Goat health

6.1 Introduction

Maintaining goats in a state of good health is obviously of great importance to the owner. Sick goats are less able to supply products and may eventually die; the economic impact on the owner’s family could be considerable. Some epidemic diseases can kill an entire flock, leaving the family destitute. For all these reasons, owners must take steps to keep their goats healthy. Keeping goats healthy does not involve the use of expensive drugs and highly trained veterinary staff. In most situations, the majority of the important diseases can be controlled through simple preventative (prophylactic) measures such as good feeding, clean, well-ventilated housing, vaccination, drenching, spraying/dipping, and foot trimming. In some countries these measures have been estimated to control 80 to 90 per cent of the diseases of economic importance. Efforts should be focused on controlling these diseases, rather than worrying about the less common diseases which may only occasionally affect a small proportion of goats. The emphasis of this chapter is on preventing and controlling the diseases of economic importance to the farmer or pastoralist.

This chapter is written for people who do not have veterinary training. In most countries in the tropics there is a chronic shortage of all levels of veterinary staff, from highly qualified veterinarians to animal-health assistants and vaccinators. These staff are often poorly equipped with transport and drugs. As a result, few farmers have easy access to veterinary services. Because of these conditions, everyone involved with goats — farmers, all extension staff, as well as the veterinary staff — must take responsibility for keeping goats healthy and helping them to recover if they do get sick. Do not be afraid of tackling problems of goat health because you are not a veterinarian. The purpose of this chapter is to help you

- to help farmers to prevent disease;
- to investigate health problems;
- to carry out simple treatments of sick goats.
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6.1.1 The goat, its environment, and defence mechanisms

Goat diseases may be caused by a variety of living organisms which exist in the environment. These agents of disease are classified as bacteria, viruses, mycoplasma, chlamydia rickettsia, fungi, protozoa, and parasites (external, internal, and blood).

These disease agents may enter the goat directly, for example through the consumption of grass contaminated with infective parasite larvae. Disease agents can also be transmitted by a vector such as a tick or biting fly; for example, the heartwater rickettsia (Cowdria ruminantia) is transmitted by the tick Amblyomma spp.

In addition, goats may become unhealthy through nutritional problems such as a deficiency of vitamins or minerals, or poisoning from plants or chemicals, or through physical damage.

The goat lives and reproduces in an environment that may contain several of these disease agents and their vectors, either permanently or seasonally or occasionally. The presence or absence of disease agents in a particular place will be determined by several factors:

- climate (temperature, humidity, etc.);
- vegetation (grassy, bushy, swamp);
- the presence of other livestock and wildlife;
- husbandry methods.

In order to prevent these agents from causing disease, the goat has a number of defence mechanisms which either protect it from attack or help it to reduce the effects of attack when it does occur. There are five main defence mechanisms.

- **The skin** is the first defence against invasion by agents of disease. Infective organisms may invade only if the skin is broken or penetrated by a biting vector such as a tick or fly.

- **The acidity of the abomasum** can destroy some invading micro-organisms that may have entered the goat with the food it ingested.

- **Mucous lining of the respiratory tract** can trap some invading organisms in the air breathed by the goat.

- **Macrophage cells in blood** consume invading micro-organisms.

- **Immunity** may be acquired through antibodies in the blood which inactivate invading bacteria and viruses. If a goat is infected with relatively low levels of an organism, large numbers of antibodies are produced to fight off the infection during the process of recovery. If the goat is infected again, even with high levels of the same organism, it already has
antibodies available to inactivate it. By this process the goat develops naturally acquired immunity. Immunity can also be acquired artificially. This is done by purposely challenging the goat, either by injecting it with low levels of the infective organisms, as with vaccines (artificial active immunity); or by injecting the goat with antibodies from another immune goat, as with anti-serum or anti-toxin (artificial passive immunity). Antibodies can also be acquired passively by the kid through drinking colostrum — the milk produced immediately after birth, which is rich in antibodies and provides the kid with natural passive immunity.

It is of course impossible to keep goats in a disease-free environment. The goat’s environment is never constant; conditions which favour or disfavour the presence of disease organisms are always changing. Likewise the goat’s own condition is also changing; its defence mechanisms are sometimes put under great pressure, while at other times they are able to defend the goat effectively.

It is the job of the goat’s owner to minimise the disease challenge faced by the goat, and to ensure that the goat has healthy defence mechanisms at all times. There will be times when the defences of even the healthiest goat are broken down by a massive attack, such as the outbreak of an epidemic disease; but, under normal conditions, the goat should be given the best chance possible of fighting attack. Factors predisposing the goat to succumb to disease have to be present for disease to appear. There are four main predisposing factors.

- **Poor nutrition**: a well-fed goat has a much better chance of fighting off disease through its active defence mechanisms.

- **Stress**: any stress placed on the goat will reduce its ability to fight disease and make it more susceptible. Stress includes a wide range of factors such as kidding, fatigue from walking or being transported long distances, poor housing, excessive cold (particularly when combined with damp), excessive heat, high humidity, and dehydration.

- **Lack of tolerance**: goats in some areas may be tolerant of certain diseases through their close association with the causative agent over generations. Goat breeds have different levels of tolerance to different disease organisms. Temperate breeds may lack the tolerance which some tropical breeds show to some tropical diseases. Goats have evolved as browsers and show poor tolerance to intestinal parasites which are acquired from grazing infected pastures close to the ground. Tolerance shown by breeds should not be confused with immunity, which can be developed by individuals.

- **Lack of immunity**: it is very important that the goat’s immunity levels are maintained. Where appropriate, immunity must be
acquired through vaccination and, for the kid, through suckling colostrum immediately after birth. The lack of immunity to infection makes the goat vulnerable to attack. Kids are particularly susceptible to disease, because they have no antibodies of their own, only those acquired from their mothers. Consumption of colostrum provides them with some immunity for their first few weeks of life. Thereafter they must make their own antibodies, a process which can be assisted with vaccination.

A disease may appear dramatically as a set of rapidly developing symptoms. This is known as the acute form of the disease. Diseases are often slow and long-lasting, indicating a chronic infection. Chronic infections may develop into an acute form of the disease, but not always. Chronic infections of goats with intestinal parasites are common and may remain in the chronic form, never appearing as an acute disease unless the goat is very weak.

**6.2 Assessing health and disease in goats: the clinical examination**

Chapter 2 explained that the problems most commonly found in various goat-keeping systems are not due to one simple cause, but to a combination of several management and disease factors. This is nowhere more true than in matters of health, where several factors contribute to ill health. Bad management is usually the main cause of disease.

Chapter 3 described methods of carrying out disease surveys and investigations in order to describe

- the incidence patterns of disease syndromes;
- the syndrome type and age/sex of goats affected;
- the effect of disease: morbidity, mortality;
- current husbandry and preventative treatment practices.

In goats, several disease problems are commonly encountered in the field. Once the problems in a particular system have been identified, it is important to identify the specific diseases and environmental factors that are influencing the disease. During the course of a disease survey, or while carrying out extension work, it is important for extension staff to be able to obtain an accurate description of a health problem. This is called ‘taking a case history’. It might be a description of an existing problem or a past problem. Learning how to take an accurate history will help in identifying the disease and will enable extension workers to discuss health problems with professional veterinary staff later.

Case histories can be taken in the field at the time of an illness or after an illness. In order to be able to identify abnormalities,
the normal behaviour and physical condition of a goat must be known. Make a point of observing the behaviour of normal goats, so that you are quickly able to identify any abnormalities.

It is important to be able to describe disease incidence in a systematic way that allows you to consult either a veterinary professional or textbook.

6.2.1 Observations to make of a sick goat

**General**
- Is the goat by itself, or with the rest of the flock?
- Is it alert, or dull and unresponsive?
- Is it breathing normally?
- Is it coughing?
- Is it shivering?
- Is it eating and drinking normally?
- Is the rumen bloated?
- Is it ruminating normally?
- Is it standing up or lying down?
- Is it lying normally?

**Head**
- Is the head held normally, or drooping or bent round?
- Are the eyes bright, clear, and shiny; or are they red, opaque, or weeping?
- Are the ears alert or drooping?
- Is there a discharge from the eyes or nose?
- Is there frothing at the mouth or an excess of saliva?
- Are mucous membranes around the eye pale, yellow, blue, or dark red?

**Skin**
- Is the coat shiny or dull?
- Are there bite or lick marks on the coat?
- Is the skin loose or tight, soft or hard?
- Are there patches of hair missing?
- Is there a swelling (oedema) under the jaw?
- Are the lymph nodes swollen?

**Legs and movement**
- Are the legs stiff?
- Is the goat lame?

**Faeces and urine**
- Are the faeces normal or abnormal (is there diarrhoea, mucous, or blood)?
- Is the urine pale yellow, brown, or red?
- Does the goat strain to pass urine or faeces?
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Recognising pain
• Is the goat bleating?
• Is the goat restless?
• Does it grind its teeth?
• Is it grunting?
• Is it licking a lot?
• Is it kicking itself and, if so, where?

Lactating goats
• Are either or both teats inflamed, swollen, and tender?
• Are the teats injured?
• Does the milk contain milk clots?
• Is the milk blood-stained?
• Has the milk yield fallen?

6.2.2 Physical examination

Five major physical measures can be taken.

Respiration rate: count the number of chest movements made per minute when the animal is at rest (Figure 6.1a). Normal values for goats are 10–20 per minute. Young and old goats have slightly higher respiration rates than normal.

Pulse: place a hand over the heart area, just under the left elbow, and count the heart beats; alternatively there is an artery that can be felt on the inside surface of the thigh (Figure 6.1b). Measurements must be taken when the goat is at rest. Normal values for goats are 60–80 per minute.

