cow has an infection or eats a toxin. These are types of abortions that you can prevent, as explained below.

MAIN CAUSES OF ABORTION IN CATTLE IN KENYA

#1 Parasites (such as *Neospora*)

The most common germ that causes abortion in Kenya is a parasite called *Neospora*. Dogs that eat the placenta and calf can carry the germ and shed it in their feces for a month after infection and when their immune system gets weaker. If cattle fodder or dairy meal is contaminated with feces from these infected dogs, the cattle eat the germ and become infected with *Neospora*- this is one way that other cows become infected and more abortions happen. Infected cows can also give birth to normal looking infected calves.

Control:

- Do not allow dogs to eat placenta or aborted calves.
- If placenta or calves must be fed to dogs, they must be cooked first.
- Do not allow dogs to have access to the manger or feed storage areas.

#2 Viruses (such as *Bovine Viral Diarrhea Virus - BVDV*)

The second most common germ that causes abortion in Kenya is a virus called BVDV. Cows can get this germ from other cattle on your farm or other farms, and also from wild ruminants such as antelopes. This virus is common and can cause not only diarrhea and abortion but also birth defects, pneumonia, weakness and poor growth. Some cows can die from it, while others can recover and develop immunity against it.

Control:

- Do not let your cows come in contact with other people's cows, especially a sick cow. Do not lend or borrow cattle from other farms.
- Do not allow other people (especially cattle farmers) to handle your cattle unless they have washed their hands and footwear beforehand.
- If you buy a new cow, keep her separate from your other cows for 3 weeks.
- Consult with your veterinarian about vaccine options for BVDV.

#3 Bacteria (such as *Brucella*)

This germ is responsible for approximately 10% of abortion in Kenya. Your cow can become infected by an infected bull at breeding. Usually cows will abort only once in their life due to this germ. Humans handling aborted fetus or placenta or drinking unboiled milk from an infected cow can develop chronic undulating fever or a testicle infection.

Control:

- Use Artificial Insemination. Only use bull breeding after unsuccessful AI twice.
- Always boil milk before drinking it.
- Consult with your veterinarian about vaccine options.

#4 Toxic Exposure (such as *Grevillea* flowers or nuts)

There are many sources of toxins that may injure or kill a developing calf in the uterus. Sources of such toxins can be weeds, flowers and fruit from *Grevillea* trees, and moldy or rotten feeds.

Control:

- Do not feed weeds or *Grevillea*, and especially not the *Grevillea* flowers/nuts.
- Do not feed moldy or rotten feeds.

#5 Systemic Diseases (such as severe toxic mastitis)

Any time pregnant cows becomes severely ill, stop eating, have a sudden drop in milk production, and/or have a fever, there is a chance for abortion. This can happen if the cow's immune system does not have enough "fighter cells" to prevent the infection from reaching the calf, and most calves are too weak to handle the infection.

Control:

- Adequate nutrition and good body condition score (not skinny) as described in Chapters 2.1 to 2.10 will ensure a strong immune system to fight infection.
- Calling the daktari as soon as you notice a pregnant cow is sick will reduce the amount of time the cow is ill, which reduces the chance of abortion.

Strategies for Preventing Abortions

- Ensure pregnant cows are in good body condition so they stay healthy and strong.
- Feed only good feeds, and no weeds.
- Do not allow dogs in cattle feed areas.
- Burn or bury placentas to stop dogs from eating them (or cook them before feeding).
- Use AI for breeding cows.
- Keep new cows separate from pregnant cows for three weeks after purchase
- Get daktari to treat sick pregnant cows that are not eating as soon as possible
- Discuss a vaccination strategy with your veterinarian to prevent abortions.

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CHAPTER 3.5

Causes & Treatment of Retained Placenta

Prepared by Drs. John VanLeeuwen, Olivia Harvey & Ayub Kaniaru



Definition of Retained Placenta:

A retained placenta is only a problem when it is still there for more than 24 hours after calving.

Effects of Retained Placenta:

- 1) Some cows that develop a retained placenta can go on to develop an infection in the uterus that can cause a fever in the cow, reduced feed intake, and reduced milk production.
- 2) Some cows with a retained placenta and uterus infection will have difficulty conceiving when they are bred.

Four Main Causes of Retained Afterbirth:

- 1) Calving more than 1 week before due date – therefore placenta is not “mature” or “ripe”
- 2) Twins – because they usually calve early, leading to an immature placenta that is not “ripe”
- 3) Vitamin E & selenium deficiency – because the attachment between the uterus and placenta is not properly formed, making it “immature” and “stronger” than normal
- 4) Difficulty with calving – because the uterus does not contract quickly afterwards due to the stress on the uterus muscle from the difficult calving

Treatment:

Only some cows with retained placenta need treatment. While the cow has a retained placenta, the cow should be closely monitored for appetite and milk production. If the milk production or appetite become worse, you should call for prompt veterinary assistance to treat the cow with medicine.

A cow that is treated promptly after retained placenta will usually produce a normal amount of milk, however delayed treatment could reduce milk production long-term.

1. Do not remove or have a vet tech remove the placenta at 3 days post-calving because the placenta only pulls out easily after seven to ten days after calving (the best time to have someone pull it out). It may look like the vet techs are removing the placenta at 3 days post-

calving, but they rarely remove it all – they only remove the part that is not attached. Yes, they remove what is hanging outside the cow so it doesn't smell as much, but you can do that too by pulling on the placenta and, with a scissors or sharp knife, cutting off the portion of the afterbirth which is outside the cow. This will also prevent dogs chewing the placenta and vulva. This recommendation may sound different from what you have done in the past, however cows with retained placenta in Canada do not have their placenta removed before day 7, but rather, they simply are monitored for signs of infection (fever, low appetite, low milk production) and given medicine when treatment is needed. Placenta remaining in the uterus after 7 days post-calving can be tugged to confirm it is ready to come out.

2. If a cow with a retained placenta has reduced appetite and an above normal temperature, get a vet tech or veterinarian to treat the cow with an antibiotic, such as penicillin or ceftiofur, administered intramuscularly for a few days in a row, or one does of bimosyl. Remember to follow milk withdrawal times before selling her milk again. A high temperature can be treated with an anti-inflammatory, such as flunixin, meloxicam, ASA or ketoprofen.
3. Do not put anything into the cow's uterus, except perhaps tetracycline pills, and only if the cow is being treated with antibiotic.

How to prevent retained placenta:

- 1) To prevent calving more than 1 week before the due date, ensure that you are feeding the cow properly, including an increasing amount of grain starting at 4 weeks before calving ("steaming up" in Chapter 2.1). Reduce stress in the environment during the month prior to the calving date. This includes avoiding such things as large changes in temperature (eg. shade no longer provided), large changes in types of feed, additions to the herd, and illness.
- 2) There is nothing you can do to prevent twins. Certain families of cows are more likely to have twins than others.
- 3) To prevent vitamin E & selenium deficiency, it is important to provide adequate dry cow mineral (equal or less Calcium compared to Phosphorus) during the dry period. It's recommended to feed at least 100 grams per day of a mineral supplement containing vitamin E and Selenium for the two weeks prior to calving, depending on the brand (read the label). Adequate nutrition will not only prevent nutritionally related retained placentas, it will also increase milk production and encourage the cow to return to estrus sooner after calving for earlier successful rebreeding. **The cow could also receive an injection of vitamin E and selenium 10 days prior to calving as prevention.**
- 4) To prevent retained placenta from calving difficulties, breed using a trait called calving ease. Cows with narrow hips and heifers are more likely to have calving difficulties. Breeding these animals using bulls that have good calving ease will decrease calving difficulties.

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SECTION 4: MILK QUALITY AND MASTITIS



CHAPTER 4.1

UNDERSTANDING MILK QUALITY TESTS

Prepared by: Drs. Marissa Steinberg, Melanie Mallet, Sheldon Russell Campbell & John VanLeeuwen

- * Many tests are available to ensure good quality milk is bought and sold.
- * Completely subjective sight and smell tests are done for every milk pick-up.
- * More objective tests, like the alcohol test, lactometer, clot-on boiling, and California Mastitis Test (CMT), are frequently used.
- * If the milk does not pass these tests, then the farmer may not receive any payment for the milk.
- * Your Dairy Group does these tests to ensure that the milk they are receiving is fresh and of good quality so that they will be able to sell it before it spoils. Your Dairy Group cannot sell spoiled milk to dairy processors, and then cannot pay you as much for your milk.
- * This chapter summarizes these tests and explains how to improve milk quality to pass the tests.

Alcohol Test



The alcohol test is a general measure of the **freshness** of milk, as defined by the strength of the **proteins**. Many factors make these proteins become less stable and then they begin to break down within the milk. Adding alcohol will cause these unstable proteins to form clots or clumps within the milk sample. Milk will clot easier if 85 % alcohol is added, as opposed to 75 %.

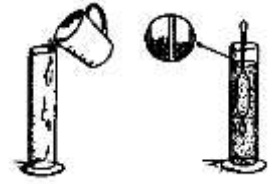
Causes of a failed alcohol test:

- 1) Inadequate minerals and energy/protein in the cow feed, so the proteins start out unstable;
- 2) Infection in the udder, where bacteria produce acid that make the proteins unstable;
- 3) Poor hygiene of anything touching the milk (for example, the milk pail), so that many bacteria in the milk produce enough acid to make the proteins unstable;
- 4) Poor storage temperature with delayed testing, so even few bacteria have enough time to produce enough acid to make the proteins unstable.

To prevent failed alcohol tests: 1) provide good nutrition (see Chapter 2.1-2.10); 2) treat mastitis and ensure good hygiene of the cow pen (see Chapter 4.5) and your hands prior to milking; 3) keep good hygiene of milking equipment (see Chapter 4.2); and 4) milk just before pick-up times and keep milk in a cool place (shade, bucket of water) prior to pick-up.

Clot-on Boiling

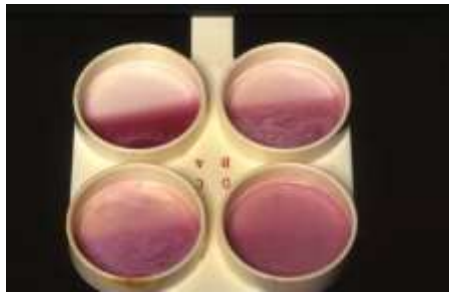
This test determines if the milk is fit for **pasteurization**. A milk sample is added to a glass tube and then the tube is dipped into boiling water. The tube is then held in the boiling water until the milk begins to boil. If the milk does not clot or stick to the sides of the tube, then the milk is fit for pasteurization. This is a general test like the alcohol test, with similar causes of failure.



Lactometer

This instrument is used to measure the **purity** of milk. It can detect whether water has been added to a sample to increase its volume and/or if powdered milk has been added to make the milk's colour whiter. The test is performed by immersing a closed tube with a scale inside of it into a container of milk. Milk normally has a 1.026-1.032 lactometer reading. Holstein-Friesians produce milk closer to 1.026, while Jerseys produce milk closer to 1.032. Failure to pass a lactometer test (that occurred without adulteration of the milk) can be fixed by improving the energy and protein fed to the cow. See Chapters 2.1 to 2.10.

California Mastitis Test (CMT)



CMT is used to detect mastitis – infections of the udder. Milk normally has a background level of soldier cells in the udder. When there is mastitis in the udder, the body sends many more soldier cells to fight the infection. The CMT is used to detect these soldier cells in the milk. A sample of milk is collected onto a paddle with 4 cups, one for each teat. The milk samples are mixed with a special purple solution. If the mixed sample gels (D & C in photo), there is mastitis. A thicker gel indicates a worse infection. If there is no mastitis in the milk sample, the solution will not gel (A & B in photo). Colostrum and milk from cows in late lactation can also be CMT positive but without infection, due to a high normal number of soldier cells relative to the low volume of milk produced. Whenever a cow fails an alcohol test or boiling test, a CMT should be done to detect for mastitis. If the CMT is normal, there is no mastitis and the cow should not be treated with antibiotics.

Interpreting the alcohol test (or clot-on boiling test) and the CMT together:

Positive alcohol test and positive CMT = mastitis → treat the affected quarter(s) for mastitis

Positive alcohol test and negative CMT = nutritional or hygiene problem → do not treat for mastitis.

If this occurs in milk that is *not fresh* out of the cow – see Chapter 4.2

If this occurs in milk *fresh* out of the cow – see Chapter 4.1

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CHAPTER 4.2



MASTITIS PREVENTION (GOOD HYGIENE AND TEAT DIP)

Prepared by Drs. Colleen Walton, John VanLeeuwen and Ayub Kaniaru

MASTITIS

Mastitis is an infection in one or more parts of the udder.

GERMS

Bacteria are invisible organisms that are found everywhere:

- Mud, dirt
- Wet bedding
- Manure
- Flies, birds, rodents
- Unclean hands
- Unclean equipment

Bacteria can cause:

- Infection of udder (Mastitis)
- Souring of milk
- Spoilage of food
- Illness of people



If milk is rejected on an alcohol test, have milk tested for mastitis, by quality control people or a vet, using a California Mastitis Test (CMT). See Chapter 4.1 for details.

Keep records of cow and quarters treated for mastitis; consult veterinarian for proper treatment.

CLEAN EQUIPMENT

Containers, strainer, pails, can covers, towels and cloth must be cleaned and dried properly after each use.

1. Rinse immediately with cold water to remove milk.
2. Wash and scrub in hot soapy water.
3. Rinse with warm water.
4. Sterilize with boiling water.
5. Drain and dry upside down on rack (in sun if possible).



The first rinse water can be used as water for the calf to drink.