Temperature: the thermometer should be inserted through the anus into the rectum in a slightly upwards direction, and held there for at least one minute (Figure 6.1c). The normal temperature range for goats is 38.0–40.5°C.

Mucous membranes: observe the lining inside the eyelids and mouth. If it is pale, the goat is anaemic, probably from gastrointestinal parasites or blood parasites. If it is yellow, there is a liver problem.

Rumen contractions: important for assessing general health and gastrointestinal function. Place the palm of your hand firmly in the depression behind the last rib on the left and leave it for two minutes. Normal contractions can be felt at a rate of 1–2/minute.

6.2.3 History of disease

In addition to observations and a physical examination of the sick goat(s), a full history of the disease in the flock should be obtained from the owner. Key factors are listed on page 160.
Assessing health and disease in goats: the clinical examination

Figure 6.1 (a) Measuring the respiration rate
CHRISTIE PEACOCK

Figure 6.1 (b) Taking the pulse
CHRISTIE PEACOCK

Figure 6.1 (c) Taking the temperature
INTERNATIONAL LIVESTOCK RESEARCH INSTITUTE
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- Age/sex of goat(s) affected.
- The first symptoms (loss of appetite, unusual behaviour, diarrhoea, difficulty breathing, colour and consistency of any discharges).
- Proportion of flock affected.
- Development of the disease after the first signs (depression, lying down, straining, diarrhoea, changes in colour and consistency of any discharges).
- Further action taken by farmer.
- Outcome of disease (death, complete recovery, partial recovery).
- Similar symptoms in other goats in flock/area.
- History of vaccination.
- Description of feeding practices.

In addition to making observations during a physical examination, it may be appropriate to take samples (faeces, urine, skin scraping, and blood) for laboratory examination. In addition, making a post-mortem examination soon after the death of a goat can be of great value. A simple post-mortem procedure is described in 6.6.2.

6.2.4 Taking samples

In order to investigate a disease problem and make an accurate diagnosis, it is sometimes useful to take samples from living or dead goats in order to identify the cause of a disease, the health of a goat, or the cause of death. The chronic shortage of veterinary staff in the tropics means that it is important for all extension staff to be able to take relevant samples from both living and dead goats for later analysis by a veterinarian or laboratory. Samples may be taken as part of a disease survey or monitoring study, or might be taken as the need and opportunity present themselves.

In order for laboratories to carry out diagnostic tests on the sample, it should either be very fresh or be preserved in some way. If the sample cannot be properly presented to the laboratory, it is probably not worth trying to collect it.

Always remember when collecting samples to record the following information:

- owner’s name
- ID of goat
- age
- sex
- date
- place
- preservant (formalin, alcohol)
- reason for sample collection

Ideally all this information will be written on the sample container itself; but, if there is not enough room, a number may be written on the sample and the information recorded separately.
The correct procedures for taking samples may be found in the following sections of this chapter:

- faeces 6.4.1
- skin scraping 6.4.2
- blood 6.4.1
- ticks 6.4.3

### 6.3 Common disease problems

Tables 6.1-6.10 show the main disease problems of goats, together with the likely causes of the problem. They have been adapted from a useful publication entitled *Goat Health Handbook* (Thedford, 1983). These tables should be used to diagnose the disease after making a physical examination or taking a case history. Often, if extension staff make irregular visits to a flock, they will miss seeing the sick goat, because it has either died or recovered. In this case, close questioning of the farmer and members of the family can give a reasonable picture.

If a specific diagnosis of the disease cannot be made, indicating a specific treatment, the symptoms shown by the goat should be alleviated where possible. In addition, action should be taken to prevent the spread of the problem to other goats in the flock or to goats in neighbouring flocks. Suggestions are made for the management of the disease problems described.

#### 6.3.1 Kid death (with or without diarrhoea)

The death of kids before they are weaned is perhaps the single biggest cause of loss experienced by goat farmers. It is a tremendous waste for a kid to be born only to die in the first few weeks of life. It is all too common when visiting goat flocks to see a weak kid, often with diarrhoea, standing listlessly apart from other goats. Kids very quickly become too weak to suckle, and at this point they will quickly die. The causes are usually complex. Predisposing factors may include lack of colostrum at birth; poor nutrition of the dam, leading to low milk production; dirty housing and pen areas, which allows a build-up of infective agents; dirty water; and failure to vaccinate the dam appropriately. These factors lead to a weak kid which is open to infection from bacteria or parasites. Kids should be kept apart from the rest of the flock with their mothers. The mother should receive good feed and clean water. Dirty bedding should be removed and disposed of safely. (See Table 6.1.)

Kids may also disappear from a flock through predation by wild animals, including birds, or simple theft.
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Table 6.1 Likely causes of kid death

<table>
<thead>
<tr>
<th>Disease</th>
<th>Causative agent</th>
<th>Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coccidiosis</td>
<td>P</td>
<td>Diarrhoea, sometimes bloody. Sudden death may occur without diarrhoea. Normally in housed goats.</td>
</tr>
<tr>
<td>Colostrum deprivation</td>
<td>M</td>
<td>Dry mouth. Fever. Severe weakness. Most die.</td>
</tr>
<tr>
<td>Enterotoxaemia</td>
<td>B</td>
<td>Sudden depression. Drunken appearance. Lies on side when close to death, paddling legs. May have watery diarrhoea.</td>
</tr>
<tr>
<td>Internal parasites</td>
<td>P</td>
<td>Sudden death. May have swelling under chin, anaemia, and weakness. PM reveals parasites in intestines, esp. Haemonchus contortus in abomasum.</td>
</tr>
<tr>
<td>Suffocation</td>
<td></td>
<td>No physical signs of disease. Can occur if many kids and adults are kept together, esp. in cold climates.</td>
</tr>
<tr>
<td>Malnutrition</td>
<td>M</td>
<td>Weakness, no stomach fill. Check dam for milk and kid for access to dam.</td>
</tr>
</tbody>
</table>

Key:  P = parasitic    B = bacterial    V = viral    M = metabolic

6.3.2 Diarrhoea and loss of condition (adults)

Adult goats may suffer from chronic diarrhoea and weight loss or, in some cases, acute diarrhoea. Predisposing factors include poor or unbalanced nutrition; dirty house or pen; lack of anthelmintic use; and lack of appropriate vaccination. Goats with acute diarrhoea should have constant access to clean water and feed, and may be treated with oral or injectable antibiotics. (See Table 6.2.)

6.3.3 Respiratory problems and fever

Respiratory diseases are common in goats, particularly in large flocks of housed goats with inadequate ventilation. Occasional epidemic diseases such as contagious caprine pleuropneumonia (CCPP) may occur in specific areas where the disease is endemic.
Table 6.2 Likely causes of diarrhoea and loss of condition (adults)

<table>
<thead>
<tr>
<th>Disease</th>
<th>Causative agent</th>
<th>Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bloat</td>
<td>M</td>
<td>Full stomach with gas or froth. Distension on left side behind ribs. Laboured breathing.</td>
</tr>
<tr>
<td>Coccidiosis</td>
<td>P</td>
<td>Acute diarrhoea, often with blood. Severe straining.</td>
</tr>
<tr>
<td>Enterotoxaemia</td>
<td>B</td>
<td>Full stomach. Fever. Sudden death is common.</td>
</tr>
<tr>
<td>Internal parasites</td>
<td>P</td>
<td>May have swelling under jaw, anaemia. Weakness, weight loss. May die before signs of diarrhoea.</td>
</tr>
<tr>
<td>Peste des petits ruminants (PPR)</td>
<td>V</td>
<td>Fever. Raw, red areas around mouth.</td>
</tr>
</tbody>
</table>

Predisposing factors include poor ventilation; large numbers of goats in close proximity; lack of appropriate vaccination; introduction of new goats into flock; or mixing at a watering place. Respiratory problems are often highly infectious, so affected goats should immediately be separated from the rest of the flock and placed in a warm, dry, well-ventilated place. (See Table 6.3.)

6.3.4 Skin diseases and swellings

Skin diseases (Table 6.4) may not seem important, but they can, if untreated, kill goats, cause major economic loss (mange), or develop into a recurrent, chronic problem (caseous lymphadenitis). Predisposing factors include lack of appropriate vaccination (goat pox); close contact with goats from other flocks; or introduction of infected goats into the flock. Poor condition worsens the infection.
### Goat health

**Table 6.3 Likely causes of respiratory problems and fever**

<table>
<thead>
<tr>
<th>Disease</th>
<th>Causative agent</th>
<th>Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anthrax</td>
<td>B</td>
<td>Bloody nasal discharge and bleeding from body openings. Death within 24–48 hours.</td>
</tr>
<tr>
<td>Contagious caprine pleuropneumonia (CCPP)</td>
<td>V</td>
<td>Nasal discharge. Raspingsound from lungs. Fever. Death in most cases, sometimes 24 hours after first signs.</td>
</tr>
<tr>
<td>Lungworm</td>
<td>P</td>
<td>Breathing difficulties, coughing leading to pneumonia.</td>
</tr>
<tr>
<td>Nairobi sheep disease</td>
<td>V</td>
<td>Nasal discharge with blood-stained, foul-smelling diarrhoea, and fever.</td>
</tr>
<tr>
<td>Peste des petits ruminants (PPR)</td>
<td>V</td>
<td>High fever. Raw patches in and around mouth. Clear nasal discharge at first, then thick, blocking breathing. Diarrhoea after 2–3 days. Commonly develops pneumonia. Death after one week.</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>B, V, P</td>
<td>Rapid, laboured movement of ribs with raspingsound. Grunting, groaning, and grinding of teeth from pain.</td>
</tr>
<tr>
<td>Goat pox</td>
<td>V</td>
<td>High fever, nasal and eye discharge. Pimples appear after 24 hours, forming itchy scabs after one week. Death may occur.</td>
</tr>
</tbody>
</table>

#### 6.3.5 Poor condition, anaemia, pale mucous membranes

It can be hard to pinpoint the cause of the generalised poor condition of a goat. Parasitic diseases often cause chronic diseases and should be suspected. Predisposing factors include poor nutrition; presence of vector (ticks, tsetse fly); dirty pens; and lack of anthelmintic use. (See Table 6.5.)
### Table 6.4 Likely causes of skin diseases and swellings

<table>
<thead>
<tr>
<th>Disease</th>
<th>Causative agent</th>
<th>Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caseous lymphadenitis</td>
<td>B</td>
<td>Small lumps under the skin, located at lymph nodes, developing into large abscesses. Usually in adults. Chronic form shows wasting.</td>
</tr>
<tr>
<td>Streptothricosis</td>
<td>B</td>
<td>Large spots commonly on face, ears, and legs, exuding clear serum. Spots may merge into large scabs, causing hair to stand erect.</td>
</tr>
<tr>
<td>Mange</td>
<td>P</td>
<td>Sarcoptic mange shows rough, hard, itchy, wrinkled skin on back of legs and between front and rear legs, gradually spreading to mouth.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Demodectic or follicle mange causes small hard itchy lumps all over body.</td>
</tr>
<tr>
<td>Orf</td>
<td>V</td>
<td>Thickened areas around mouth, on gums and teats. Often affects kids.</td>
</tr>
<tr>
<td>Ringworm</td>
<td>F</td>
<td>Roughly circular areas of missing hair, leaving rough, scaly skin</td>
</tr>
<tr>
<td>Warts</td>
<td>V</td>
<td>Growths appear on the skin, starting small but sometimes growing and spreading to affect a large area. May affect any area, including udder and teats.</td>
</tr>
</tbody>
</table>

**Key:**  
F = fungus

### 6.3.6 Lameness

Lameness can be a serious problem in grazing goats: it can limit or even prevent their ability to graze with the main flock. For this reason it should be treated seriously and prevented whenever possible. Predisposing factors are mainly overgrown, untrimmed hoofs. In tick-infested areas, a common cause of lameness is the attachment of ticks to the sensitive skin between the claws of the feet, resulting in inflammation and severe lameness. Lameness can also be a side-effect of other important diseases such as foot and
Goat health

Table 6.5 Likely causes of poor condition, anaemia and pale mucous membranes

<table>
<thead>
<tr>
<th>Disease</th>
<th>Causative agent</th>
<th>Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anaplasmosis</td>
<td>P</td>
<td>Poor condition and severe anaemia.</td>
</tr>
<tr>
<td>Babesiosis</td>
<td>P</td>
<td>Bloody diarrhoea and dark red urine. Poor appetite, listless with fever. Most recover, but some die, showing nervous symptoms including paddling.</td>
</tr>
<tr>
<td>Coccidiosis</td>
<td>P</td>
<td>Acute bloody diarrhoea. Weak. Severe straining.</td>
</tr>
<tr>
<td>Internal parasites</td>
<td>P</td>
<td>Good appetite, but poor body condition. Sometimes diarrhoea. In severe cases, swelling under jaw ('bottle jaw').</td>
</tr>
<tr>
<td>Teeth problems</td>
<td>P</td>
<td>Weak or damaged teeth.</td>
</tr>
<tr>
<td>Trypanosomiasis</td>
<td>P</td>
<td>Poor body condition, poor appetite. Chronic weight loss. Swollen lymph nodes.</td>
</tr>
</tbody>
</table>

Mouth disease or melioidosis. Good nursing, and cutting and carrying feed to the goat, are very important if the goat is lame and unable to graze for itself. (See Table 6.6.)

6.3.7 Nervous diseases

Goats show nervous symptoms — circling, convulsions, and head pressing — in the course of several important diseases. Unfortunately in many diseases nervous signs are shown only towards the end of the disease, when the goat is close to death. Lying down and making paddling movements with the front legs is a common sign before death from many diseases. (See Table 6.7.)

If rabies is suspected, very great care must taken in dealing with the goat, as this a highly infectious and fatal disease in humans (see 6.5.8).

6.3.8 Female and male infertility

A doe's inability to breed can be caused by many factors, acting together or separately. Management problems should be investigated first, to check that oestrus is being shown; if it is shown, is it being detected by the buck, or, in the absence of a buck, observed by the owner? If oestrus is shown and mating takes place without
Table 6.6 Likely causes of lameness

<table>
<thead>
<tr>
<th>Disease</th>
<th>Causative agent</th>
<th>Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Akabane disease</td>
<td>V</td>
<td>Kids born with rigid joints, often blind as well.</td>
</tr>
<tr>
<td>Caprine arthritis encephalitis</td>
<td>V</td>
<td>Young kids show weakness in hindlegs and finally cannot rise. Death usually follows. In adults, swollen joints develop slowly (2 years). Difficulties in walking.</td>
</tr>
<tr>
<td>Contagious agalactia</td>
<td>B</td>
<td>Hot, painful, swollen joints that may rupture as an abscess.</td>
</tr>
<tr>
<td>Foot and mouth</td>
<td>V</td>
<td>Small blisters between claws of feet, causing lameness.</td>
</tr>
<tr>
<td>Foot rot</td>
<td>B</td>
<td>Lameness in one or more foot. Affected foot appears ragged and rotten, with bad smell. Often occurs in wet season, or in dirty conditions.</td>
</tr>
<tr>
<td>Mastitis</td>
<td>B</td>
<td>Does with inflamed udder may show a straddling walk.</td>
</tr>
<tr>
<td>Melioidosis</td>
<td>B</td>
<td>Joints, testicles, and lymph nodes sometimes swollen.</td>
</tr>
<tr>
<td>Mineral deficiencies</td>
<td>M</td>
<td>Kids born with deformed joints because of calcium:phosphorus imbalance or deficiency.</td>
</tr>
<tr>
<td>Navel ill</td>
<td>B</td>
<td>Inflamed navel and hot painful joints in kid.</td>
</tr>
<tr>
<td>Ticks</td>
<td>P</td>
<td>Tick attachment between claws of feet. Inflammation of skin at site of attachment.</td>
</tr>
<tr>
<td>Physical injury</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vitamin deficiencies</td>
<td>M</td>
<td>See Table 6.16.</td>
</tr>
</tbody>
</table>

conception, the possibility of infertility in the buck must also be investigated. Female infertility may be caused by the presence of another disease which suppresses oestrus in the female, or by a condition such as lameness which prevents the buck from serving. Congenital physical deformities of the reproductive organs occasionally occur. There are very few diseases that directly cause infertility. (See Table 6.8.) Problems of infertility are described in more detail in 7.3.
### Table 6.7 Likely causes of nervous diseases

<table>
<thead>
<tr>
<th>Disease</th>
<th>Causative agent</th>
<th>Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caprine arthritis encephalitis (CAE)</td>
<td>V</td>
<td>In addition to lameness, often head tremors, blindness, jerky movement of eyeballs, and circling.</td>
</tr>
<tr>
<td>Copper deficiency</td>
<td>M</td>
<td>Muscle tremors and nodding or shaking of head.</td>
</tr>
<tr>
<td>Enterotoxaemia</td>
<td>B</td>
<td>Star gazing, convulsions, teeth grinding, pitiful cry of pain. Paddling movements and throwing back head just before death.</td>
</tr>
<tr>
<td>Listeriosis</td>
<td>B</td>
<td>Facial paralysis, resulting in drooping eyelids and ears. Circling and head pressing.</td>
</tr>
<tr>
<td>Melioidosis</td>
<td>B</td>
<td>Sometimes staggering, jerky movement, or paralysis, with swollen joints.</td>
</tr>
<tr>
<td>Navel ill</td>
<td>B</td>
<td>Convulsions may occur in kids when close to death. Enlarged navel stump is a critical symptom.</td>
</tr>
<tr>
<td>Pregnancy toxaemia</td>
<td></td>
<td>Inability to stand, poor balance during late gestation.</td>
</tr>
<tr>
<td>Rabies</td>
<td>V</td>
<td>Staring eyes, eating unusual objects, confusion, drooling saliva, strange bleat.</td>
</tr>
<tr>
<td>Scrapie</td>
<td>V</td>
<td>Only in adults. Uncoordinated limbs, especially hind legs, high-stepping fore-legs. Salivation.</td>
</tr>
<tr>
<td>Tetanus</td>
<td>B</td>
<td>‘Rocking-horse’ straight-legged stance. Usually 2 weeks after wound.</td>
</tr>
</tbody>
</table>

Key: R = rickettsia
Common disease problems

Table 6.8 Likely causes of female and male infertility

<table>
<thead>
<tr>
<th>Disease</th>
<th>Causative agent</th>
<th>Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brucellosis</td>
<td>B</td>
<td>Swollen testicles (orchitis), causing infertility in buck.</td>
</tr>
<tr>
<td>Intersex</td>
<td>H</td>
<td>Mixture of male and female reproductive organs.</td>
</tr>
<tr>
<td>Metritis</td>
<td>B</td>
<td>Dark, sticky, smelly discharge after giving birth indicates metritis. If left untreated, may develop into chronic problem and infertility.</td>
</tr>
<tr>
<td>Physical damage</td>
<td></td>
<td>Physical damage to penis or testicles may result in male infertility.</td>
</tr>
<tr>
<td>Sperm granulomas</td>
<td>H</td>
<td>Sterility. Small, hard tumour at top of unusually small testes can eventually be felt.</td>
</tr>
<tr>
<td>Trypanosomiasis</td>
<td>P</td>
<td>Inflammation/degeneration of testes.</td>
</tr>
</tbody>
</table>

Key: H = hereditary

6.3.9 Abortion

Spontaneous (non-infectious) abortion is slightly more common in goats than in other species, because the foetus is entirely dependent on the corpus luteum throughout gestation. However, there are several infections which can cause abortions. If aborters are not culled, abortion may spread and build up into a serious problem in the flock. Investigating a problem of abortion can be difficult, even with the support of a competent laboratory. It is simplest to cull goats which abort twice consecutively. Any disease that raises the body temperature of a pregnant goat may result in abortion. Predisposing factors are poor nutrition; stress; and shock (gunfire has been found to trigger abortion!). (See Table 6.9.)