PREVENTING MASTITIS AND MILK SPOILAGE – PREVENTING REJECTED MILK

1. Milking area should have a hard floor, clean of manure and mud, and a roof not leaking
2. Sleeping area should have lots of dry bedding, cleaned of manure every day, with a roof not leaking, extending at least 30 cm beyond udder area. See cow comfort (Chapter 4.4)
3. Healthy person only should milk cows. Wash hands with soap and water before each cow
4. Milk as close to collection time as possible
5. If udder is dirty, wash with warm water and dry udder using a separate washcloth and towel for each cow
6. Brush udder with your hand to remove loose hair, then wash teats. Gently dry teats using a separate clean towel for each cow
7. Strip milk to check for mastitis. Put mastitic milk in separate container. Milk the cow with mastitis last and milk the teat with mastitis last as well. This will reduce spread of germs to uninfected teats.
8. Wash hands again and apply Coopers Milking Salve or equivalent to teats (protects/heals chapped teat skin)
9. Milk into clean container or pail
10. Use proper milking technique (See Chapter 4.3)
 - a. Don't pull on teat unless teat is small
 - b. Start squeezing teat near udder with thumb and index finger and progress toward teat end closing fingers one at a time going down the teat
11. Pour milk into clean can through clean strainer
12. Pour teatdip (Coopers Mastrite) into small dip cup and dilute it so it is one part Mastrite and 2 parts water
13. Need to dip bottom 1/3 of each teat with diluted Mastrite teatdip in dip cup to prevent mastitis.
14. Never pour remainder of diluted and used teatdip into original Mastrite container. Only add more Mastrite to dip cup. Clean the dip cup thoroughly when there is only a tiny bit of teatdip at the bottom of the dip cup
15. Feed cow during or immediately after milking to keep her standing for 1 hour after milking so the hole where the milk comes out has time to shrink before she lies down.
16. Store covered milk container in shade or cool water to keep it cool until pick-up
17. Transport milk as quickly as possible after milking to collection station
18. When treating a teat with an infection, clean the teat like you do before milking. Then, with alcohol, scrub the tip of the teat where the hole is. Wait 30 seconds for the alcohol to work, then insert the tube of medicine.
19. In a cow book, record teats with infection (e.g. date, days in milk, which teat, treatment, cured or not) so that information is available for making decisions on future treatments and culling



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CHAPTER 4.3

Causes & Treatment of Blocked Teats



Prepared by Drs. John VanLeeuwen, Gerald Dykstra, Shauna Richards, & Aleta Schmah

A blocked teat is a teat that does not easily allow removal of milk, and can be a partial or complete blockage, in one or more of the cow's teats, at any point in time. The cow may or may not find it painful. The three main causes of blocked teats are:

1. Injury
2. Mastitis,
3. Genetics (inherited).

1) Injury (common and painful):

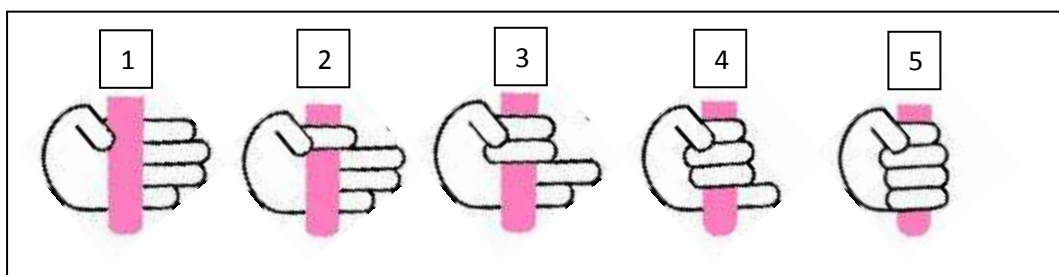
Injuries to teats can lead to partial or complete blockage that is temporary or permanent. Teats (especially the inside lining of the teat) are fragile. The following **causes** can damage them easily:

- stepped on (by the cow herself or by another cow)
- sucked on too vigorously by a cow's own calf (or others calves or even cows)
- inappropriate milking technique over many years (excessively hard pulling)
- insertion of instruments into a teat by an animal health technician or veterinarian.

Successful treatment usually involves locally applied medicines, and occasionally surgery. Consult an experienced animal health technician or veterinarian with proven success with injured teats for proper treatment. Inexperienced surgeons often do more harm than good when putting instruments into a teat, and will not know when teat surgery is needed and likely to produce a good result in the long term.

To prevent injuries to the teats:

- cow stalls should be of the appropriate size and design (see Chapter 4.4)
- young animals should be prevented from suckling each other- use a sharp nose ring
- gentle and proper milking techniques should be used at all times (see picture below)
 - Squeezing the teat, instead of pulling the teat, is more effective, and less traumatic to the teat. With practice it is just as quick as pulling, and your cow will have a longer productive life. Only young cows with small teats should be milked by teat-pulling.



2) Mastitis (common and painful)

Mastitis is an infection of the udder. Severe mastitis can lead to thickened milk which can block the teat, partially or completely. If **treated** with antibiotics early on, the cow's milk will return to normal and milk will come out of the teat easily again. **Surgery is not required to fix a blocked teat due to mastitis.** If the infection is untreated, it can lead to scarring of the inside of the teat, which can lead to a permanently blocked teat. A veterinarian cannot fix a chronically blocked teat due to mastitis.

Blocked teats from mastitis can be prevented by:

- keeping the udder clean and dry through proper stall design and management
- using hygienic milking procedures

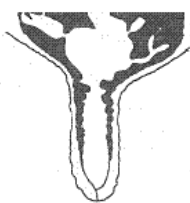
Refer to Chapter 4.2 to 4.4 for further information on mastitis causes and prevention.

3) Inherited (uncommon and not painful)

Some cows can be born with one or more blocked teats. The teat can be blocked at various locations including the base, in the middle or at the very tip. To **prevent inherited blocked teat**, you should avoid keeping offspring of cows that were born with a blocked teat.

Treatment: Unless the blockage is very minor, treatment (surgery) success is poor due to scar formation and re-blocking, even though temporary fixes appear to work in the short-term. Also, attempts to fix these blocked teats can lead to an infected or dead cow that used to be a healthy cow. The best option is to milk the 3 functional teats because 3 teats will produce almost as much milk as 4 teats. A teat cannula (plastic or metal) can help get milk out while healing from injury.

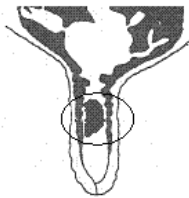
Normal Teat (below) Teat cannula (right)



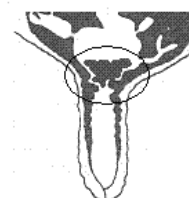
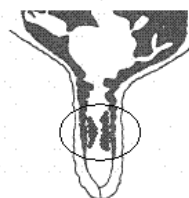
Blocked at Teat End



Blocked in Middle Teat



Blocked at Teat Base



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CHAPTER 4.4

Comfort and Welfare of Cows & Calves



Prepared by Drs. Shauna Richards and John VanLeeuwen

While it may seem strange to think about it, your cow needs to be comfortable. Cows feel pain and discomfort in the same way that humans do. Cows can also experience fear, stress (from anxiety, hunger or thirst) and other emotions (such as happiness). Research has proven that cows that are **happy** and **comfortable** will eat more, produce **more milk, get pregnant faster** and **have less disease** than cows that are uncomfortable and stressed.

Signs your cows are uncomfortable and you need to improve their stalls:

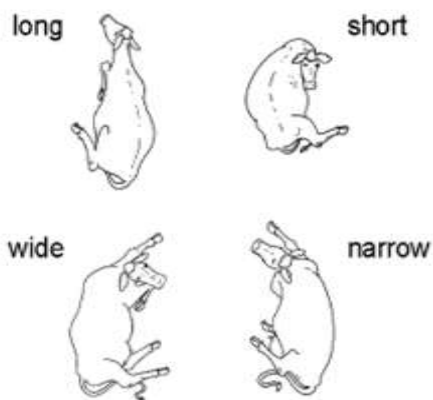
- Cows lie down outside the stall, or stand fully or partially in the stall for prolonged periods of time without lying down
 - These indicate that the cows cannot lie down and/or rise easily in the stall, or they think the stall is less comfortable than other areas to lie down
- Cows lying down for less than 10 hours per day
 - Cows that spend more time lying down produce MORE MILK and should spend at least 11-12 hours per day lying down. The energy used for standing could go towards making more milk.
- Cows are dirty – especially around the udder and legs
 - This shows that the cows are lying down in a dirty area (in the stall or outside the stall). Dirty cows are more likely to have mastitis
- Wounds or hair loss or swellings on the neck or body
 - These indicate improperly placed boards (eg. manger) or sharp objects
- Wounds or hair loss or swellings on the front or back legs
 - These indicate the cow is getting injured when getting up or lying down, or the stall surface is not soft enough (eg. cement with no bedding)

What can be done to make cows more comfortable?

- Build/alter the stall in order to make it the right size for your cow
 - See Table 1 on stall dimensions and Figure 1 on design guides
 - Most common errors – neck rail that is TOO LOW and/or located TOO FAR back towards the curb, and inadequate lunging space in front or beside cows to stand up. Stalls should allow the following:
 - Easily lie down on chest with legs underneath them
 - Lie with front legs stretched forward, or head to rest on cow's side
 - Lie on their side with their head and neck stretched forward
 - Legs, udder & tail to rest on a clean, dry, soft bedded area
 - Easily stand up without hitting boards with their head or body
 - Remove sharp or rough edges (nails, boards) from your cow shed to prevent injury
 - Sizes in Table 1 are just a recommendation – if your cow is not lying in the stall consistently, adjust the stall size or neck rail and brisket board placements - place the neck rail so it is just touching the cow's neck when she is standing in the stall just far enough in the stall that when the cow passes manure, the manure does not fall in the stall. Similarly, place the brisket board (10 cm high) so it is just touching the cow's brisket when she is lying down in the stall just far enough in the stall that when the cow passes manure, the manure does not fall in the stall.

- Ensure stalls are bedded with clean dry material such as shavings or dry leaves
 - Amount of bedding: The best way to ensure you have enough bedding that is clean and dry is to perform the **KNEE TEST** - Stand in your cows stall where the udder would rest against the floor, and fall onto your knees and stay kneeling for 10-20 seconds
 - If you hurt your knees when falling to your knees, a cow's knees will hurt too, and you need to give MORE dirt to cover stones and bedding
 - If your knees get wet or dirty, the stall needs to be cleaned and dry bedding needs to be added to prevent MASTITIS
- Ensure the cows have shade from heat and shelter from rain
 - Make sure the roof extends so that no water can fall where the cows udder will be when she is lying down
- Clean the stall **at least** twice a day, but it is better if you clean it more often
 - Remove manure from the stall each time you milk the cows
 - Also remove soiled bedding and replace it with fresh bedding
- In a 2014 research study of zero-grazing smallholder dairy farms at Wakulima Dairy in Mukurweini Kenya, we re-constructed stalls on farms using resources found on farms (low cost). Stalls were made wider, longer, and less restrictive so cows could lie down more easily. Neck rails and brisket boards were added to ensure the stalls were kept clean from manure, but still allowed the cow to lie down comfortably. Soil was tilled to soften the stall base & then made level (if the stall base was dirt), and wood shavings added as bedding.
 - Before any changes were made, cows spent 9.3 hours per day lying down, which is less than the ideal of 11-14 hours per day
 - Cows lied down for at least an additional hour per day when stalls were fixed, and some cows lied down an additional 7 hours per day when their stalls were fixed!
 - After fixing stalls, fewer cows stood idly or perched in their stalls, and fewer cows lied down in the alleyway
 - Other benefits included softer and drier stalls on knee testing, and cleaner cows – all of which lead to reduced mastitis
 - This study shows that making small and low cost changes on your farm can make a big difference to your cows, and your milk production
 - In a follow-up study we did in Meru County in 2017, farmers were asked to do these reconstructions themselves and 75% of farmers did them, with similar results.

Normal Resting Positions



How a Cow Stands Up

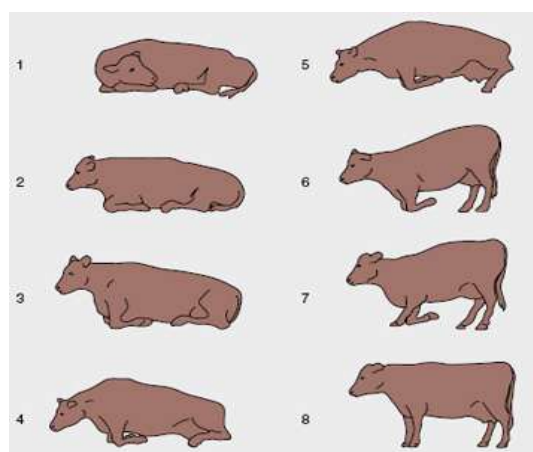
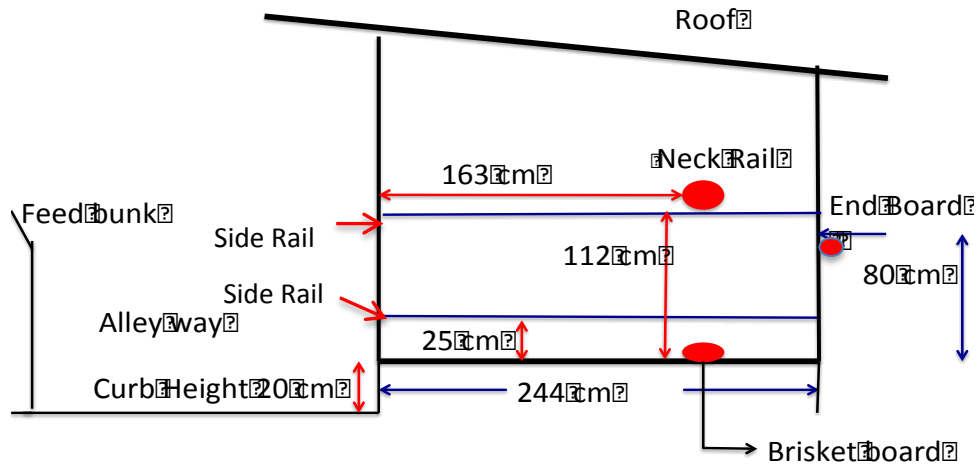


Figure 1. Diagram of stall measurements for a 450 kg cow



What can be done to make cows happy instead of fearful and stressed:

- Ensure there is feed and water always available, and provide fresh feed at least 3 times per day – remove undesirable feed (thick grass/maize stalks) once per day
- Ensure walkways are not slippery (eg. wet wood or smooth cement is slippery)
- Do not make loud noises or sudden movements around cows
 - Approach cows slowly and talk to them calmly and quietly
 - Get cows to move forward by standing/walking in the shaded triangle labelled ‘A’ in Figure 2 below
 - Do not hit or yell at cows to get them to move

Figure 2. How to move a cow without causing stress

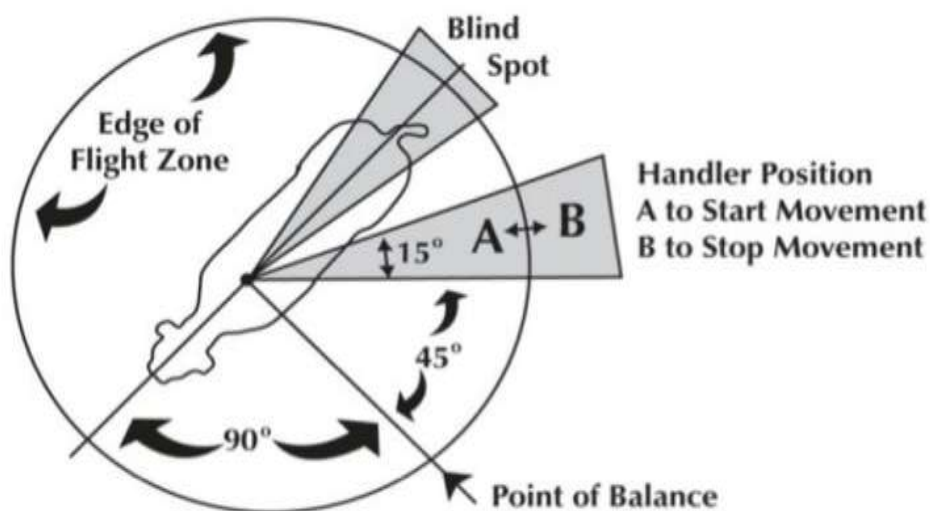


Figure 1. Flight zone
Taken from "The Cattle Industry's Guidelines for the Care and Handling of Cattle", National Cattlemen's Beef Association

What can be done to reduce pain in cows, calves and heifers?