6.3.10 Udder problems

A doe’s udder problems (Table 6.10) can jeopardise her kid’s life, because the doe may be so uncomfortable that she cannot bear the kid to suckle. Mastitis will affect total milk production and quality.
### Goat health

**Table 6.9 Likely causes of abortion**

| Disease               | Causative agent | Symptoms |n
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Brucellosis</td>
<td>B</td>
<td>Abortion in last 50 days of the 150-day gestation. Possibly swollen joints.</td>
</tr>
<tr>
<td>Chlamydial abortion</td>
<td>B</td>
<td>Abortion in last 50 days of gestation. High proportion of herd will abort.</td>
</tr>
<tr>
<td>Foot and mouth disease</td>
<td>V</td>
<td>Abortion at any time of gestation, early in course of disease. Sores on tongue, in mouth, and between claws of feet.</td>
</tr>
<tr>
<td>Listeriosis</td>
<td>B</td>
<td>Abortion in last 70 days of gestation. May have drooping ears and eyelids. Tongue may hang out. Fever, depression, and nervous symptoms.</td>
</tr>
<tr>
<td>Malnutrition</td>
<td>M</td>
<td>Abortion at any time during gestation, but especially in last 50 days if short of energy.</td>
</tr>
<tr>
<td>Nairobi sheep disease</td>
<td>V</td>
<td>Abortion at any time of gestation, if goat survives disease.</td>
</tr>
<tr>
<td>Poisoning</td>
<td>M</td>
<td>Abortion at any time of gestation, as side-effect of poisoning.</td>
</tr>
<tr>
<td>Rift Valley fever</td>
<td>V</td>
<td>Abortion at any time of gestation during the course of the disease. Affected goats are feverish, vomit, and stagger. Sore on tongue and cheeks.</td>
</tr>
<tr>
<td>Salmonellosis</td>
<td>B</td>
<td>Abortion in last 50 days of gestation. Fever, no appetite, diarrhoea.</td>
</tr>
<tr>
<td>Shock and stress</td>
<td></td>
<td>Abortion at any time during gestation, usually 2–4 days after shock or stress.</td>
</tr>
<tr>
<td>Toxoplasmosis</td>
<td>P</td>
<td>Abortion in last 50 days of gestation. Rare.</td>
</tr>
<tr>
<td>Trypanosomiasis</td>
<td>P</td>
<td>Abortion during acute disease.</td>
</tr>
</tbody>
</table>
### Table 6.10 Likely causes of udder problems

<table>
<thead>
<tr>
<th>Disease</th>
<th>Causative agent</th>
<th>Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mastitis</td>
<td>B</td>
<td>Heat, pain, and swelling of udder. May become bright red. Udder black and cold if gangrenous.</td>
</tr>
<tr>
<td>Orf</td>
<td>V</td>
<td>Small, scabby, painful sores on udder. Doe will not allow kid to suckle.</td>
</tr>
<tr>
<td>Physical damage</td>
<td></td>
<td>Physical damage such as tears, tick damage, thorn damage can make udder sore and affect milk production. Can lead to infection.</td>
</tr>
<tr>
<td>Warts</td>
<td>V</td>
<td>Small warts may grow on teat and persist for several months.</td>
</tr>
</tbody>
</table>

### 6.4 Common diseases of goats

The set of diseases that are important to any flock of goats will vary from place to place. The economically important diseases must be identified, in order to establish cost-effective control measures. The diseases that have been found to be of most common importance to goats in different systems are described in detail below. This is not a definitive list. It may be that in a particular place a relatively uncommon disease becomes of overwhelming importance, perhaps because the goats have no immunity, or the symptoms are unknown to veterinary staff, or suitable control measures cannot be taken.

#### 6.4.1 Internal parasites

Internal parasites are of universal importance in goats, although the species will vary according to the climate, management system, and breed of goat. It seems that goats are more susceptible to internal parasites than sheep and cattle are. This is perhaps because they are browsers by nature: they naturally consume vegetation above the height at which infective parasite larvae exist. Under natural feeding conditions, their exposure to parasites is low and their natural tolerance of them is also low. Internal parasites become a problem in goats when they are forced to graze close to the ground because they have no browse to eat. Sheep, being natural grazers, appear to have developed more tolerance to internal parasites than goats have. Goat farmers all over the world have found that the economic control of the internal parasites
encountered in their area is one of the key determinants of successful goat production.

There are three main types of parasite that may live inside goats, excluding blood parasites:

- gastro-intestinal parasites in the rumen, abomasum, small intestine, and large intestine;
- flukes in the liver;
- worms in the lung.

**Gastro-intestinal parasites**

The main gastro-intestinal parasites can be divided into four groups:

- Cestodes (*Moniezia* spp).
- Trematodes (*Paramphistomum* spp).
- Protozoa (Coccidia, including *Eimeria* spp).

![Figure 6.2 Location of main parasites in the goat](image)
Of all the gastro-intestinal parasites that affect goats, *Haemonchus contortus* is by far the most important species. In the adult form it is a small worm, 1–3 cm long, which may be found attached to the wall of the abomasum or swimming in its contents. The male is red, while the female has red and white stripes in a spiral up its body, giving it the common name 'barber's pole worm'. Twenty adults can suck 1 ml of blood per day from a goat. If parasites are thought to be a problem, *Haemonchus contortus* should always be suspected first.

**Investigating parasite problems**

Identification of the parasites affecting goats, together with a quantitative assessment of the parasite burden in an area, can be made by using three methods:

- Examination and culture of parasite eggs in the faeces, together with a faecal egg count.
- Post-mortem examination of adult parasites in gastro-intestinal tract, including, if possible, a total worm count.
- Estimates of the Packed Cell Volume (PCV) of the blood.

**Faecal egg counts**

Faeces are collected in order to identify the parasites currently inside the goat. This can be achieved by

- microscopic examination to differentiate nematodes, cestodes, trematodes and protozoa;
- larval culture from nematode eggs to differentiate nematode species.

Defecation should be induced by inserting a moist finger into the rectum to collect a small sample of faeces. At least 3 grammes of faeces are required for analysis. This is equivalent to 6–8 faecal pellets in adults, and 10–12 pellets in kids. The sample should be placed in a small, clean container with a lid. Special bottles can be bought for this purpose; otherwise a small clean glass jar or similar container can be used with equal success.

If a faecal egg count is required, the sample should be either fresh or refrigerated. Without preservation, the eggs will start developing and the sample will be spoiled within 12–24 hours of collection. Refrigerated samples can be kept for longer periods.

If the sample is taken simply in order to identify the species of parasite, it can be preserved for long periods if submerged in 5 per cent formalin or in a concentrated saline solution, made by dissolving 400 mg salt in one litre of water, or by simply adding salt to a quantity of water until the salt stops dissolving.

The number of eggs per gramme (e.p.g.) of faeces is counted by using the McMaster Counting Technique. E.p.g. counts provide an indication of the severity of parasite infection with nematode
Goat health

parasites only. However, this is only an indication, because eggs per gramme may vary according to the season, the quantity of feed consumed and thus the volume of faeces produced, and the species and stage of growth of the parasite. The effect of a parasite burden also varies between breeds and between individuals within a breed. Some individual goats are able to tolerate higher parasite burdens than others, and some breeds appear to withstand higher levels of parasites than others.

Table 6.11 provides a rough guide to help interpret the results of faecal egg counts. Generally, for any parasite species, egg counts that fall into the ‘medium’ severity category should be considered as an important problem requiring action. Egg counts in the ‘heavy’ range must be considered a critical problem, particularly for *Haemonchus contortus*.

<table>
<thead>
<tr>
<th>Species</th>
<th>Light</th>
<th>Medium</th>
<th>Heavy</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Haemonchus</em></td>
<td>100-1,000</td>
<td>1,000-4,000</td>
<td>4,000+</td>
</tr>
<tr>
<td><em>Trichostrongylus</em></td>
<td>100-1,000</td>
<td>1,000-2,000</td>
<td>2,000+</td>
</tr>
<tr>
<td><em>Nematodirus</em></td>
<td>50-100</td>
<td>100-600</td>
<td>600+</td>
</tr>
<tr>
<td><em>Oesophagostomum</em></td>
<td>100-800</td>
<td>800-1,600</td>
<td>1,600+</td>
</tr>
</tbody>
</table>

*Adapted from Hansen and Perry (1990)*

**Post-mortem parasite counts**
The most accurate method of estimating the parasite burden is to count the number of adult parasites in the intestinal tract after the death of a goat. The adult and larval parasites are washed out of the intestinal tract, from the abomasum to the rectum, identified, and counted for each species. This should be done by a veterinarian or animal-health assistant who has been properly trained.

**Packed Cell Volume**
Anaemia, a reduction of the number of red blood cells, is one of the main effects of parasites. An assessment of the degree of anaemia can be made by estimating the Packed Cell Volume (PCV) of blood from goats suspected of having a parasite burden; this procedure can indicate the severity of the burden. Blood samples from the jugular vein should be collected by a trained person. Blood samples for PCV estimates should be collected in a plain vacutainer.
The life cycle of nematode gastro-intestinal parasites (roundworms)

In order to design an effective control programme, it is important to understand the life-cycles of the parasites of major importance. The nematodes all have similar life-cycles, which do not involve an intermediate host. Adult nematodes live in the gastro-intestinal tract, where they mate. The female then produces eggs, which pass out of the goat in the faeces. The eggs, once on the ground, develop into larvae which, if they are on grass eaten by goats, will re-infect the animal, and so the cycle proceeds (see Figure 6.3). The time taken by the larvae to develop from eggs to infective larvae depends on the climatic conditions and species of parasite. If it is warm and wet, they may become infective after 7–10 days, but they will take longer if it is colder.

In order for the eggs to develop and the larvae to survive long enough to be consumed, the environment must be warm and wet. Desiccation will quickly kill the larvae. Once they have developed, infective larvae, in order to survive, may have to migrate to moist shady areas at the base of the grass sward. This dependence on moisture can follow a diurnal pattern, with the larvae moving...
higher up the grass during the cooler, damper, period at night, and migrating down to the base of the grass when the sun rises. Larvae seldom rise higher than 5–10 cm above ground-level. They can also be washed into drinking water and infect it. Eggs can survive for long periods inside faeces, protected by the outside crust. For all these reasons, most internal parasites are picked up by goats during the wet season. In the humid tropics, environmental conditions favourable to nematode parasites may exist for most of the year. A prolonged dry season does break the cycle of infection for a while; but, with the onset of rain, conditions will immediately become favourable for larval development. Goats in even quite arid environments, such as the Sahelian zone, can suffer greatly from the effects of nematode infestations, like *H. contortus*, at the beginning of the wet season. Even in quite arid environments, local sites of infection can persist through the dry season around water points and along irrigation canals. At all times of the year, potentially highly infective sites can build up around the farmer’s house, where goats may spend time during the day. Kids kept at home may nibble on infected grass around the house and quickly build up a worm burden. Be aware of the potential sources of infection.

Effects of internal parasites on goats
The effects of nematode infestations in goats may be clinical or sub-clinical. Kids are particularly susceptible to parasite burdens and often die from them. The effect on the goat will depend on the numbers of parasites and on its nutritional status. There is also some evidence that individual goats have different degrees of susceptibility to intestinal parasites, some being able to cope with relatively large burdens, while others show clinical signs at quite low levels of infection. Researchers are investigating the possibility of using this genetically-controlled resistance in breeding programmes, to breed goats with genetic resistance to intestinal parasites.

The main symptoms of parasite infection are weight loss, reduced feed intake, reduced milk production, pale mucous membranes from anaemia, diarrhoea, and sometimes death. Infection with parasites which suck blood, such as *H. contortus*, or liver damage from flukes often result in a swelling (oedema) around the jaw, known as ‘bottle jaw’ (see Figure 6.4). Parasite infections will dramatically reduce milk production, which can have a drastic effect on suckling kids. If the dam is infected, the chances are high that the kid will also become infected. If the kid is already weak from lack of milk, it will have a poor chance of survival. This combination of factors is one of the main causes of death among kids.

The effects of cestodes (tapeworms), such as *Moniezia* spp, are relatively minor, except in kids. Kids infected with tapeworms are
also likely to carry other parasites, with the result that they grow slowly and possibly develop diarrhoea. Tapeworms in adult goats are not thought to be a problem.

Trematodes, such as *Paramphistomum*, are found in two sites in the goat. Adults inhabit the rumen and are not thought to cause any problems, even in quite large numbers. Young immature trematodes attach themselves to the mucous membrane of the small intestine and in large numbers may cause diarrhoea and sometimes death.

Protozoan parasites such as coccidia, mainly of the *Eimeria* family, inhabit the mucous membrane of the small and large intestines. Once the goat is infected, the coccidia multiply rapidly and damage the mucous membrane of the goat's intestine. Adults usually develop some immunity, but continue to shed coccidia eggs. Kids are very susceptible to coccidia, which may cause bloody diarrhoea. Heavy infections may kill kids. Coccidia tend to be a problem in housed goats if many animals, adults and kids, are kept in close proximity in damp conditions. Bedding and dirty floors can become contaminated.

**Developing treatment and control strategies**

The objective of a parasite-control strategy is not to permanently free all goats of parasites, because that would be impossible. A parasite-control strategy should aim to reduce the challenge to kids by controlling the parasite burden of adults; and to reduce the rate at which pasture is reinfected.

There are two approaches that should, ideally, be taken together to control internal parasites in goats: improved management, and strategic intervention with drugs (anthelmintics). It is wasteful to rely entirely on expensive anthelmintics to control
parasites. In many situations where drugs are not available, or are too expensive, improved management is the only option open to farmers. So what can be done?

In order to design an integrated control strategy, we need certain key pieces of information:

- rainfall pattern
- grazing-management practices
- flock-management practices
- species of parasite
- labour availability.

First, look at the rainfall pattern to see in which months conditions exist to allow larval development. Describe the current grazing practices: are goats grazing on communal land with other goats and other species of livestock or wildlife? Describe how the flock is divided for grazing: are all ages grazing together, or are young kids kept separately? What are the important species of parasite? Do you know their life-cycle? Where are the goats most likely to be picking up infective larvae? If goats are all grazing together, is there labour available to split them into two flocks? When these questions have been answered, a control strategy can be planned — with or without the use of anthelmintics.

**Parasite control without drugs**

Before considering the use of drugs, think about what can be done without them. There are actions that can be taken to control parasites by reducing the ingestion of infective larvae.

- Safe, larvae-free pastures should be used when possible, such as pastures ungrazed by cattle, sheep, or goats for at least three months in the humid tropics or one-two months in the semi-arid tropics; or land used for hay, or crop-stubble fields.

- If labour is available to split the flock, kids should be grazed ahead of adult goats.

- In the wet season, the grazing day should start after the sun is up and the grass is dry.

- When possible, wet areas (water points, irrigation channels, etc.) should be avoided. If this is impossible, flocks should not be allowed to linger around them.

- Goats should not be grazed intensively; they should not be forced to eat close to the ground; bushy areas should be selected when possible.

- The farmer should consider adopting cut-and-carry feeding, and wilt wet forage before feeding.
Parasite control with improved management and anthelmintics

Anthelmintics are drugs that kill internal parasites. For the most economical use, these expensive drugs should be used in combination with improved management and used at strategic intervals. In order to design a strategic anthelmintic regime, the basic rainfall pattern of the area must be described. A basic strategy for anthelmintic use must reduce the parasite burden carried into the dry season by drenching at the end of any wet period; and reduce the parasite burden of kids during prolonged wet periods.

Figures 6.5 and 6.6 show examples of high-cost and low-cost drenching strategies in a bi-modal rainfall pattern (two wet seasons each year) and a mono-modal rainfall pattern (one wet season each year). These basic drenching strategies should be combined with the management improvements described above.

Not all anthelmintics will kill all parasites, or all stages of the parasite, so check carefully before buying an anthelmintic, to ensure that it will control the parasites you want it to. There are no anthelmintics developed specifically for goats, so those developed for sheep or cattle must be used. Anthelmintics can be purchased in many forms:

- liquid drench
- powder
- bolus
- injection
- paste
- pour-on

Liquid drenches should ideally be applied with a special drenching gun, but this is expensive for owners to buy. Instead, a rubber teat could be attached to a Coca-Cola bottle, or something similar. The teat can be made from an old inner tube, if a baby’s feeding teat is not available. A syringe can also be used. Paste also needs a special applicator. Boluses can be given with a simple plastic gun (often given free with the drug), or simply by hand; this is probably the cheapest method for a farmer to use. Boluses are harder to give at correct doses. It is not possible to give any dose other than a whole or half bolus, which may under-dose or over-dose the goat. Injectable anthelmintics, such as Ivermectin, have a wide-ranging activity, controlling external as well as internal parasites. This multiple action makes the drug expensive, but in some circumstances it may be cost-effective. See 6.6.1 for guidelines on the use of injectable drugs. Likewise some drugs that are poured along the back of the goat will be effective against both internal and external parasites. In places where dips or sprays do not exist, or water is difficult to procure, multiple-action drugs may be recommended against external parasites, controlling internal parasites as a beneficial side-effect.

If purchasing drugs from overseas, consider the weight of the drug and the cost of transport. Liquid drenches are quite heavy
Goat health

Goat types

Adults

Kids

Rainfall

Figure 6.5 (above): Drenching regime: two wet seasons
Figure 6.6 (below): Drenching regime: one wet season

Key

▼ Drenching time for basic (low-cost) control strategy
▼ Additional drenching times for more effective (higher-cost) control
Common diseases of goats

per unit of active ingredient. Lighter drug types, such as boluses or powders, would probably be cheaper.

The methods of applying anthelmintics are shown in Figure 6.7. When using liquid drenches, care should be exercised to ensure that the anthelmintic enters the digestive system and not the respiratory system. Pneumonia can be caused by the bad administration of anthelmintics.

The common anthelmintics for use in goats are listed in Table 6.12. In most places, only one or two types of drug will be available, if at all, so farmers will have little choice. It is important that the drug selected is effective against all the forms of the parasites that are a problem. The parasite problem itself can be made worse if the owner believes the drug to be effective when it is not; what is more, the owner's money is wasted.

Most modern drugs will effectively control a wide range of parasites, but it has been found that the repeated use of one drug can lead parasites to develop resistance to it. The anthelmintics are grouped in Table 6.12 into their drug 'families'. Drugs in the same
family have a similar mode of action; so to avoid resistance, use a drug from one family and then change to a drug from a different family. It is best to change the chemical group of drug, either every year or after every four treatments, so that resistance does not develop. Anthelmintic resistance has been reported in many countries and it can develop into a serious problem. Resistance can also develop from the use of sub-standard drugs such as generic drugs made locally.