Common painful conditions include: mastitis, down cow, pneumonia, diarrhea, surgery, and dehorning. Anything you would consider painful will be painful for a cow or calf. To reduce pain and suffering in cases of illness or injury, call a veterinarian or animal health technician to come treat your cow or calf as soon as possible. Use of special medications like *Meloxicam*, *Flunixin*, *Ketoprofen* or *Aspirin*, and *Lidocaine* can reduce pain especially if your cow or calf needs surgery or dehorning.

All of the above recommendations also apply to calves and heifers. If you raise your calves or heifers and you handle them gently, they are more likely to be well-behaved cows as adults. A clean and dry shed for calves will also reduce the risk of illnesses like diarrhea and pneumonia.

Table 1. Recommended Dimensions for Stalls of Various Size Cows

Weight of Cow	250 kg	350 kg	450 kg	550 kg
Total Stall Length (cm)	165	185	206	229
Distance from rear curb to brisket board (cm)	122	132	145	155
Stall width (cm)	84	91	102	112
Upper edge of lower divider above stall surface (cm)	20	20	25	25
Height below neck rail (cm)	90	94	102	109
Distance from rear edge of neck rail to curb (cm)	122	132	145	155
Rear curb height (cm)	10	10	15	15

Adapted from the National Farm Animal Care Council of Canada and Drs. Ken Nordlund and Nigel Cook

Table #1 has guidelines for stall requirements for various sizes of cows and heifers. The total stall length includes 15 inches of space in front of a cow's stall that a cow can use to put her head when she lunges forward with her head in order to stand up. If this space is not available because of obstructions at that end of the shed, then the body resting length should be made 15 inches longer. Note that end boards at the end of a stall can be placed too low and therefore not allow a cow to fit her head into this lunging space.

Figures 3 and 4 give dimensions and an overview for a cattle shed for 3 mature cows and 2 heifers (there is a cubicle for lying down for each animal). The total length of the shed can be reduced by one or two cubicles if you have only 1 or 2 cows or only 1 heifer (or increased for more than 3 cows or 2 heifers).

The heifer stalls are as large as the cow stalls to allow for dry cows to be housed with heifers or to allow the entire shed to be used for the milking herd as cow numbers increase. You could make the stalls smaller for smaller cows according to the listed requirements in Table 1.

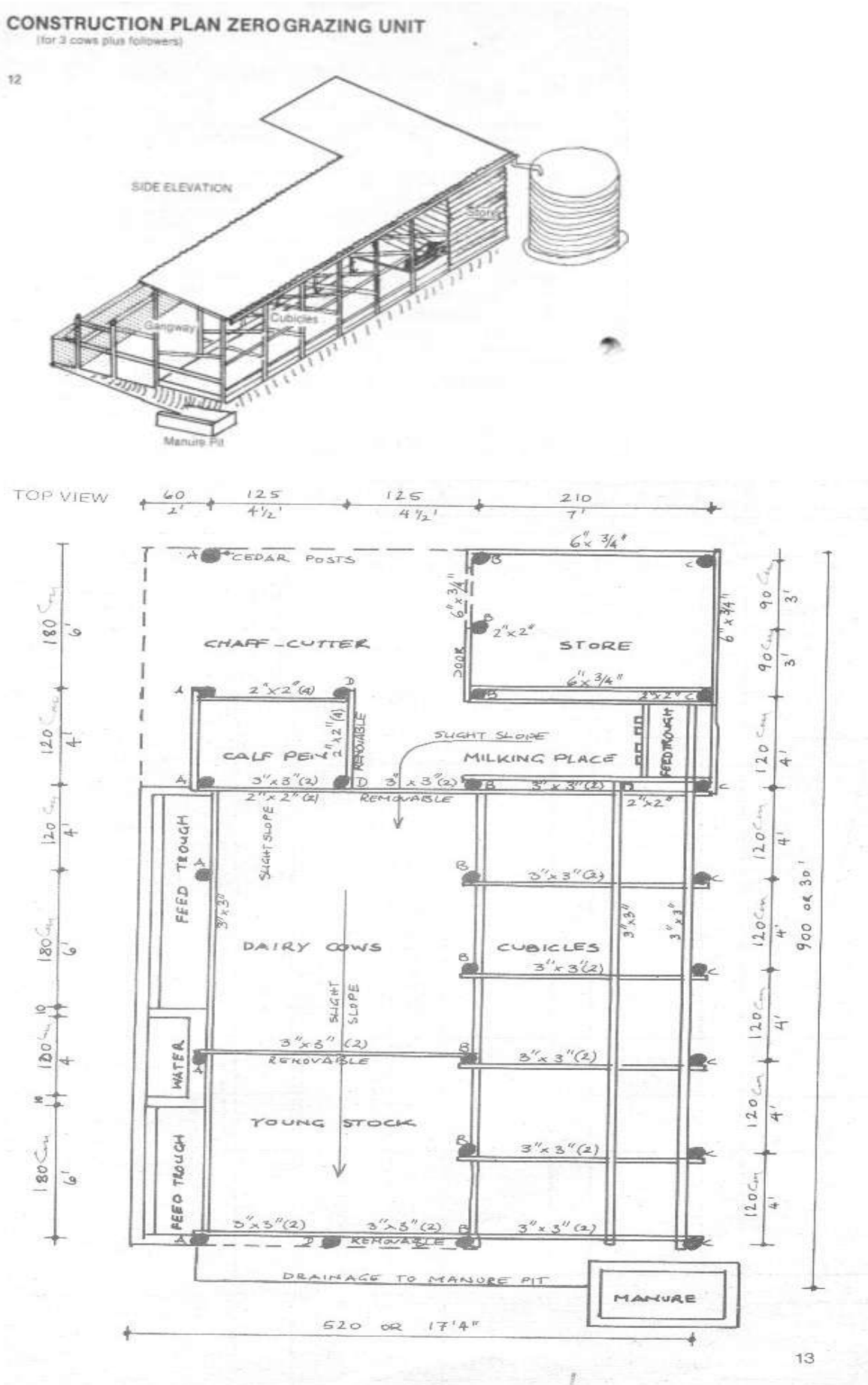
Source for Figures 3 & 4 on next page: Kenya Ministry of Livestock Development

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Figure 3 (top): Overview of Cattle Shed

Figure 4 (bottom): Top View of Cattle Shed





SECTION 5: YOUNGSTOCK MANAGEMENT AND DISEASES



CHAPTER 5.1

Overview of Calf Care

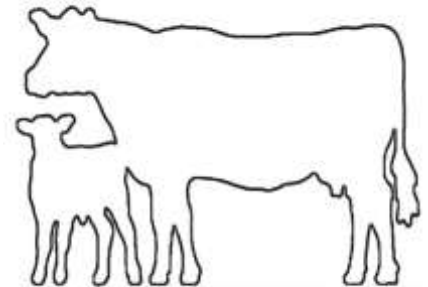
Written by Alina Gardner, Kelly Hammond, Megan White, Drs. Shauna Richards and John VanLeeuwen

Calves are the future milking cows of your herd. If you raise them properly and provide good nutrition, they will reach breeding size younger and show more heats. With proper care and management, they will deliver a calf earlier, and start making money for you with their milk sooner.

****The first two years of your calf's life are the most important. If the calf is not cared for properly during this time, it will never grow to its full size****

1. Feed Adequate Colostrum:

Colostrum is the milk that the cow produces immediately after giving birth. Colostrum contains important proteins that help protect the calves from disease. It appears yellow and thicker than normal milk.



- Calves need 4 litres of colostrum **within 6-12 hours of birth** to get a healthy start to life
- Calves should be fed frequently for the first 24 hours (at least every 8 hours)
- Remove calves from their cows immediately after birth. Be sure to clean the cow's udder before milking.
- If calves are weak and not suckling on their own, you must bottle feed or have a veterinarian tube feed them 4 litres of colostrum **within 6-12 hours of birth**

2. Feed Your Calf Properly

The more good food you feed your calves, the bigger they will grow and the more milk they will produce when full grown. Limiting what your calf eats will stunt its growth, make it weak and decrease its milk production as an adult. If you feed as recommended, your calf should reach breeding size by 16 months (minimum 240-300 kg which is 60% of mature body weight). **DO NOT** breed animals younger than 16 months of age, regardless of their size.

- **0-2 months:**
 - Keeping the calves clean is extremely important
 - For the first 2 months, milk is the most important part of a calf's diet
 - A calf must be fed a minimum of 10% of its body weight in milk per day for the first 2 months. More is ideal, but do not feed more than 2 kgs at one time.
 - Use a weight tape to verify the weight of your calf. See dairy manual for details.
 - For example, a 40 kg calf needs at least 4 litres of milk per day: 2 litres in the morning and 2 litres in the evening
 - As the calf grows to 60 kg, you can feed them 6 litres of milk per day (2 litres three times a day) if you can afford it and want the calf to grow faster
 - Start feeding calf pellets at 2 weeks of age. Offer a small, fresh handful each day and increase as calf will take more, up to 1 kg per day.
 - Start feeding small amounts of good quality forage such as chopped short Napier grass, tender Calliandra or Sesbania shrub branches, or sweet potato vines. Protein and energy needs are very high in young preweaned calves.
 - The calf should be growing 0.5 to 1.0 kg/day.
 - You can store colostrum for a long period of time if you ferment it. See Chapter 5.3.

- **2-4 months:**
 - Calves eating 1 kg of calf pellets or dairy meal per day can be weaned from milk
 - When close to weaning time, start offering high quality chopped forages. When weaned, have forages available at all times.
 - Avoid feeding milk and large volumes of forages together
 - If you try to switch between milk to forages without using calf pellets or dairy meal, your calf could starve
 - Continue feeding good quality forage such as chopped short Napier grass, tender Calliandra or Sesbania shrub branches, or sweet potato vines. Protein and energy needs are still very high in post-weaned calves.
 - The calf should still be growing 0.5 to 1.0 kg/day.
 - Once weaned, add a red mineral block to your feed bunk for the calf

****Being weaned is very stressful for the calves and their risk of developing disease can increase****

- **Older than 4 months**
 - Feed concentrate (pellets, pencils, dairy meal) at 1 kg per day in divided feedings (1/2 kg each) in combination with forage
 - Protein and energy needs start to drop after 6 months of age. Feed calf pellets until 6 months, then switch to calf pencils until 1 year, and dairy meal after 1 year of age
 - Continue feeding good quality forage such as chopped short Napier grass, tender Calliandra or Sesbania shrub branches, or sweet potato vines.
 - Calf will start to slow down but should still be 0.5 to 0.7 kg/day.
 - Ensure red mineral block is available at all times. Switch to powdered mineral 2 months before breeding age.

- Feed only the amount of calf pellets the calf will eat within a day. If pellets get stale or wet the calf will not eat them.
- If you have a chaff cutter, use it to cut the calf's forage (pieces should be less than 5 centimetres long)
- Keep all dishes used to feed calves clean. Calves fed from dirty dishes will get calf scours from bacteria.
- Larvae (baby worms) like moisture, so make sure that the feed is kept dry
- If you have several calves, house them separately unless they are the same size or else the small ones will not get enough to eat.

3. Calves need Water at ALL times:

- Calves should be given all the water they want to drink. If it is available to them at all times, they will not drink water excessively, preventing bloody urine from water overload.
- Water buckets should be emptied, washed, and refilled with clean water daily
- When the calf is still drinking milk, it is important to have separate buckets for water and milk. Calves will eat more calf pellets or dairy meal if water is available all the time.

4. Prevent Disease:

If your calves are sick, their energy will be spent fighting the infection instead of growing properly. If your calf appears sick, you should call your veterinarian immediately. The sooner sickness is treated, the more likely it is to be cured. By vaccinating your calves, feeding them properly, and maintaining good hygiene, you can prevent many diseases and save money that would otherwise be spent on treatment.

- **Diarrhea (See Chapter 5.4)**
 - o Calf diarrhea is caused by many types of infections
 - o Infections are spread from calf-to-calf through manure
 - o Keep your calf clean, and provide proper housing and nutrition
- **Pneumonia (See Chapter 7.4)**
 - o Calves that cough, have difficulty breathing, and eat/drink less have pneumonia
 - o Calves can die from pneumonia. Consult a daktari immediately.
- **Dehydration**
 - o Calves need water at all times
 - o Dehydration can lead to death
- **Parasites (See Chapter 6.1)**
 - o **Worms**
 - Start deworming calves at 16 weeks
 - Continue deworming every 3 to 4 months with albendazole or levamisole, or every 4-6 months with ivermectin (commonly sold at feed supply stores)
 - Clean the feed troughs every day and remove the dirty, spoiled feed promptly to decrease parasite numbers
 - Zero grazing systems help reduce infection by parasites leading to the need for less frequent deworming (e.g. only twice per year)
 - o **Ticks, Fleas and Lice**
 - If you see ticks, fleas or lice on your calves, call your veterinarian for treatment. If left untreated, calves can become very sick very quickly.

****If your calf appears weak or is eating less than normal, call your veterinarian immediately****

5. Provide a Good Home for your Calf:

The calf should be born in a clean, dry area to reduce the possibility that it will get sick. Calves should be housed individually, and away from cows.

- **Individual calf pens should:**
 - o have dimensions at least twice as long as the calf in all directions.

- The calf should be moved into a cow shed when it is similar in size to an adult cow. If you have to put the calf in the cow shed, keep it separate from adult cows.
 - Have raised, slatted floors to promote good hygiene and reduce the chances of disease
 - Have hard floors (cement or wood) to reduce the chances of infection by worms from grass. Lots of bedding is important to ensure comfort of the calf. Any soft, dry material is appropriate for bedding and should be changed daily.
 - Have solid sides to minimize calf-to-calf or calf-to-cow contact, and have adequate ventilation
 - Have a solid roof to protect against sun and rain
 - Have separate water and milk buckets, as well as a separate forage feeding area
- If individual pens are not possible on your farm, communal calf pens can be used
 - No more than 4 calves of similar ages per pen
- Do not tie your calves outside. If they are tied:
 - Calves will have a higher exposure to parasites and tick-borne diseases
 - You cannot properly feed them or provide adequate amounts of water
 - Ropes can also cause injury to the calves

6. Management:

Proper management of your calf is vital to help prevent illness and injury.

- **Navel Care**
 - The navel of the calf should be dipped in disinfectant **immediately after birth**
 - Use a 1% iodine solution, not teat dip. Ask your local chemist.
 - Navel should be dipped daily until it is dry (approximately 1 week)
- **Castration**
 - Bull calves that will not be used for breeding should be castrated by 2 months old, and kept for meat
 - Consult a veterinarian when it is time to castrate your calf. Ask for pain medication.
- **Vaccination**
 - The government provides a yearly vaccine for only 100 KSH. It protects against rabies, foot and mouth disease, lumpy skin, anthrax, and blackwater. Contact your veterinarian for the nearest vaccination location.
 - At times of disease outbreak, the appropriate vaccine can be administered on your farm by a veterinarian
- **Extra Teat Removal**
 - Extra teats should be removed when the calf is 2-6 months old when dehorning
- **Dehorning**
 - Disbud at less than 2 weeks of age with a caustic paste if available.
 - If calves were not disbudded with paste in the first 2 weeks of life, they can have their horns burned at 1 to 4 months old. Use medication to reduce pain.
 - Complete removal (cutting) of larger horns after 4 months old is a more painful and expensive procedure with possible infection. Better to dehorn calves early in life.

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CHAPTER 5.2



MINERAL AND VITAMIN FEEDING FOR YOUNGSTOCK

Prepared by Drs. Shauna Richards and John VanLeeuwen and Mr. Ken Mellish

Part 1: Introduction

See introductory mineral and vitamin feeding information in Chapter 2.8

Part 2: Recommendations

Feeding Minerals to Calves <6 months old

If calves are given free-choice calf pellets or dairy meal, they do not need additional mineral. If calf pellets or dairy meal are not fed, 1-2 level tablespoons of **general mineral** should be provided per day or make sure there is a brown mineral block available for licking.

Feeding Minerals to Young Heifers (6-16 months)

Giving 1-2 kg/day of calf pencils (heifers) or dairy meal and short Napier grass will likely meet mineral needs when no breeding is needed. Provide 2-3 level tablespoons (30-45 grams) of **general mineral** if feeding pollard or maize germ (1-2 kg/day) instead of dairy meal or calf pencils. Provide **trace mineral and salt blocks**.

Feeding Minerals to Breeding Heifers

If breeding is needed, mineral needs increase. Dairy meal (1-2 kg/day) and short Napier grass will not meet mineral needs. Provide 3 level tablespoons (45 grams) of **general mineral**, and **double if feeding pollard or maize germ** (1-2 kg/day) instead of dairy meal. Provide access to **trace mineral and salt blocks**.

Part 3: General Tips and Specific Minerals

See general mineral and vitamin feeding tip information in Chapter 2.8

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CHAPTER 5.3



FERMENTED COLOSTRUM FOR CALVES

Prepared by Drs. Jeff Wichtel and John VanLeeuwen

Feeding fermented colostrum is a healthy meal for your calves. Fermented colostrum is colostrum with special bacteria (germs) added to allow it to ferment without becoming harmful to consume. Fermenting colostrum produces acid and this acid slows the growth of harmful bacteria.

Advantages of fermenting colostrums:

- 1) You can store the colostrum for a long period of time, giving options for use
- 2) You can make full use of the colostrum, like feeding it to your calf for up to 4 weeks
- 3) Your calf will be stronger and grow faster from this protein rich milk product
- 4) You don't feel bad that you cannot ship the first days of milk to the Dairy

Method For Making Fermented Colostrum

- Clean pail thoroughly with soap and water. If possible, line pail with a clean garbage bag.
- Use the extra colostrum from the cow's first milkings. Don't use colostrum from cows with mastitis or cows getting injections of medicine.
- Pour colostrum into the pail. Add a cup of lala or yoghurt and close the lid.
- Store the pail in the shade to prevent it from getting hot.
- Stir the colostrum each time you add the next milking of colostrum, or take some for calf.
- You can keep fermented colostrums for 2 to 4 weeks, depending on the storage temperature. After that, its nutrients start disappearing and mold starts to grow.

Feeding Fermented Colostrum

The first day's feedings should be the mother's fresh colostrum. Then, fermented colostrum can be fed. Three parts fermented colostrum can be fed to calves if mixed with two parts water so that it becomes watery and easier to drink by the calf. Feed the calf 10 per cent of its body weight in feed each day. For example:

Daily Amount of Fermented Colostrum and Water to feed:

Weight of calf in kg (lbs)	Colostrum	Water	Total Daily Amount
40 - 45 (88 - 99 lbs)	2.5	1.7	4.2
35 - 40 (77 - 88 lbs)	2.2	1.5	3.7
30 - 35 (66 - 77 lbs)	1.9	1.3	3.2
25 - 30 (55 - 66 lbs)	1.6	1.1	2.7

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CHAPTER 5.4

CALF DIARRHEA

Prepared by Dr. John VanLeeuwen, Ken Mellish and Dr. Ayub Kaniaru

CALF DIARRHEA (ALSO KNOWN AS CALF SCOURS)

Calf diarrhea is caused by many different infections that are spread when manure gets into the mouth of young calves. All of these infections can be prevented with good care of the calf. The two main parts of this good care are good nutrition to make sure the calf is strong so it can fight the infection better, and good sanitation to minimize ingestion of infection so the calf does not have to fight against as much infection.



GOOD NUTRITION

- Make sure the calf gets a minimum of 4 litres of good quality colostrum within the first 6 to 12 hours of life. Vigorous sucking starting within 2-3 hours of birth will likely achieve this, but if there is any doubt, supplementation should be given, either through a nipple bottle or stomach tube (see daktari or veterinarian – see photo). Frequent attempts (every 2-3 hours) during the first day should be made to help the calf to drink milk from a clean bucket.
- The colostrum (first milk after calving) contains antibodies. Antibodies are a natural medicine, which protects the calf from many diseases including scours. The first milk has high amounts of these antibodies, much higher than the second day.
- Close attention should be given to calves from first calvers because they usually produce less colostrum, with fewer antibodies, they do not mother their calves as well, and often they have more difficulty calving, so they are more likely to produce weak calves that are slow to rise and nurse. Colostrum from a neighbour's high-producing cow (frozen or fresh if calved on the same day) could be provided if a cow's colostrum is inadequate in volume or quality (poor quality colostrum comes from leaking milk prior to calving, mastitis, poor feeding, etc.).
- Good nutrition in the cows and heifers, particularly during the last month prior to calving, will make more good quality colostrum and healthier calves that are better equipped to fight the diarrhea-causing infections. Provide access to clean water and trace mineralized salt all the time. A 1:1 (forage-based diet) or 2:1 (grain-based diet) calcium to phosphorous ratio mineral mixture should be provided with additional Vitamin A, E and Se.



- Calves less than 1 month old have weak immune systems, so do not feed milk from teats with mastitis, or milk from cows receiving antibiotics (since the antibiotics can lead to diarrhea)

GOOD SANITATION AND HOUSING

- The calf pen type and location should be in a place where the calf can be as clean and dry as possible. Locate calf pens in a place with good drainage and shelter so that rain cannot get in and urine will drain away from where each calf lies down (a raised calf pen with wood floor is ideal). If located on a dirt floor (next best) or cement (worst), there should be a slope away from the area where the calf lies down. There should also be a dirt or cement “berm” to divert down-flowing rain water around the pen. A roof is important to give the calf a dry place to lie down. For the first 1-2 months, individual pens are better than group pens to prevent disease transmission between calves during this susceptible period.
- Sanitation of the calf pen is very important, regardless of the housing type and location. Supply abundant fresh bedding daily. Clean out all manure and bedding periodically (every few weeks). Clean and disinfect the calf pen (using lime or antiseptic) between calves to prevent spread of the infection to the next calf in that pen.
- Clean your hands before handling calves and their feed and water (assume all manure is bad). Clean the milk feeding bucket (or pan) with soap and water after every feeding and set the clean bucket upside-down in the sun to kill bacteria.
- Separate any sick calf from other calves to reduce spread of the infection. If possible, the person treating and handling sick calves should not have any contact with other healthy calves. Alternatively, wash hands before moving from sick to healthy calves, and use separate buckets or bottles for sick and healthy cattle. Clean and disinfect feeding equipment in between calves.

TREATING CALF DIARRHEA

- When calves have watery diarrhea for more than a day, they lose water and electrolyte salts from their body faster than they can replace them with normal milk consumption. They need electrolyte salts mixed with water to replace those lost in the diarrhea. The veterinarian will have these electrolyte salts. Continue to feed 2 litres of milk twice a day, but in addition, at other times of the day, feed 2 to 6 litres of fluids per day (depending on how watery the diarrhea is and how sunken the eyes look). Without replacing these fluids, the calf will become weaker. Use clean water to make up the electrolyte salt solutions. These solutions are a very successful way to keep the calf strong while they are fighting the infection. Continue giving them until the diarrhea is gone.
- Giving antibiotics can also improve the calf’s ability to fight against the infections that cause diarrhea, but only if the calf has a fever or blood in the diarrhea. Tetracycline or a sulfa drug are good alternatives. Consult your veterinarian before giving antibiotics and always first give electrolyte salt solutions as a treatment.
- If the diarrhea is watery and the calf is very weak (cannot stand on its own), you need your veterinarian to give it electrolyte salt solutions and antibiotics in the blood immediately to make it stronger faster and save its life.

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SECTION 6:



PARASITE CONTROL

CHAPTER 6.1

INTERNAL PARASITE (WORMS) AND EXTERNAL PARASITE CONTROL IN CATTLE

Prepared by Dr. John VanLeeuwen, Ken Mellish and Dr. Ayub Kaniaru

TYPES OF WORMS

All animals (and humans) can become infected with worms. Cattle can be infected with several types of worms.

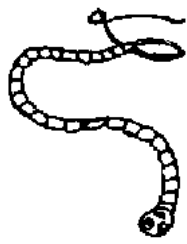
Roundworms are small, often white in colour, and look like threads. Different roundworms are found in all parts of the gut and the lungs.

Tapeworms are long, and flat and look like white ribbons. They consist of many segments and live in the intestine.

Flukes are flat and leaf-like. They live in the liver. Schistosomes are small and worm-like. Both flukes and schistosomes infect animals kept on wet, marshy ground (or fed feeds from wet marshy grounds – eg. Rice bran is common in dairy meal) as their eggs develop in water.



Round worms



Tape worm



Fluke



Schistosomes

HOW DO ANIMALS BECOME INFECTED WITH WORMS?

Roundworms, flukes and schistosomes lay eggs (not visible without a microscope) which pass out of the animal in the manure. Tapeworms produce eggs in the segments which break off and pass out in the manure (and you can see these sometimes). The eggs hatch and the baby worms (called larvae – also not visible without a microscope) crawl out of the manure and onto the leaves of nearby plants, and the larvae on the grass survive for weeks to months, depending on the temperature and moisture. The larvae will usually die by the end of the dry season. Animals become infected when they eat fresh green grass (or other plants) with worm eggs or larvae.

THE EFFECT OF WORMS ON THE ANIMAL

Worms feed on the blood or on the food in the gut of the animal. Young cattle become weak and lose weight or do not gain weight, especially if nutrition is not good. Young animals are especially affected by worms because they have no immunity and are not as strong. Young cattle can develop diarrhea if they have a large infection with worms, and can become weak and die. They will often have a rough hair coat as well. Mature cows will lose weight, give less milk and can take longer to get pregnant.