Under-dosing of goats is common, because farmers tend to under-estimate the weight of their goat, and because most dosage rates given on the drug label are for sheep, which are more resistant to internal parasites. Slightly higher dosages, 1.5 times the sheep dose, are recommended for goats. It is best to divide a large flock into groups of roughly the same weight, and calculate the dose according to the needs of the heaviest goat in each group.

If resistance is known to be a problem in a flock, care should be taken to make sure that goats carrying resistant parasites are not purchased.

*Liver fluke*

The liver can be infected with two main types of fluke: *Fasciola hepatica* and *Fasciola gigantica*, both of which have a snail as an intermediate host (Figure 6.8). *F. gigantica* is widely distributed in Africa and Asia; *F. hepatica* is widespread in the highlands of Africa and Asia. In certain areas, where conditions are favourable for the snail, it can be one of the biggest problems of keeping goats. Marshy, poorly-drained pastures and grassland beside irrigation channels are common sources of infection for goats. These areas may be too wet to graze during the wet season, but may be an important source of dry-season grazing. For this reason, infection often occurs during the dry season, when the ruminant host is at its weakest.

Eggs shed from goats or from other hosts (sheep, cattle, and wild ruminants) hatch and produce cysts able to swim and infect their intermediate snail host. While in the snail, they further develop into cysts that are able to infect their major host. This form of the fluke is able to survive, separate from any host, for one year. The snail host requires a warm wet environment. Adult snails cannot survive desiccation, but immature snails can remain dormant through a dry season. So even if a swampy area dries out during the dry season, do not exclude the possibility of later infection from these areas.

Once ingested, the larvae penetrate the intestinal wall and develop further in the liver, which may become severely damaged. This causes the acute phase of the disease. The final maturation of the fluke occurs in the bile ducts.
### Table 6.12 Anthelmintics for goats

<table>
<thead>
<tr>
<th>Benzimidazoles</th>
<th>Common name (examples)</th>
<th>Dosage (mg/kg)</th>
<th>GI</th>
<th>L</th>
<th>T</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Albendazole</td>
<td>‘Valbazen’</td>
<td>5-10</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Febantel</td>
<td>‘Rintal’</td>
<td>5-10</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Fenbendazole</td>
<td>‘Panacur’</td>
<td>5-7.5</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Mebendazole</td>
<td>‘Telmin’</td>
<td>12.5</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Oxfendazole</td>
<td>‘Synanthic’</td>
<td>5</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Oxfendazole</td>
<td>‘Systamex’</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oxibendazole</td>
<td>‘Widespec’</td>
<td>10</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Thiabendazole</td>
<td>‘Thibenzoze’</td>
<td>44</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Thiophanate</td>
<td>‘Wormalic’</td>
<td>50</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Triclabendazole</td>
<td>‘Fasinex’</td>
<td>10</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
</tr>
</tbody>
</table>

<table>
<thead>
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<th>Dosage (mg/kg)</th>
<th>GI</th>
<th>L</th>
<th>T</th>
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</thead>
<tbody>
<tr>
<td>Levamisole hydrochloride</td>
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<tr>
<td></td>
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<tr>
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<th>T</th>
<th>F</th>
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<td>+</td>
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<td>+</td>
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<td>‘Zanil’</td>
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<td>-</td>
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<th>GI</th>
<th>L</th>
<th>T</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morantel</td>
<td>‘Exhelm’</td>
<td>10</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Pyrantel tartrate</td>
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<td>25</td>
<td>+</td>
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<table>
<thead>
<tr>
<th>Miscellaneous</th>
<th>Common name (examples)</th>
<th>Dosage (mg/kg)</th>
<th>GI</th>
<th>L</th>
<th>T</th>
<th>F</th>
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</thead>
<tbody>
<tr>
<td>Avermectin</td>
<td>‘Ivermectin’</td>
<td>0.2</td>
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<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Nitroxynil</td>
<td>‘Trodax’</td>
<td></td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>+</td>
</tr>
</tbody>
</table>

**GI = Gastro-intestinal nematodes**  
**T = Tapeworms**  
**L = Lungworms**  
**F = Liverfluke**  

+ = effective  - = ineffective
Goat health

Infection with liver flukes can produce an acute and a chronic disease. Acute fascioliasis can cause sudden death, due to massive liver destruction during migration of the larvae through the liver tissue. This is common in *F. gigantica* infections, where even light infections can cause death. Chronic fasciolosis causes weight loss, anaemia, and facial oedema (‘bottle jaw’, illustrated in Figure 6.4). The nutritional state of the goat is of great importance, as well-fed goats are able to tolerate higher burdens of flukes than under-nourished ones.

The drugs effective against adult flukes are indicated in Table 6.12. Few drugs are effective against immature flukes; the best available is triclabendazole (‘Fasinex’). If swampy areas are grazed for a specific period, such as the dry season, drenching at the start of grazing and again at the end would be a minimum control strategy. If goats have to graze an infected area, acute fascioliasis can be avoided only by an intensive drenching strategy, drenching every 8–10 weeks; but this will be expensive. Snail-control programmes can also be considered at a community level, either by chemical control of the snail, or by draining the swampy area, or by biological control through the use of snail-eating birds such as ducks. It is difficult to control the snail completely, because it can produce vast numbers of infective cysts. Excluding livestock from the infected area is probably a more effective approach, either by fencing off swampy areas or simply by avoiding grazing those places. Unfortunately the lack of alternative dry-season grazing may make this approach difficult for farmers to follow. Delaying the grazing of swampy areas until well into the dry season, so that a lower challenge is faced, will also help.

Lungworms

Most lungworm infections of goats are caused by *Dictyocaulus filaria*. Lungworms are found mainly in the tropical and sub-tropical highlands. They inhabit the airways of the lung. Males may be 3–8 cm long, females 5–10 cm. Eggs are laid in the lungs and are coughed up and digested, passing out in faeces. Once outside the goat, the larvae take 6–7 days to develop and become infective. Infection is by ingestion of larvae on herbage. After consumption, the larvae penetrate the intestinal wall, entering the lymphatic vessels, then blood vessels, and eventually the lungs. The larvae develop in the air passages of the lung. Once in the lungs, worms cause parasitic bronchitis. Symptoms are coughing and difficulty in breathing; they may eventually predispose the goat to secondary infection, resulting in pneumonia. The cause of this pneumonia is often, mistakenly, thought to be only pasteurella, and thus the lungworms go untreated. Secondary infections with pasteurellosis may occur in goats infected with lungworms. Coughing with a fever will indicate a likely bacterial, or viral, infection, while coughing
without any fever is most likely to indicate lungworms. The disease
is important in kids. Treatment using anthelmintics for gastro-
intestinal parasites is effective: see Table 6.12. Control measures
are the same as for the nematodes.

6.4.2 Mange

Mange is a skin disease caused by tiny mites. Most mite species
burrow deep into the skin, provoking severe itching, and
sometimes causing the skin to break and infections to enter. There
are three main species of mite which affect goats in the tropics:
sarcoptic mange (Sarcoptes scabei), demodectic mange (Demodex
folliculorum), and chorioptic mange (Chorioptes caprae). Sarcoptic
mange is by far the most important mange of goats in the tropics;
in some systems it can be the most important cause of death.

Sarcoptic mange

Sarcoptic mange is caused by the female mite burrowing into the
skin, forming tunnels in which she lays eggs. In a few days, larvae
hatch and may wander in the tunnels or on the surface of the skin.
Nymphs develop from the larvae in the tunnels, and the disease
can be spread by contact with either larvae, or nymphs, or adult
mites. The burrowing and feeding of the mites cause intense
itching and scratching. Crusts form on the skin, thickening and
wrinkling it. Loss of hair is common (Figure 6.9). Typically, the
disease in goats starts in the less hairy areas around the udder and
the abdomen, and between the front legs. Tethering goats can
predispose them to the disease, if the rope rubs away the hair on
the back of the neck or leg, and thus makes the mite’s penetration
of the skin easier.

Once the disease takes hold and spreads
over the body, the goat will start to lose
weight, because the skin around the mouth
becomes hard, making feeding difficult.
Once the goat has reached this point, it will
quickly lose condition and die. High
mortality can ensue from the disease, and
so it is very important either to try to
prevent the disease, or at least to spot it and
treat it in its early stages. Early signs include

• bite marks on flanks where the goat has
turned its head to bite and scratch itself
(this can also be a sign of fleas);

• hardening of the skin around the udder,
abdomen or chest area, together with hair
loss, which is a definitive sign of mange.

Figure 6.9 A case of sarcoptic mange
CHRISTIE PEACOCK
Confirmation of the disease should be made by taking a skin scraping (see below for the method) and looking for the mites under a microscope. However, in practice it is rare to have the luxury of a nearby laboratory to make a definitive diagnosis. Rapid early treatment is important in mange, and waiting for laboratory confirmation may lead to the loss of the goat.

There are acaricide chemicals available to treat mange, but they are only really effective in the early stages. The poor penetration of externally applied chemicals can be improved by washing and vigorously scrubbing infected goats by hand. Some of the chemicals available are amitraz, quintiofos, flumethrin, diazinon or permethrin; of these, amitraz has been found to be the most effective. Care must be taken when using these chemicals (see 6.4.3).

There are also drugs which have a systemic action; they are injected or poured on the skin, and are able to move through the goat from their point of application and attack the mange mites in the skin. The injectable 'Ivermectin', and pour-on chemicals such as trichlorphon and phosmet, act in this way and may be useful; but they are quite expensive.