CONTROL OF WORMS

1. In general, young cattle should be dewormed every 3-6 months with albendazole or levamisole because they have limited immunity against worms. Pregnant heifers and pregnant cows could be dewormed with levamisole or ivermectin to prevent abortion that can occur with albendazole. You should avoid deworming during the last 2 months of pregnancy to prevent the calf growing too large, leading to calving difficulties.
2. Cows should be dewormed at calving with albendazole or eprinex, and again 3 to 6 months after calving to give more milk and to increase chances of conception at breeding. Deworming every 3 to 6 months after these two times could lead to increased milk, better body condition, or both. If your cow is not grazing grass, and the grass they are being fed is cut one day and fed the next day, the larvae usually crawl off the grass that is lying down, so deworming can be delayed to every 6 months. Similarly, if a cow is not grazing grass and is being fed maize or grass silage, deworming can be delayed to every 6 months.
3. With the new dewormers (cydectin or eprinex) that you pour onto the animal's back, deworming is required less frequently because it has residual activity for a month, and has a nearly complete kill of susceptible worms. You can even consume or sell a cow's milk with these new dewormers. Ask your daktari for advice on which dewormer you should use on which animals, when and how often. You can buy Eprinex in Nanyuki, Kenya.
4. Reducing reinfection through feed management. If zero-grazing, use a waiting period between manure application to grass and feeding fresh grass from that area to cattle, especially for young animals with less immunity. Making silage or dry hay will usually kill the worm eggs and larvae during the storage period, so no waiting period is necessary for stored feed.
5. The length of the waiting period depends on what is possible on the farm. A dry season should kill the eggs and larvae on the grass. Therefore, if possible, apply manure to grass fields at the start of the dry season. By the end of the dry season, grass from these areas should have few surviving eggs and larvae. Manure passed during the three weeks after deworming treatment should have no eggs and therefore would be an exception to this rule.
6. Removing the manure from the pen daily will prevent the animals from picking up more worms directly from the manure in their pens.

Remember for Worm Control in Cattle:

Use good manure management practices

Wait one dry season after manure application before giving feed to cattle

Use dewormers recommended by your veterinarian or daktari

Weigh your animal using a heart girth measuring tape (see Chapter 6.2)

Give the proper amount of dewormer according the animals' weight

There are many different types of dewormers. **Read the bottle** to know what it is and how to use it.

- Some dewormers have more than one medicine (Table 1).
- Some dewormers are not safe for pregnant animals (e.g. albendazole)
- Some dewormers have very long milk withdrawal (e.g. ivermectin)
- Some dewormers are more concentrated than others (Table 2).
- You get what you pay for.

Table 1: Characteristics of popular dewormers in Kenya

Brand name	Medicine#1 (category)	Medicine#2	Milk withdrawal	Meat withdrawal	Safe if animal pregnant
Force 1 plus	1.5% levamisole	3% oxclozanide	1.5 days	12 days	Yes
Metrizan	1.5% levamisole	3% oxclozanide	1 days	14 days	Yes
Nilzan plus	1.5% levamisole	3% oxclozanide	1 days	14 days	Yes
Levafas	3% levamisole	6% oxclozanide	1 days	14 days	Yes
Nilzan super	3% levamisole	6% oxclozanide	3 days	28 days	Yes
Duotech	5% closantel	2.5% oxfendazole	3 days	14 days	Yes
Twigazole	2.5% albendazole	Or 10%	3 days	14 days	No
Albafas	2.5% albendazole		3 days	14 days	No
Ivomec/Supermec	1% ivermectin		Cannot give	28 days	Yes
Eprinex	0.5% eprinomectin		0 days	0 days	Yes

Table 2: Comparing popular dewormers with levamisole and oxclozanide

For dewormers where you are encouraged to give the entire bottle in the mouth:

Brand name	Container size	Dosage	Maximum wt of cow	Cost estimate
Force 1 plus	150 ml	50 ml/100 kg	300 kg	185 ksh
Metrizan	135 ml	50 ml/100 kg	270 kg	150 ksh
Nilzan plus	125 ml	50 ml/100 kg	250 kg	140 ksh
Levafas	125 ml	25 ml/100 kg	500 kg	300 ksh
Nilzan super	125 ml	25 ml/100 kg	500 kg	200 ksh

- Nilzan super is the best deal – get biggest cow treated for the money spent
- Should switch categories of dewormer in the table every 2 years to prevent resistance
- Best time to give dewormer is at calving because the cow's immune system is lower at that time, and dosing then will increase peak milk production
- Know the animal weight to give the right amount

EXTERNAL PARASITE CONTROL IN CATTLE

Cattle can be infected by several parasites of the skin (external parasites) which feed on the animal's skin and blood. These parasites look like insects. There are various types.

Mites are very small and cannot be seen without a microscope. They live and lay their eggs in the skin and make the cow itchy, leading to swellings and hair loss, and sometimes infection in udder skin folds.

Lice are big enough for you to see. People can be infected with head lice. Cattle, buffalo, sheep and goats can be infected with different lice which attack the body, legs or tail region. Lice live on the skin and lay their eggs on hairs.



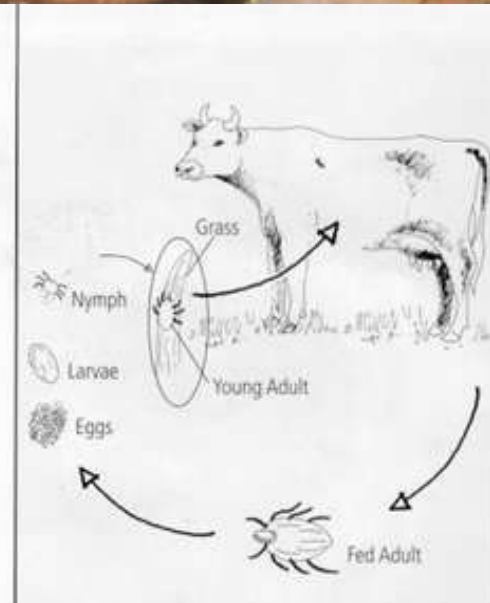
Ticks are bigger than lice and can be as big as a fingernail. Young ticks have 6 legs while adults have 8 legs. The life of a tick starts when a female tick lays eggs on the ground. The eggs hatch and go through the stages shown in the diagram below. The young ticks climb onto grass, where they wait for an animal to come near, upon which they attach themselves onto the cow/calf and start feeding on the blood of at least one animal. It is then that they transfer the diseases. Once they are full of blood, they drop off onto the pasture to lay eggs and start the cycle again.



PROBLEMS CAUSED BY EXTERNAL PARASITES

Mites cause mange. They infect the head, legs, body or tail region, causing the skin to become crusted and cause loss of hair (and wool in sheep). The infected area itches and the animal scratches it, spending less time eating. The infections cause loss of valuable wool in sheep and damage hides of cattle and goats.

Lice also cause irritation of the skin and the animal scratches, rubs and bites the infected areas. The animal loses, or does not gain weight, and looks in poor condition. Both lice and mites can pass from one animal to another. If lice are on the animal, you will find them or their eggs on the skin and hair, but if you do not see any lice or lice eggs, the animal probably has mange caused by mites.



Ticks are very important parasites. They bite the animal, suck its blood, and when full, they drop off onto the pasture where they can live for many months without feeding again. Animals can be poisoned or paralyzed by the bites of some ticks. Ticks also spread diseases, tick-borne diseases such as East Coast Fever, which can cause death of the animal. With the blood loss, ticks cause reduced growth and milk production, and damage to the skin.

PREVENTION/CONTROL OF MITES AND LICE

Mites and lice are controlled by applying an appropriate pour-on dewormer, or spraying or dipping the animal (see dipping or spraying below) with a suitable treatment. Some animals can be infected but show little or no signs of infection and the parasites will spread from them to other animals if they are not treated too.

PREVENTION/CONTROL OF TICKS (AND TICKBORNE DISEASES)

1. Rotational or Zero-grazing

Moving animals to different pastures and resting the contaminated pasture for a length of time can help to control the ticks. Cutting the bushes and ploughing the affected area can help to control ticks. Large numbers of ticks can be found around water holes and animal shelters. Use grass or hay free from ticks and avoid contact with other animals.

2. Hand picking (plucking)

If an animal has only a few ticks these can be carefully pulled off making sure the mouthparts of the tick are removed. Rubbing ticks with a cloth soaked in kerosene (paraffin) will make them drop off the animal. Keeping poultry near the cattle can help to reduce numbers of ticks, because the birds will eat the ticks.

3. Chemical control

Large numbers of ticks are treated using sprays and pour-ons. It will be necessary to treat all of the herd or flock. Certain commercial spray (e.g. Delete EC) and pour-on dewormers are used to kill ticks on the animal. Seek the advice of your veterinarian or vet tech.

Farmers have also experimented with home-made products and found the following effective: A) Grind 250 g of dried flowers with a little water into a paste. Dissolve this paste in 10 litres of water and leave it standing for 12 hour, then sieve and apply all over the animal. B) Grind 20 g of dried tobacco leaves with a litre of water. Leave it standing for 6 hours. Add 5 litres of water and apply all over the animal.

4. Proper fencing

Proper fencing of the farm to keep out wild animals and stray dogs should be enhanced as they might act as a source of ticks on the farm.

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CHAPTER 6.2



HOW TO ESTIMATE YOUR COW OR CALF'S WEIGHT

Prepared by: Dr. John VanLeeuwen and Stephen Chandhi

Why do you need to know the weight of your cow (or calf)?

It is important to accurately estimate your cow's weight when you are:

- Determining how much dewormer to buy and give
- Calculating how much medicine to give when she is sick
- If she does not get enough, the medicine or dewormer may not work and you will be wasting your money on it.
- Giving a cow too little medicine and dewormer will also contribute to resistance to the medication or dewormer.

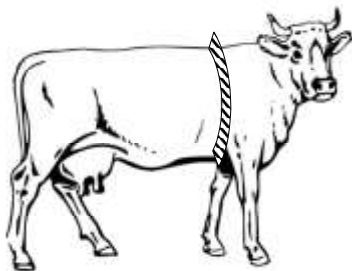


What you need: a measuring tape **or** rope



How to measure:

1. Place the measuring tape or rope around the cow just behind the shoulders, and pull it snug but not tight, like a comfortable belt you wear (see picture):



2. Read the measurement on the tape where the ends meet (in **CENTIMETERS - cm**) and compare it to the table on this page. If you have a rope, make a knot in the rope and then compare its length to a measuring tape and then use the table on this page.

Girth (cm)	Weight (kgs)
65	35
70	40
75	45
80	50
85	59
90	69
95	79
100	89
105	104
110	119
115	135
120	150
125	170
130	190
135	210
140	230
145	251
150	276
155	303
160	330
165	362
170	395
175	432
180	469
185	507
190	545
195	583
200	623
205	663
210	703

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CHAPTER 6.3

Cattle Infections Spread by Ticks

Prepared by Dr. John VanLeeuwen, Dr. Anna Portnoy and Dr. Ayub Kaniaru

There are 3 major diseases transmitted by ticks that affect cattle. This chapter briefly describes each disease and what you can do to treat it and prevent it.

ANAPLASMA:

- **Effects:**
Animals are pale, not eating, and a decrease in their milk production is seen. They breathe fast, and are weak when they walk. They also have an increased temperature and pale gums. The main effect that is different from other diseases causing pale gums is that they may have hard feces and dark yellow urine.
- **Treatment:**
Early treatment is the important. When effects are seen you should call your veterinarian. Treatment includes an antibiotic, such as tetracycline, an anti-inflammatory, such as dexamethasone, and a blood-builder, such as hemo 15.
- **Prevention:**
This disease is spread mainly by ticks but can also be spread from infected cattle to uninfected cattle by blood-contaminated equipment, and occasionally by flies and mosquitoes. Tick control is also essential for prevention (see below under East Coast Fever). Equipment with blood contamination, such as dehorner, should be cleaned well before use on another animal. Flies can be controlled through manure management, muscovy ducks, and fly sprays, while mosquitoes can be controlled through standing water management (fish) and mosquitoes sprays.

BABESIA:

- **Effects:**
Animals with this infection have a high fever and their gums/eyes can look pale or yellow. They are weak, not eating and cows have less milk production. They have a high heart rate, and can have difficulty breathing. The main effect that is different from other diseases causing pale gums is that the urine is red.
- **Treatment:**
Early diagnosis is the key. Once effects are observed your veterinarian should be called. Treatment includes an antibiotic such as imidocarb (1-3 mg/kg).
- **Prevention:**
This disease is also transmitted by ticks. Tick control is essential (see above).



EAST COAST FEVER (ECF)

- **Effects:**

Animals are pale, not eating and cows have a decrease in milk production. They have a fever and can have diarrhea or trouble breathing. If left untreated, they will lose weight, be unable to get up, and will die. The main effect that is different from other diseases causing pale gums is that they have excess tearing, large lumps in front of their shoulders and knees (lymph nodes or “glands”), and red hemorrhage lines under their tongue.

- **Treatment:**

Successful treatment depends on early diagnosis. When effects are seen, your veterinarian should be called immediately. Treatment includes an antibiotic, such as buparvaquone, an anti-inflammatory, such as dexamethasone, an antihistamine, such as ephedrine, and a blood-builder, such as hemo 15. Do not burn the large lumps in front of their shoulders (photograph above) or knees because this does not cure the animal and only causes additional pain, skin infection, and slower recovery.

- **Prevention:**

This disease is spread by the brown ear tick. Tick control is essential for prevention. Spray or dip the whole animal with a tick-killing product, such as permethrin, every 7 days during the rainy season (10 days during the dry season). Also, cut grass 1 day before it is fed, store it horizontally so the ticks crawl off of the grass before it is fed.



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SECTION 7

OTHER DISEASES



CHAPTER 7.1

Red Urine in Dairy Cattle

Prepared by Dr. Fabienne Uehlinger and Dr. John VanLeeuwen

Red urine in dairy cattle can have many different causes. Some causes are severe and require treatment, while others can be controlled by making changes to your cow's or calf's management.

RED URINE IN A CALF AFTER DRINKING TOO MUCH WATER

Some farmers wrongly give calves only milk to drink when they are young. Other farmers may give milk but only give water once or twice per day. In both cases, the calf will get dehydrated during the time it does not have access to water, especially when it is hot and dry. When the calf is then allowed to drink water, it drinks so much that the water makes the blood too dilute and destroys some cells in the blood. This results in red urine in a normal healthy calf. No treatment is needed.



This problem can be easily prevented by providing the calf with water all the time. A calf will never drink too much water all at once if it has access to water anytime it wants some. In fact, calves will likely eat more calf pellets and short Napier grass or other nutritious feeds if they have water to wash it down with, and so they will grow faster and stronger, giving more milk when they are mature.

This problem can occasionally occur when older animals drink too much water all at once, and can be prevented by having water available all the time.