The castor bean plant (*Ricinus communis*) is a very common perennial, growing in a very wide range of environments in the tropics. It contains an insecticidal chemical, ricin, in the leaves and stems. Being water-soluble, ricin can be extracted from the leaves and stems, using a simple water-extraction process. A quantity of chopped leaves and stems should be added to 50 times its weight in water. The mixture should be heated to just below boiling point. The residue should be pressed to extract the liquid. The liquid can be used to wash goats, but be careful: ricin is very...
poisonous. Under no circumstances should it be consumed. Great care must be taken in handling this chemical. Children should be carefully supervised during the extraction process and during its use. Washing with all chemicals should done away from the home and away from water supplies for humans.

The goat should be thoroughly washed with one of the recommended chemicals. It must be remembered that the mange mites are buried deep within the skin, so it must be rubbed very hard for the chemical to come into contact with the mites. Pinpricks of blood will be seen if the washing is done properly.

If the case is very severe, wash every 2–3 days until signs of improvement can be seen. If it is not so severe, washing every 5–6 days is probably enough. It can be helpful to wash the skin with soap and water before using the chemical, as this softens up the skin and helps the chemical to penetrate it.

Demodectic mange
Demodectic mange (Figure 6.11) is caused by a mite which burrows into the hair follicles and sebaceous glands of the host. Eventually small pustules (tiny abscesses) form; if squeezed, they exude yellow pus. This is very characteristic of this form of mange. The same treatment as for sarcoptic mange should be given.

Chorioptic mange
Chorioptic mange is not common, but may be seen in housed goats. It is known commonly as ‘heel mange’ for its propensity to attack the backs of the legs. It may also be seen under the tail. This mange is not so severe as the other mange diseases and can be treated easily with any of the chemicals recommended for sarcoptic mange.

Figure 6.11 Demodetic mange: note the small bumps all over the body
JENNY MATTHEWS/OXFAM
Prevention of mange

It is often thought that only malnourished goats succumb to mange, but experience has shown that this is not true. Seemingly healthy, well-fed goats can develop mange. Demodectic mange, particularly, can develop very slowly, making it hard to trace the original point of infection. Basic hygiene is important and separation of uninfected goats from those known to be infected is also important. Farmers must be trained to be alert to the start of the disease, because it is relatively easy to treat in the early stages, but becomes very hard to control once it is widely spread on the goat's body.

If there is a skin problem, a scraping of the skin may allow a laboratory to identify the cause. Use a razor blade, or sharp knife, to scrape the skin until pinpricks of blood appear. Scrape around the edge of the affected area. Use a slide, if available, to collect the scrapings. Ideally smear a layer of Vaseline on to the slide so that the scrapings stick to it; or sticky tape will do. If a slide or tape is not available, scrape on to a piece of paper and fold it. If mites are in the skin scrapings, the scrapings may move on the paper.

6.4.3 Tick-borne diseases and tick control

There are four diseases of goats that are transmitted to them by ticks. They are heartwater, anaplasmosis, babesiosis, and Nairobi sheep disease.

In addition to transmitting disease, ticks can cause physical damage to the goat. Their blood sucking causes anaemia. Tick bites can damage sensitive areas of skin (teats, vagina, eyes, etc.) and also reduce the final quality of the skin after slaughter. Tick attachment between the claws of the feet may cause severe lameness. For all these reasons, cost-effective tick-control strategies need to be developed in each situation.

Heartwater

Heartwater is probably the most important tick-borne disease of goats. It is caused by a rickettsia, *Cowdria ruminantium*, leading the disease to be known also as cowdriosis. The rickettsia is transmitted by *Amblyomma* ticks, most notably *Amblyomma variegatum* (Figure 6.12). It is a common disease in Africa and has been reported in the Caribbean. Goats reared in an environment of infected ticks are able to develop some resistance to the disease. Goats that have not been exposed to the disease will be susceptible to it when challenged with it. For this reason, goats brought into a heartwater-endemic area will be at risk unless adequate tick-control measures are taken. Exotic breeds of goats will, inevitably, be susceptible to heartwater, although they can develop resistance to the disease if reared in a heartwater-endemic environment.
Symptoms of heartwater are pronounced in adult goats, but kids show few signs. The disease starts with a rapid rise in temperature. Sometimes this is the only sign of the disease, until the goat is close to death, when nervous signs are shown: circling, lip-licking, eyelid-flicking, and a high-stepping walk. Once these signs are shown, the goat will soon be unable to stand and will die on its side, its legs paddling in the air. Post-mortem examination will show a clear fluid trapped around the heart, the characteristic sign which gives the disease its name.

Heartwater responds well to antibiotics, such as tetracyclines, if they are administered during the very early stages of the disease. However, heartwater can be difficult to spot early, unless there is a history of the disease in the area and it is expected by veterinary staff. The clearly visible nervous signs are shown so late in the course of the disease that treatment given at this time is rarely effective. If there is a sudden outbreak of the disease in a large flock, surveillance of body temperatures should be considered, together with prophylactic (preventative) antibiotic treatment.

The manufacture of an effective heartwater vaccine has been sought for many years for cattle, as well as for sheep and goats. Immunity can be induced by injecting infected blood into a goat and treating the ensuing disease. This exposure may result in immunity for up to four years, even without any subsequent challenge; but it is a risky procedure and should be carried out only by experienced veterinary personnel. Tick control is still the main method of controlling the disease (see below). Care should be taken when moving goats. Tick-infested goats and cattle should not be introduced into 'clean' areas; likewise, susceptible stock should not be introduced into infested areas, unless adequate precautions have been taken.

**Babesiosis**

Babesiosis is a disease caused by protozoan parasites such as *Babesia ovis*. It is widespread in most tropical and sub-tropical countries. The disease is mainly transmitted by ticks of the *Rhipicephalus* family, which introduce the organism into the host's bloodstream while feeding. The protozoa invade and break down the red blood cells. It is not so severe in goats as it is in cattle. Goats reared in an endemic area are normally immune to babesiosis, while those introduced into an endemic area are susceptible.

There is a range of symptoms: sudden death; the severe symptoms of the acute form, including blood in the urine, anaemia, and jaundice; and the more common mild form, which shows few symptoms.

Treatment, if required, involves the use of quinurionium sulphate ('Acaprin') at 0.5–1.0 mg/kg or diminazene aceturate ('Berenil') at 3 mg/kg. Control measures should try to maintain an equilibrium by allowing a low-level disease challenge to stimulate
immunity continuously (this is known as ‘enzootic stability’). Tick-control regimes that are too rigid will leave goats susceptible to the disease. Moving susceptible goats into an endemic area should be avoided.

**Anaplasmosis**

Anaplasmosis is caused by a rickettsia, *Anaplasma ovis*, which invades red blood cells and causes anaemia. Anaplasmosis is common in Africa and Asia. The disease may be transmitted by ticks, biting flies, and contaminated needles and equipment. Severe anaemia is the most common symptom, causing poor condition and performance. Stress may cause a goat carrying the disease to develop it, but it is rare in goats reared in the presence of the disease. Susceptible goats introduced into an anaplasma area should be carefully monitored.

**Nairobi sheep disease**

Nairobi sheep disease is a tick-borne virus disease of sheep and goats. The main vector is the tick, *Rhipicephalus appendiculatus* (Figure 6.13). This tick is distributed throughout East Africa and as far west as Zaire. Goats reared in tick-infested areas seldom show any clinical symptoms, but goats that have not been exposed to the disease, and enter an infested area, will normally show marked symptoms and high rates of mortality (15–100 per cent) and abortion (10–20 per cent). The main symptoms are fever, depression, bad-smelling and blood-stained diarrhoea, and nasal discharge. The discharge will form a crust, restricting breathing. Affected goats are likely to die 4–6 days after showing these symptoms. Pregnant females will normally abort.

Outbreaks normally occur on movement of susceptible goats into a tick-infested area. The tick thrives in dense vegetation after rainfall and may temporarily extend its normal range considerably, retreating as the vegetation dries up and dies. Even small movements of susceptible goats outside their normal grazing areas may trigger the start of an outbreak. Movement of pastoralists’ flocks, at different seasons, can set up the necessary exposure of susceptible goats to the tick. Immune flocks may carry the ticks into new areas, infecting susceptible goats; or susceptible goats may be obliged to graze tick-infested areas during a drought. Control of the disease therefore involves restricting the movement of susceptible goats, and particular vigilance and tick control during movements away from normal grazing areas. There is an effective vaccine for Nairobi sheep disease, but no effective treatment. In tropical regions where Nairobi sheep disease does not occur, peste des petits ruminants is the condition which appears most similar (see 6.4.5).
Common diseases of goats

Sampling of external parasites

External parasites such as ticks, fleas, or lice may remain in good enough condition for identification for several days. In order to identify a tick species, samples should be detached from the goat with their mouth-parts intact. Ticks have to be irritated to detach their mouth-parts from the skin. A hot metal or glowing cigarette can be used. Several ticks should be taken, in case some are not intact. Indicate on the container from which part of the goat the ticks were taken and how severe the infestation was. Ticks can be stored in any container with a lid, such as an old film case or glass jar. If the ticks are to be kept for a long time before reaching a laboratory, preservation in 5 per cent formalin, concentrated saline solution, or even plain water will keep them in better condition and prevent mould from developing, or dehydration of the specimens.

Tick control

For most of the tick-borne diseases affecting goats, an equilibrium between the disease-carrying tick and the immunity levels of the goat can exist and is the preferred state to achieve. It is more damaging to control ticks rigorously for a period, preventing any immunity from developing, and then discontinue the rigid control, than not to control at all. In Africa, in particular, it is a common occurrence for communal dips to stop working because supplies of the chemical are exhausted, the water supply is disrupted, or the dip-bath cracks and becomes unusable. The abrupt cessation of dipping leaves livestock vulnerable to tick-borne diseases, because the earlier tick control did not allow immunity to develop.