BABESIA

This is an infectious disease caused by ticks. The disease is better explained in the chapter with the title 'Cattle Infections Spread by Ticks' (see Chapter 6.3). A cow with babesia is sick with fever, pale gums and red urine, and a veterinary doctor should examine and treat her. Tick prevention and management will prevent this disease.

BRACKEN FERN

Long-term feeding (over months) of bracken fern can result in urinary bladder tumors that cause red urine in an otherwise healthy cow, and there is no treatment. You should slaughter this animal, and hope that the meat inspector will say she is OK to eat. If bracken fern is only fed once or twice, it will not result in tumors. Bracken fern is a weed that is not very nutritious, and can cause health problems, so it should not be fed to cattle.





RED URINE AFTER NATURAL BREEDING

When a cow is bred by a bull, red urine may occur a few days to a week after breeding due to an infection that has developed in the urinary bladder. The cow may become sick with a fever and decreased appetite. She may also strain to pass urine and only pass little bits of urine at a time. Artificial insemination will prevent this problem occurring. A veterinary doctor should be called for a diagnosis and to treat the cow.



LEPTOSPIRA

This disease is caused by a germ. All animals are susceptible to this infection and humans can also become sick. Calves are more severely affected than mature cows and can have red urine, fever, pale and yellow gums, and decreased appetite. Mature cows can have abortions, stillbirths or the birth of weak calves. They can also have a drop in milk production and may even have blood clots in the milk. A doctor can give medicine to cure this.

Cows and calves become infected with *Leptospira* when they drink water or eat feed contaminated with the germ. The germ is shed in the urine of infected animals, and pests such as rats and mice can also harbor the germ and spread it. People can also become infected with *Leptospira* when they drink infected milk (boiling kills the germ) or contact contaminated water or urine (the germ can infect through skin wounds – so wash hands with soap). Aborted fetuses and placenta should only be handled with gloves or a shovel/pitchfork and then burnt or buried. Dogs should never be allowed to eat the placenta or aborted fetus because they could get sick or spread a disease causing abortion. Rainwater is less likely to cause this disease than river water.

Any animal with red urine that is also sick with a fever and/or decreased appetite should be examined by a veterinary doctor or vet tech!

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CHAPTER 7.2



Toxic Plants to Ruminants in Kenya

Written by Drs. Natalie Dow, Terra MacDonald, Matt MacFarlane, John VanLeeuwen

In the dry season, forage is often scarce and weeds are frequently fed to cattle as an alternative feed source. Many weeds in Kenya can be toxic to livestock and, therefore, only familiar plants should be fed. In general, grassy weeds are acceptable feed, while others should be avoided. If feeding weeds cannot be avoided, changes to a new feed source should be done gradually. The following list reviews common toxic plants found in Kenya that should not be fed to cattle. If cattle develop any of the signs of toxicity from weeds mentioned in the next chapter sections, the weed feeding should be stopped and a “daktari” (or veterinary doctor) should be consulted.

Bracken Fern

This is a leafy green plant that is toxic to cows if eaten for a long period of time (several months). Prolonged ingestion can lead to development of tumours in the urinary bladder and therefore result in bloody red urine. Cows may become depressed and weak due to anemia (lack of blood). This plant may also cause tumours in the throat and lead to weight loss and regurgitation. No treatment can cure these tumours and therefore prevention is better – avoid feeding this fern.



Cestrum

Ingestion of cestrum causes severe signs if given to cows as feed for a long period of time. Cestrum contains a form of Vitamin D, which increases calcium to toxic levels within the body. Ingestion of this plant causes weakness, weight loss, slow growth rate, and abnormal heart beats, and should never be fed.

Castor Oil Plant

Castor oil plants cause toxicity within 6 hours of ingestion. Cows will go off feed and exhibit watery and bloody diarrhea, excessive salivation, and weakness. Cattle may experience signs if they are fed leaves from this plant or if maize or other crops are contaminated with castor oil seeds.



Acokanthera

Leaves from this small tree are tempting to feed, as they remain green even when dry. The ripe fruits are edible, however all other parts of the plant are poisonous. Toxicity signs include diarrhea and rapid shallow breathing. Death may occur suddenly.



Nitrate-Accumulating Plants (Sorghum, Nightshades, Jimson weed)



Nitrates are compounds that accumulate within plants at high levels when they are grown under stressful conditions, such as drought. Although nitrates themselves are not toxic to cattle, they are converted to nitrites in the rumen, which decreases the ability of blood cells to carry oxygen. The majority of the nitrates are found in the stem of the plant. Cows may experience weakness, depression, tremors, pale or brown mucous membranes, and collapse due to a lack of

oxygen in tissues.

Brassica Plants

Brassica plants include cabbage, kale, broccoli, turnips, and mustards. Ingestion of these plants causes indigestion, diarrhea, pale gums, reduced milk production, and poor growth rates. Feeding small amounts of these plants may not cause problems, but large amounts will cause cows to go off feed, and certain individual cows can be sensitive to small amounts.



Oleander



Oleander is a shrub with pink or white flowers and dark green leaves. All parts of the plant are poisonous. Cattle will become depressed, stop eating, and have smelly diarrhea after ingesting a very small amount of this plant. Later signs include dilation of the pupils, teeth grinding, bloody diarrhea, convulsions, and paralysis. Death may occur suddenly.

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CHAPTER 7.3



Skin Diseases of Dairy Cattle

Prepared by: Drs. John VanLeeuwen, Erin Ramsay, Erika Kubik & Murray Gillies

Skin diseases of cattle are a common problem. This handout will discuss some of the more common skin diseases in cattle, how to recognize them, whether they need treatment, and how to prevent them.

Infectious skin diseases (Germs):

Ringworm: This appears as grey hairless circles (that is why it is called “ring” worm) of varying size. It is typically found on the face and neck of the animal, but can be anywhere on the body. It is usually not itchy and has little effect on the animal, although it looks bad. It is an infectious skin disease that is caused by a fungus, not a worm. It can affect all animals, but especially young ones because they have no immunity against it. It is worse in animals with poor nutrition, another disease, or a damp environment. It is spread by contact with infected animals or equipment.



There is no good cost-effective treatment, and the animal usually develops immunity in 2-3 months, if fed well, and then the rings go away. Ringworm can affect humans too. Prevention: good nutrition and a roof protecting from the rain, isolation from affected animals.

Rain scald: This appears as lumps or lines of swollen skin that may have pus coming out of them. It often causes patches of hair to become crusted and matted together, resembling a paintbrush. The swollen skin is usually located along the back but can be found on the udder and limbs as well. Active infections may be painful and itchy but non-active infections cause no effect on the animal. This is an infectious skin disease that is caused by bacteria, not “hot rain”. It can affect all animals, but especially those with poor nutrition, poor hygiene and stress. It often infects animals which have inadequate shelter from the rain, allowing their skin to become moist and susceptible to bacterial infections.

Treatment with antibiotics from a veterinarian will enhance healing, although most antibiotics have a milk withdrawal. Prevention is through good nutrition and a roof providing protection from the rain.



Cowpox: Parts of the teat become red and swollen, and then, within 48 hours, there is a dark red scab that takes a long time to heal. This is caused by a very contagious virus affecting the teats of cattle, especially young naïve cattle.

Mastitis can occur if the scab is close to the teat end, and should be treated with antibiotics. Milking technique should be changed to reduce physical stress on the teat to allow it to heal faster – squeeze the teat rather than pulling on the teat. Preventing the spread of cowpox is by milking affected cows last. Cowpox can also affect humans, causing a disease known as milkers’ nodules.

Abscess: These are lumps with thick walls (usually), and pus and bacteria in the center. They can occur at any age and are common following injury or use of contaminated or dull needles, leading to infection under the skin. They can occur anywhere on the body, and grow in size until they burst and release some pus. They can recur if they do not drain properly.

Treatment is by ensuring proper drainage and flushing; this should be done by a veterinarian or an animal health technician. Antibiotics are usually not required. Prevent by avoiding the use of dull or contaminated needles, and making sure there are no nails or sharp points in the cow shed that can injure your cattle.



Lumpy Jaw: This appears as a large firm mass on the jaw or cheek that continues to grow in size. It can be painful and often interferes with the cow's ability to eat. It is a bacterial infection seen in cattle fed a very coarse, dry forage that can cause puncture wounds on the inside of the mouth. The bacteria live in the mouth normally and only cause problems when the puncture allows them to become seeded within the bone and muscle of the jaw.

Treatment may include antibiotics. This should be done by a veterinarian. Prevention includes feeding soft forages, like short Napier grass.



Skin parasites: Many parasites can cause skin problems in cattle of all ages. These include mange, lice, ticks, fleas, flies and worms. Mange is often dry, scaly and consistently very itchy, whereas fly bites are usually small lumps within the skin and are only temporarily itchy. These can be a nuisance to cattle, can transmit disease, and can result in decreased milk production.

Powders, sprays and dips can be used for treatment. Prevention is through zero-grazing, good manure management, and weekly spraying. Please refer to the handout on ectoparasite control for more information on these.

Foot and Mouth Disease: This virus causes skin blisters and ulcers in the mouth, and on the feet and teats. Cattle of all ages can be affected, as well as goats, sheep and pigs. Contact a veterinarian for confirmation and treatment, especially if the animal is not eating or develops mastitis due to an ulcer affecting the teat opening. Prevention is with effective government quarantining of animals/farms infected (and the people working on those animals/farms – can be spread by people), and vaccines.

Lumpy skin disease: This appears as a rapid onset of multiple lumps that can develop ulcers in the middle. Infected animals can have a fever. The nodules can be anywhere on the body, and more likely affect young naïve animals. The animals usually get better on their own after 3– 6 months. Prevention is with a vaccine and insect control.



Warts: This can look like a mild case of lumpy skin disease, except with fewer and smaller lumps, and without the fever. They frequently appear on the teats, and in this case look like raised pale nodules. They are caused by a virus and usually go away on their own in 1-6 months when immunity is developed. If a wart is interfering with milking or is in a bad location (like the eye), a veterinarian or an animal health technician can remove the wart. Prevent spread of warts by milking affected cows last.



Non-Infectious skin diseases (Other causes):

Sunburn: This appears as reddening of the skin, and even scaling, crusting and scabbing. It is usually found on light-coloured skin along the back of the animal and on the udder and teats. This can affect any animal that has excess exposure to the sun, not enough shade, or is not using the shade/stalls provided. Also, some weed toxins can make animals more sensitive to the sun. Treatment includes providing shade when the sun is hottest (10 am to 3 pm), and antibiotics may be needed.



Irregular skin lumps which are seen primarily in the Buuri sub-district region where there is substantial precipitation and sunshine, but also inadequate shelter from sunlight. These appear on white skin only, and can remain for years without growing or reducing in size. Fortunately, they are not painful or harmful. Therefore, no treatment is recommended. Shelter from rain and sun should prevent them from starting and getting worse.



Cancer: Any growing mass or lump affecting the skin of a cow, especially ones which feel hard, could potentially be cancer and should be examined by a veterinarian. Cancer of the eye can be prevented by providing adequate shade for your animals.

Hair loss or fading: Deficiency or imbalance of various minerals can lead to hair loss or fading. These include zinc, copper and selenium. Treatment and prevention is through provision of the recommended amounts of mineral through feeds and licks. Read the labels. See Chapter 2.8 on feeding minerals.

Prevention of skin conditions:

- Provide adequate shelter from the sun and rain – a comfortable stall to lay in.
- If they are not using the stall, change it so they will (size, comfort, hygiene, etc.).
- Provide good nutrition and proper mineral supplementation, especially selenium.
- Avoid feeding overly mature, coarse forage.
- Avoid feeding or letting your cows graze toxic plants.
- Provide proper worm, fly and tick control. Read the label and/or consult your veterinarian about proper products to use for de-wormers, fly and tick sprays. Make sure you use the right product at the right amount for the size of your animal (animals can be weighed with a weight tape or a rope and chart).
- Milk cows with lumps on their teats last and clean them with a separate towel.
- Protect yourself as many of these conditions also affect humans! Contact a doctor if you think you may have been exposed to a disease from your cattle.

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CHAPTER 7.4



LUNG DISEASES (PNEUMONIA)

Prepared by Drs. Ashley Butt, Stephanie Hatayama, Jaimee Gillis and John VanLeeuwen

HOW TO RECOGNIZE RESPIRATORY DISEASE (PNEUMONIA)

- Increased breathing rate – A cow taking over 30 breaths per minute and a calf taking over 40 breaths per minute may indicate a problem in the lungs
- Increased breathing effort – A cow may be struggling (groaning) to breathe
- Fever, reduced appetite and reduced milk production
- Unusual liquid or gel coming from the nose or mouth **THROUGHOUT THE DAY** – may be clear, cloudy, yellow, or red in colour
- Coughing, rattling or wheezing noises while breathing **THROUGHOUT THE DAY**

If your cows show one or more of these signs, it may indicate they have pneumonia. It is important to call a veterinary doctor or vet tech for treatment as soon as possible because pneumonia can result in permanent lung damage with decreased feeding intake, decreased milk production and distressed cows – especially when it is hot.

Different causes of coughing may or may not be pneumonia, as explained below

1. PNEUMONIA SPREAD BY CATTLE CONTACT (OR PEOPLE HANDLING CATTLE)

Viruses are one of the major causes of pneumonia and they are spread from cow-to-cow and by people handling infected cows and then healthy cows. Often the viruses cause enough damage to the lungs that bacteria then also infect the lungs, making the cow even more sick, with reduced appetite and milk, and increased breathing effort & fever.

To prevent your cow from getting pneumonia from viruses and bacteria:

- Eliminate contact between your cattle and other people's cows and calves
- Wash (soap and water) hands and footwear if you help a neighbour with their cattle, and make sure they wash up before they handle your cattle
- If you buy a calf/cow, keep it separated from your other cattle for at least 3 weeks
- Do not borrow or lend cattle
- Ask your daktari about available pneumonia vaccines

2. PNEUMONIA CAUSED BY POOR AIR QUALITY

Strong well-managed cattle can have the viruses and bacteria in their nose but not get sick. Ammonia in manure is irritating and damages the trachea lining going from the nose to the lungs, so the germs can move from the nose to the lungs, causing pneumonia.

- Ensure good air movement (but no draft) through the stalls where cattle lie down
- Remove manure and urine from stalls and pens every day

3. PNEUMONIA FROM A POOR IMMUNE SYSTEM

Because calves have an immature immune system, they have a higher risk of pneumonia by either of the first two types of pneumonia. Good calf management is essential to enhance a calf's immune system to fight pneumonia (and diarrhea), including:

- 1) Good colostrum intake: All calves must have 4 kg of colostrum within 6 hours of birth to give their immune system a good start. The best farmers milk the colostrum from the cow to make sure the calf gets the 4 kg within 6 hours.
- 2) Reduce stress: provide good nutrition, water at all times, and shelter from rain & draft
- 3) Good Nutrition: Feeding calves inadequately will reduce calf growth and their immune system response (see Chapter 5.1 to 5.4 for details). Also see Chapters 2.1-2.10.
- 4) Freedom from a cold draft: immunity is reduced by the stress associated with a cold draft – trees or partial walls should protect cattle from cold drafts
- 5) Vaccinate calves and/or ensure good colostrum intake from vaccinated cows

4. LUNG PROBLEMS SPREAD BY INSECTS

In Kenya, insects can spread other types of infections, including:

- EAST COAST FEVER
- RIFT VALLEY FEVER
- ANAPLASMA
- BABESIA

It can be difficult to tell these diseases apart (see Chapter 6.3). Tick-borne diseases affect the blood's ability to carry oxygen, resulting in an increased respiratory rate and effort. Call the daktari if you notice increased breathing effort and decreased feed intake.

5. PNEUMONIA SPREAD THROUGH CONTAMINATED PASTURES (LUNGWORM)

A lungworm infection starts with a persistent cough (throughout the day) but normal breathing, appetite and milk production. It may progress to fever, poor appetite and difficult breathing if the lungs subsequently become also infected with bacteria.

Lungworm infections are most common in younger cattle who are grazing on pasture, and who are not frequently dewormed. They get the parasites by grazing on infected pasture. New infections are most common during the rainy season.

Treatment and prevention of lungworm are very easy: deworming and pasture management. In general, cows grazing on pasture should be dewormed every 3-4 months while zero-grazing cows should only be dewormed every 6 months, unless they are showing signs of lungworm in between scheduled dewormings. It is important to use the correct amount of dewormer for the weight of your cow (see Chapter 6.2). Zero-grazing your cattle reduces exposure to the worm. Call your daktari for antibiotic treatment if your cow has trouble breathing and reduced appetite. Severely affected cows could die without treatment.

6. LUNG AND AIRWAY IRRITANTS or ALLERGENS

If cattle have a bit of coughing with normal appetites and no other problems, medicine is likely not needed because the coughing is likely due to the following irritants or allergens.

Dust: One major cause of coughing in cows in Kenya is dust. It is common for cows to cough in the morning or evening from sleeping in a dusty cow stall. Try to keep dust to a minimum in the cow's sleeping area - it is helpful to use bedding such as straw or wood shavings to cover the dirt, and/or sprinkle water on the dirt in the head area of the stall.

Allergens and strong chemicals (eg. chlorine) have the potential to irritate the airway of cows, people and other animals. Always have adequate ventilation on-farm (but no drafts) and keep animals away from dangerous chemicals.

7. UPPER AIRWAY PROBLEMS THAT CAN LOOK LIKE PNEUMONIA

Problems in the head or neck can affect breathing or coughing but are not pneumonia.

Traumatic injury: Cows can injure themselves or others. A kick by another cow in the neck, or injuring themselves on a nail or hard piece of metal or wood can cause neck damage and abscesses, affecting the cow's airway and breathing (such as the trachea).

Eating weeds with thorns, metal, or garbage: Many cows that are grazing can eat something potentially damaging. These items can cause scratches and cuts inside the mouth or neck area, which can lead to infections and abscesses that can affect breathing.

Tooth damage: Dental problems, especially involving the tooth root, can become infected and form similar abscesses that can affect breathing.

Contact a daktari to examine and treat your cow if you suspect any of these head or neck problems, especially if your cow is not eating well.

****A BIT OF COUGHING JUST IN THE MORNING
AND/OR EVENING WITH NORMAL APPETITE IS
LIKELY JUST DUST**

****IF THE COUGHING IS THROUGHOUT THE DAY AND
APPETITE IS REDUCED, CALL A DAKTARI FOR
TREATMENT TO PREVENT PERMANENT DAMAGE TO
THE LUNGS**

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SECTION 8: KEEPING YOUR FAMILY HEALTHY



CHAPTER 8.1

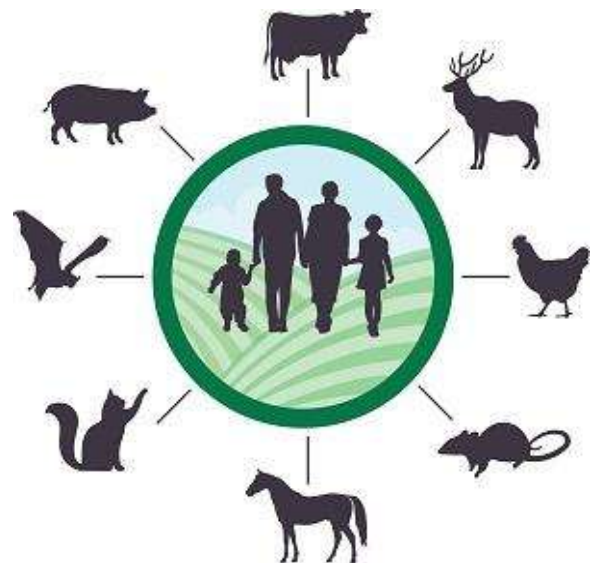
Diseases you can get from animals

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What is a zoonotic disease?

Some diseases are caused by germs that can be spread between animals and people; these are called zoonotic diseases. An animal that has a zoonotic disease can spread it to people through milk, urine, manure, blood, fluids from the nose or mouth, meat, and skin contact. An animal with a zoonotic disease does not always look sick.

In some cases, people die from zoonotic disease.



How can you get sick from a zoonotic disease?

Touching fluids from an animal's nose or mouth, manure, urine, milk, and aborted fetuses, are common ways to get a zoonotic disease from an animal. In some cases zoonotic diseases can be passed from animals to people through the air. Animal bites and scratches, especially from dogs, are another way that an infected animal can pass a disease to a person. Drinking raw milk or eating contaminated meat/food can also make a person sick.

Zoonotic disease prevention

To avoid getting sick from animals, always wash hands with soap and water after touching or working with animals, and always wash hands before eating.

- Wet hands with clean running water
- Apply soap and rub hands together
- Scrub hands for at least 20 seconds
- Rinse hands well under clean running water
- Dry hands

Have protective clothing like boots and aprons, or have a set of clothes to wear only when working with animals, and do not wear them to do other activities or when leaving the farm. If animals are

sick it is important to call a veterinarian to treat them, they can also tell you if the disease the animal has can spread to people. When handling sick animals, consider wearing gloves or a mask, especially when handling aborted fetuses. Sick animals should be separated from other animals and people on the farm to reduce spread of a disease.

Manure of animals should regularly be removed to a site away from where animals and people are housed. Manure should also be stored away from water sources. Composting manure will reduce the number of disease-causing germs in it.

Do not eat meat from an animal that was sick before it died or was slaughtered unless a vet says it is safe. Wear protective clothing when slaughtering animals. Only drink milk that has been boiled or pasteurized. Only eat meat that has been well cooked, and wash hands after handling raw meat. Always make sure all kitchen tools are washed well after cutting raw meat.

Be careful around animals you are not familiar with – they may carry zoonotic diseases that can spread to humans and other animals.

Type 1: Reportable Diseases

Some diseases are reportable - government vets must be alerted when an animal is suspected to have a reportable disease for international trade or human safety reasons. Farmers are responsible to contact their own vet or the government vet directly when a reportable disease is suspected in an animal. It is good practice for the farmer to have their own vet attend all sick animals in order to treat the animal, determine the disease, and report it on the farmer's behalf. Reporting of reportable disease slows or stops the spread of disease, and reduces illness in animals and humans.

RABIES - Reportable disease

How it spreads: Virus is spread through the saliva (spit) of an infected animal. Most commonly spread through a bite from an infected dog or wild animal or bat.

Animals infected: All mammals

Signs in animals: Increased **aggression**, change in behaviour, **excessive drooling**, weakness and failure to breathe leading to death.

Signs in people: Weakness, discomfort, fever, headache, agitation and hallucinations.

Treatment: There is NO treatment once animals or people display signs. Death is the most common outcome. People can be given treatment before they show signs of illness that will prevent sickness and death.

Prevention: Vaccination of animals. Avoid interactions with stray dogs.

See a doctor as soon as possible after being bitten by an animal as it could have rabies. If possible, tie up the animal which caused the bite.



ANTHRAX- Reportable disease

How it spreads: Breathe in or eat anthrax spores from the soil, water or plants. People and animals can also get anthrax by consuming meat or milk from an infected animal.

Animals affected: All mammals and some birds.

Signs in animals: Blood from the nose, mouth, anus and vulva. Fever and difficulty breathing. Animals will often be found dead with blood leaking from the body. The blood does not clot.

Signs in people: Blisters on the skin, and bloody coughing, vomiting and diarrhea.

Treatment: Treatment more successful in early stages in animals as death occurs quickly. Successful treatment in people depends on where the infection is. Death is a possibility.

Prevention: Vaccinate livestock, avoid direct contact with dead animals with anthrax and burn or bury (2 meters deep) anthrax-infected carcasses. Bury the top 20 cm of soil contaminated with blood. People should not eat or drink milk or meat from sick or dead animals. People should practice proper hand-washing, and wear protective clothing (gloves) when handling sick or dead animals. You should not be cut open a body that could have anthrax because this will release large amounts of germs which may infect you and contaminate the soil.



RIFT VALLEY FEVER (RVF) - Reportable disease

How it spreads: The virus is mostly spread through mosquitoes, but also contact with infected animals. It is more likely to occur in areas and years with flooding. Humans become infected through touching fluids or eating meat/milk from infected animals, or from biting mosquitoes.

Animals affected: Cattle, sheep, goats, rodents

Signs in animals: **Abortion**, fever, runny nose, low appetite, weakness, **vomiting**, and **diarrhea**. Death in young animals that are often more severely affected.

Signs in people: Usually mild illness, fever, and weakness (like the flu). Sometimes leads to more severe infection of the brain and eyes, and abnormal bleeding. People can die.

Treatment: No treatment and can be deadly. Most animals and people recover on their own.

Prevention: Vaccination of livestock, insect control, and avoid touching infected animals. People should always boil milk and cook meat well.

BOVINE TUBERCULOSIS (TB) – Reportable disease

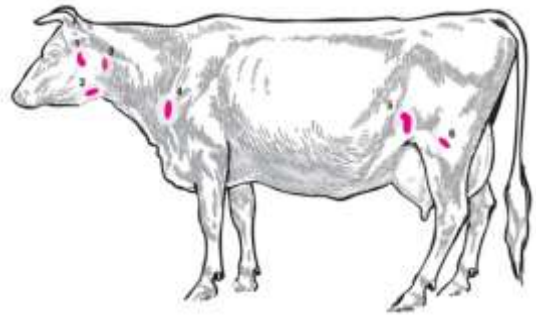
How it spreads: Breathing in the spit drops (with bacteria) of infected animals, eating contaminated meat, drinking raw milk, getting blood with bacteria in open wounds when slaughtering animals.

Animals infected: Cattle.

Signs in animals: Early in the infection there are no signs of illness. As time goes on the animal gets very **thin**, fever, weakness, not eating, **persistent cough (perhaps with blood), enlarged glands (lymph nodes)**. Will eventually result in death.

Signs in people: Fever, sweating at night, weight loss, bloody cough, diarrhea.

Treatment: Infected animals should be slaughtered and buried since treatment is expensive and doesn't cure animals. Treatment for people is with antibiotics.



Prevention: Drink boiled or pasteurized milk, an inspector should inspect animals when slaughtered to ensure no tuberculosis. Slaughter and bury infected animals. No vaccine.

Easy to feel enlarged lymph nodes

in cows with bovine tuberculosis

TRYPANOSOMIASIS (Sleeping Sickness / Ngana) – Reportable disease

How it spreads: Bite from parasite-infected tsetse flies, occasionally spread by other biting flies. Donkeys can spread this parasite to one another through natural breeding.

Animals affected: Cows, sheep, goats, humans, donkeys, dogs, and wild game like antelope are most likely to be infected.



Signs in animals: Anemia, weakness, low fertility, enlarged lymph nodes, chronic weight loss, recurrent fever. Open sore on skin at site if tsetse fly bite.

Signs in people: Headaches, fever, weakness, enlarged lymph nodes, pain in the joints, sleep disorders, seizures, and coma. Open sore on skin at site if tsetse fly bite.

Treatment: Treatment is more successful in the early stages of the disease. Medication can be used to treat sleeping sickness in people and animals, although death is a possible outcome. Appropriate use of medication is important - seek advice from a vet daktari if you believe your animal has Ngana.

Prevention: No vaccine is available for people or animals, therefore insect control and treatment of animals in endemic areas is the only way to prevent the illness. Talk with your vet daktari about prevention, treatment and insecticide application to your cows.

Type 2: Non-Reportable Diseases

The following diseases are non-reportable - government vets do not have to be alerted when an animal is suspected to have these zoonotic disease. It is still good practice for the farmer to have their own vet attend all sick animals in order to determine the disease and treat the animal

BRUCELLOSIS

How it spreads: People get the bacteria in raw milk or undercooked meat, or a skin wound coming in contact with abortion fluids/fetus from infected animals (wild or tame). Infection of cows occurs through the semen of an infected bull during natural mating. The bull does not show signs of disease.



Animals Infected: All mammals

Signs in animals: Can cause **abortions, poor fertility**, low weight gain, **poor milk production**, and **swollen joints**. Some animals appear healthy.

Signs in people: Weakness, fever, muscle and joint pain (looks like malaria or flu). It can cause abortions in women and testicle pain in men. Some people die from this infection.

Treatment: Treatment is expensive and does not cure animals. Infected animals should be slaughtered and buried. Medicine for people is available, but is not always successful.

Prevention: Use artificial insemination to breed cows, **boil or pasteurize milk before drinking**, and practice proper hand-washing. A vaccine is available for animals but is not widely used. **Wear protective clothing (gloves) when handling abortions from animals, and wash afterwards.**

DERMATOPHYTOSIS (RINGWORM)

How it spreads: The fungus (not worm) enters the skin through a scratch or small wound. The fungus lives on the surface of the wound and on wet posts or boards.

Animals affected: Young people, cows, sheep, goats, pigs, cats, dogs, or rodents without immunity.

Signs in animals: Round, grey, hairless circles that often begin on the head and neck. They are not painful or itchy.

Signs in people: Round, red circles on skin that may be itchy.

Treatment: Usually not necessary in healthy cattle – ringworm goes away within a few weeks to months. Animals with many rings on its body can be supported with improved feeding and special creams or soaps (ask veterinarian) to make recovery faster.



Prevention: Avoid contact with infected animals. Good nutrition will keep immunity strong, so animals are less likely to get infected. Provide shelter from rain so animals' skin stays dry and strong. Do not share towels or equipment between cows. People should wear gloves around affected animals and wash hands well after touching.

INTERNAL PARASITES AND DIARRHEA

Diarrhea infections are caused by parasites, viruses or bacteria that frequently affect humans and animals.

How it spreads: Eating/ drinking food or water contaminated with manure. Contact with manure, and not washing hands. Eating infected or contaminated meat.

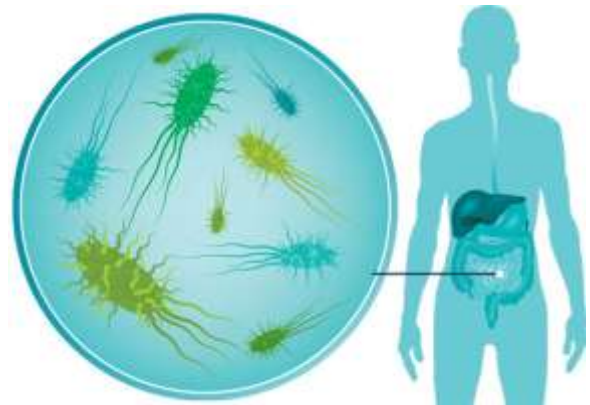
Animals Infected: All animals.

Signs in animals: Adult animals usually appear normal, but may have lower milk production, less likely to get pregnant, and may be in poor condition. Young animals may show signs of **diarrhea**, slow growth, weakness, and in some instances, death can occur.

Signs in people: Upset stomach, vomiting, diarrhea, fever, weakness, headaches, aching joints and muscles. Some parasites cause cysts in the brain, spinal cord, or other organs.

Treatment: Depends on type of infection. Common dewormers for animals do not work for all parasites.

Prevention: Always ensure meat is well cooked. An inspector should be present during slaughter to detect unsafe meat. Avoid contact with manure from all animals. Always wash hands after touching or working around animals, gardening, and before eating. Wash or peel raw fruit, and cook vegetables. Drink clean water (boiled/filtered). **Keep animals in clean pens (regular removal of manure).**



PSEUDOCOW POX (POX)

How it spreads: Virus spreads from infected to uninfected cows by a farmer's hands, equipment, or suckling calves. Insects can also spread it between teats or animals. The virus enters the skin through a scratch or other break in the skin surface. People get cowpox by milking affected teats.

Animals affected: Cattle.

Signs in animals: Blisters on the teats in cows, blisters on calves' mouth if suckling infected teats. Mastitis possible.

Signs in people: Blisters, most often on hands. Young people (and animals) without immunity are most likely to be affected. They are painful but not itchy.

Treatment: Usually not necessary. Blisters will heal without treatment after about two weeks. Blisters may be infected by other germs and may cause mastitis. Treatment of other germs or mastitis may be needed.



Prevention: Cows with blisters should be milked last if milking more than one cow. Teat dip should be used in all cattle every time after milking. Hands must be washed before milking and after every cow to prevent infection in cows and people.

REMEMBER – you can prevent zoonotic diseases!

1. Wear protective clothing and wash hands after handling or working around animals.
2. Vaccinate animals to prevent disease.
3. Keep areas where animals live clean and prevent them from coming into contact with sick animals or animals that you are unfamiliar with.
4. Talk to your veterinarian to keep animals healthy, learn if your animal could have a zoonotic disease, and treat sick animals.
5. Report to your vet or government vet when you suspect a zoonotic disease!

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CHAPTER 8.2



FAMILY NUTRITION

Compiled by: Farmers Helping Farmers, Wakulima Dairy Ltd, University of Prince Edward, Egerton University and nutritionists (Colleen Walton, Samwel Mbugua, and Hilda Macharia) and funds from the Canadian Home Economics Foundation.

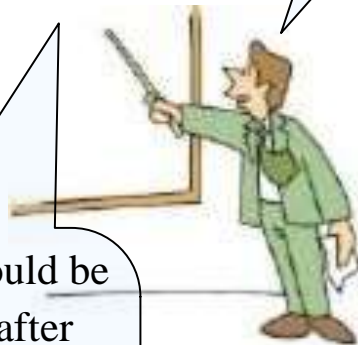
The truth is

Eating well prevents diseases, develops strong bones and helps students get good grades.

Fact #1 Eating fruits and vegetables throughout each day helps the body fight diseases.

Fact #2 Soaking githeri before cooking and not taking food together with tea enables the body to use food's nutrients better

Fact #3 Porridge should be fed to children only after six months of only giving breastfeeding, and should be a mixture of mostly maize flour with some sorghum, and millet

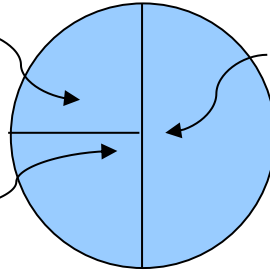


Fact #4 Eating food from animal origin like liver, meat, eggs and milk enhances children's learning abilities and provide vital nutrients and energy

FOOD SERVINGS FOR ALL PEOPLE

Energy giving foods – ugali, rice, potatoes. (1/4 of plate)

Body building foods – beans, green grams, meat. (1/4 of plate)



Protective foods – kales, amaranthus, carrots, tomatoes. (1/2 plate)



Drink Naironi or water (not tea) with your meal!

People's food needs depend on their age and how physically hard they are working. Make sure that you eat a mixture of preventive foods, body building, and energy foods every day.

Milk servings per day

Years	Serving per day (1 cup = 2/3 of a '15' cup)
Children less than 9 years	2 or 3 cups
Children between ages 9- 12	3 cups
Children between ages 13 - 19	4 cups
Adults – 19 years and above	2 cups

DIFFERENT COOKING METHODS TO HELP YOUR FAMILY

Githeri

Soak the maize & beans in water overnight. After soaking, the githeri cooks faster, is more nutritious and reduces stomach problems.

Fried kale

Fry onion and tomatoes in cooking oil; for each person use a small spoon of oil. Add amaranthus (see photo below), kales, spinach, or any other green vegetable. Cook until ready. Cook for a short time to conserve the vitamins.

Ugali cooked with milk (this will make up part of the milk servings needed for the day)

Prepare with equal amounts of water and milk

Put milk and water in a sufuria and boil.

Add flour as you mix until stiff enough.

Cook ugali until ready.



Amaranthus

Milk porridge

Prepare with equal amounts of water and milk and sugar (if desired)

Boil milk and water together in a sufuria.

Mix the flour and little water then put in a sufuria.

Continue mixing until a thick consistency develops.

When cooked, add sugar.

Porridge can be taken with sweet potatoes, arrow roots and yams.

SECRETS TO GREAT HEALTH

Vitamin A

Green leafy vegetables (kales, amaranthus, pumpkin leaves, nettle leaves – see photo on right) and yellow fruits (pawpaw, mangoes, pumpkins and carrots) are good sources of Vitamin A. Cabbage is less good. Vitamin A protects the body from diseases and aids in keeping good eye sight.



Factors interfering with nutrients entering your body.

Tea, coffee and unsoaked beans contain substances that interfere with food digestion and utilization of vitamins and minerals.

Soaking beans for 12 hours before cooking helps remove these substances. This improves your body's ability to use essential minerals like iron, zinc, and calcium in the food.

It's recommended to take tea two hours before or after meal but not with a meal to avoid combining the anti-nutrients and your meal. This way the food will have been digested and the nutrients absorbed before you take your tea.

Diets for infants and children six months and above.

An infant should be fed exclusively on breast milk for 6 months, with no other food or even water. Breast milk is not enough after six months; therefore supplementary food is acceptable as the child continues to breast feed. These foods include porridge with milk and sieved fruits. The porridge flour should be made from a mixture of 2 kilograms of maize and 2 kilograms mixture of sorghum, millet and other grains. Preparing the porridge with milk will further help the baby grow well and develop good learning capabilities. Feeding sieved fruit (eg. ripe pawpaw) provides important vitamins and minerals.

Food from animal sources

Liver, meat, eggs and milk help build the body as they contain minerals (for example iron, zinc), and other essential vitamins and nutrients that improve understanding and prevent the child from getting diseases.

Fruits

Fruits like mangoes, pawpaw, passion fruits, guavas and lunguads contain Vitamin C. When eaten with a meal, they will help the body to better use minerals (iron and zinc) in the food. Fruits have many other vitamins and important nutrients and therefore eating them every day is important.

Calcium and bone development

Milk without tea leaves provides essential calcium to help people, especially women and children grow and remain strong and healthy. Children ages 18 and below need calcium for height and bone development. Two servings of milk is essential. Women should take two servings of milk, without tea leaves, per day to help in breastfeeding and maintaining strong bones.

Breakfast

Everyone should eat breakfast before going to school or to the garden or other work. Eating ugali, arrow roots, sweet potatoes, chapatti or any other foods including fruits and vegetables, and with milk, is good morning eating. This will improve concentration in school and quality of work.

Sugar

Limit sugar in tea to one small spoon. Too much sugar contributes to diseases such as increased blood pressure and diabetes.

Oil

Use liquid oil rather than solid fat in cooking to keep your heart and blood healthy.

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CHAPTER 8.3



DRINK MILK FOR BETTER NUTRITION

Prepared by Samwel Mbugua, Regina Wanjiru Gachuru and Dr. Colleen Walton

DAILY MILK REQUIREMENTS

AGE	RECOMMENDED INTAKE PER DAY
Children Under 9 years	2 – 3 cups
Children 9 – 12 years	3 cups
13 – 19 years	4 cups
Adults (19 – 50 years)	2 or more cups



IMPORTANCE OF MILK

Milk contains important nutrients, that keep your child strong and healthy, and helps him or her do well in school.

FACTS

- School children require proper amounts of milk to help them grow into tall, healthy adults with strong bones and teeth.
- Boiled milk, Mala (sour milk) and Yoghurt are ways to consume milk.
- Milk can also be used to prepare ugali, porridge, chapattis, and tea and improve family health.

SCHOOL CHILDREN'S DIET

- Children who eat a nutritious breakfast do better in school than children who miss breakfast.
- Even when hunger is temporary, as when a child misses one meal, behaviour and learning are affected.
- The average child up to age of 10 years needs to eat 4 to 6 times per day to maintain high energy, to learn best, and participate in activities.
- Children should also drink a lot of clean water (boiled). Boiling water kills germs that may cause diseases.

A Good Diet should Contain **Energy**, **Protective** and **Growing** Foods, including milk, each day for best health, growth and learning.

ENERGY FOODS

Cooking oil, ugali, nuts, margarine, rice, sweet potato (ngwachi), potato.

PROTECTIVE FOODS

Vegetables: Pumpkins, pumpkins leaves, cabbages, fresh maize, carrots, onions, green beans, peas, spinach, sukuma-wiki, terere.

Fruits: Mangoes, oranges, lemons, pawpaw, pineapple, passion, avocado, etc..

GROWING FOODS

Milk, beans, eggs, soya beans, yoghurt, lala, peas, meat, fish, millet, sorghum, nuts

SOME COMMON RECIPES USING MILK

UGALI COOKED IN MILK

Ingredients

1 cup milk; 2 cups water; maize flour

Method

Mix the milk and water in a sufuria (sauce pan) and bring to boil.

Add the maize flour in small portions as you stir the mixture until a thick soft solid consistency is attained.

Continue turning to avoid sticking on the sufuria until cooked.

Serve hot or cold with cooked vegetables and meat stew or legumes.

CHAPATI COOKED WITH MILK

Ingredients

Wheat flour 1kg; milk 2 cups; salt/sugar (as desired); water

Method

Combine all the dry ingredients and add the milk. Then add small volumes of water until the dough is hard enough to form balls that are not sticky.

Cut the dough and roll them on a flat surface floured using a rolling pin.

Pre-heat a frying pan and fry the chapattis on both sides until cooked.

Serve when hot or cold with vegetables, meat stew or legumes or with a glass of milk.

PORRIDGE ENRICHED WITH MILK

Ingredients

Porridge flour (preferably home fermented); milk; sugar

Method

Boil 4 cups of water in a sufuria.

Mix the porridge flour with 1 cup cold water in a small bowl.

Pour the mixture into boiling water as you stir, continuously until the boil restarts to avoid forming clods

Add 1 cup of milk and continue boiling for at least 10 minutes then remove from the fire.

Add desired amount of sugar and serve hot or cold with a slice of Yams (nduma), sweet potatoes (Ngwashee) etc..

HOME- MADE YOGHURT

Ingredients

5 litres milk; ½ litre yoghurt; sugar to taste

Method

Pour the milk into a sufuria, add the sugar to desired taste and bring to boil.

Allow the milk to cool to where you can pour a spoonful of the milk on the back of your hand without getting burned, 42^oC if a thermometer is available.

Stir the ½ litre packet of yoghurt into the warm milk and keep warm overnight.

Stir the mixture after the overnight stay and serve with or after a meal.

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Developed by Samwel Mbugua¹, Regina Wanjiru Gachuru² and Colleen Walton³, for the Wakulima Self Help Group Dairy, 2005

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