Tick control can be achieved through chemical and physical means. If a small flock experiences a minor tick challenge, it is possible to kill them by hand, using a needle or thorn; children can be given this task, supervised by adults. A commercial tick-grease ('Py-grease') can be applied to sensitive areas such as the udder or between the legs, preventing the attachment of ticks at these sites. If there are no tick-borne diseases in the area, these simple procedures may be enough to reduce tick damage. However, if tick-borne diseases are important, and tick control is employed to control these diseases, effective chemicals, known as acaricides, should be used and applied in an effective way.

Acaricides may be applied by washing the animal by hand; by pouring them on to its body; by spraying; by injection; and by dipping.

Dipping

Pour-on systemic chemicals, such as flumethrin ('Bayticol'), and injectable drugs, such as avermectin ('Ivermectin'), tend to be expensive to purchase, but they are relatively simple and cheap to
Goat health

Spraying and dipping require special equipment or structures which are expensive to purchase or construct, and also require much water, which may not be available (Figure 6.14). Washing by hand is effective for a small number of goats, provided that washing of the main sites of tick attachment is carefully done. As with internal parasites, the pen feeding of goats, instead of grazing, reduces their exposure to external parasites and is a useful way of controlling ticks at no cash cost.

There is a bewildering number of chemicals that can be used in dips and sprays and for washing by hand. Like anthelmintics, they can be divided into families. As with anthelmintics, ticks can develop resistance to particular chemicals through their repeated use. In some parts of Africa the resistance of ticks to the common acaricides is a major problem. Table 6.13 presents the main...
families of chemicals used to control external parasites (ticks, mange mites, fleas, and lice) on goats. All these chemicals are potentially dangerous to humans and goats if improperly used. The instructions for their use must be read and strictly followed.

The tick-control strategy adopted depends on the species of tick and its life cycle, the incidence of tick-borne diseases, the seasonal incidence of ticks and diseases, the availability of acaricides, the amount of cash available to purchase them, and the means of application.

In commercial cattle-ranching, quite precise estimates of the financial loss from ticks and tick-borne diseases have been calculated, and an economical tick-control strategy can be developed. In smallholder production, the situation is much more complicated and, unless all livestock owners act together, tick control may not be a viable option. It may be better to try to keep a balance between the disease challenge from the ticks and the goats’ resistance to the challenge.

Dipping or spraying may be carried out strategically during seasons of high tick numbers. Frequency will depend on the life-cycle of the tick and the numbers of ticks attached. Certain tick species, such as *Amblyomma variegatum*, which transmits heart-water, attach themselves to the goat on the lower part of its legs. For farmers with only a few goats, it may be feasible to dip all four feet in a dip bath made from an old 20-litre oil container, or a similar container. This can be sufficient to control tick numbers and the diseases they transmit.

If lack of money is limiting acaricide use, or acaricides are simply not available, farmers could try using a number of plants

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### Table 6.13 Acaricides for goats

<table>
<thead>
<tr>
<th>Family</th>
<th>Chemicals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organo-phosphates</td>
<td>Chlorpyrifos, Dichlorvos, Malathion, Diazinon, Phosmet, Coumaphos, Fenthion, Chlortefrinphos, Tetrachlorvinphos (Stirofos)</td>
</tr>
<tr>
<td>Carbamates</td>
<td>Carbaryl, Propoxur</td>
</tr>
<tr>
<td>Pyrethrins</td>
<td>Flumethrin, Permethrin, Resmethrin, Allethrin, Fenvalerate, Cypermethrin</td>
</tr>
<tr>
<td>Formamidines</td>
<td>Amitraz</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>Avermectin, Sulphur</td>
</tr>
</tbody>
</table>
found widely in the tropics that have acaricidal or repellent properties. Some of the best-tryed ones are listed in Table 6.14. All local remedies should be used with as much care as commercial acaricides. Experiment on a small scale first, before recommending the widespread use of any local plant. Be aware that some drugs can become absorbed in the blood-stream and may enter the milk consumed by humans.

### Table 6.14 Some natural ectoparasite control medicines

<table>
<thead>
<tr>
<th>Scientific name</th>
<th>Common name</th>
<th>Part of plant</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Acorus calamus</em></td>
<td>Sweet flag or</td>
<td>Rhizomes (infusion)</td>
<td>Repellent</td>
</tr>
<tr>
<td></td>
<td>Sweet sedge</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Derris elliptica</em></td>
<td>Derris</td>
<td>Roots (powder)</td>
<td>Acaricide</td>
</tr>
<tr>
<td><em>Juglans nigra</em></td>
<td>Black walnut</td>
<td>Leaves (infusion)</td>
<td>Repellent</td>
</tr>
<tr>
<td><em>Mammea americana</em></td>
<td>Mammey apple</td>
<td>Fruit (infusion) Seeds (powder)</td>
<td>Acaricide</td>
</tr>
<tr>
<td><em>Nicotiana tabacum</em></td>
<td>Tobacco</td>
<td>Leaves (infusion)</td>
<td>Acaricide</td>
</tr>
<tr>
<td><em>Ricinus communis</em></td>
<td>Castor bean</td>
<td>Leaves (infusion)</td>
<td>Acaricide</td>
</tr>
<tr>
<td><em>Tephrosia vogelii</em></td>
<td>Fish poison bean</td>
<td>Leaves (infusion)</td>
<td>Acaricide</td>
</tr>
</tbody>
</table>

*Source: Matzigkeit (1990)*

### 6.4.4 Contagious caprine pleuropneumonia

Contagious caprine pleuropneumonia (CCPP) is an acute pneumonia of goats which causes high death rates. It is caused by a mycoplasma, identified as the F38 strain. The disease is widely distributed in North and East Africa, the Middle East, Eastern Europe, and some parts of Asia. It is a highly contagious disease. Once it has entered a flock of goats, it is likely that 100 per cent
will become infected, of which 60–100 per cent will die. In endemic areas, epidemics occur when goats from different places come into close contact. One infective goat in contact with un-immunised stock is enough to trigger epidemic outbreaks of CCPP. Epidemics may start from marketing goats, especially if goats from several flocks are kept together in holding yards. Movement of goats through theft, as occurs in northern Kenya, may also result in the disease. CCPP can cause significant economic losses to goat keepers, who may lose their whole flock, as well as to livestock traders, who may lose large numbers in the course of their transactions.

**Symptoms**
In the acute form, goats may die within 24 hours, showing few symptoms; but more commonly infected goats show difficulty in breathing, nasal discharge, and fever. Goats may cough and rapidly become weak and emaciated. Recovery is possible, but death is more likely.

**Treatment and control**
Goats treated in the early stages of the disease respond well to tylosin (10 mg/kg intramuscular (i.m.)) for three days, or long-acting tetracyclines (20 mg/kg i.m.). Quarantine of infected stock is very important. Markets may have to be temporarily closed and goat movements banned. Effective vaccines, to be given annually, are made in Kenya, Turkey, and France. It is now possible to make a heat-tolerant vaccine which could be of value in controlling the disease in more remote parts of Africa and Asia. Unfortunately the low status given to the goat has meant that relatively little research has been carried out on this important disease.

### 6.4.5 Peste des petits ruminants

Peste des petits ruminants (PPR) is a highly contagious viral disease of goats, similar to rinderpest in cattle. It is widespread in the Sahelian and forest zones of West Africa and has recently been identified in East Africa. It is thought to have been introduced to the Middle East through exports of live goats. It has also recently been reported in India. Devastating outbreaks can occur, with mortality rates of 70–90 per cent. PPR is the most important disease of goats in the humid tropics of West and Central Africa, where it inhibits the expansion and intensification of goat production.

**Symptoms**
The first sign of PPR is a fever with a discharge from the nose and eyes, sometimes with sneezing. The nasal discharge becomes thick,
Figure 6.15 A chronic case of PPR. The face is covered by a thick, smelly discharge from the eyes and nose. The area around the mouth (and inside the mouth) is covered with lesions. Peter Roeder

and the breath is smelly. Sores will appear in the mouth, and diarrhoea may develop after two–three days of the disease. The discharge may become dry and encrusted. Affected goats become very depressed and most die from the disease (Figure 6.15).

Treatment and control
There is no treatment for PPR. Goats that do survive will have lifelong immunity. Control is by quarantine, restrictions on movement, and vaccination. Vaccination using the cattle rinderpest vaccine has been found to be effective. It is best if this can be organised on a village basis, because a vaccine vial is normally intended for 100 goats. Goats should be three months old before vaccination. PPR outbreaks occur more often during the rainy season, so vaccination should take place before the start of the rains.

6.4.6 Pneumonia
Respiratory problems are relatively common in goats, particularly housed goats. Infection of the lungs is known as pneumonia, which can be caused by mycoplasma (as in CCPP), by bacteria, or by viruses. It is often difficult to identify the specific cause of infection. The general symptoms of pneumonia are laboured, fast breathing, sometimes a nasal discharge, sometimes coughing, and sometimes a fever. In severe cases, the goat will grunt in pain as it breathes. In kids the effect of pneumonia can be rapid, and the kid may have died before clearly defined symptoms are seen. On post-mortem examination the lungs will appear infected, purple-black in colour, but the exact cause of death may never be known.

Most pneumonia problems in housed goats are due to poor ventilation and are often triggered by some sort of stress. Pneumonia can develop in goats that are housed only at night, and it is common in large flocks of permanently housed goats. The air in a goat house must constantly change to avoid the build-up of air contaminated with bacteria and viruses. The air must always smell fresh and never smell of ammonia, a sure sign of poor air quality. There should never be any condensation on the walls or roof. Goat houses in the tropics should be simple structures that keep goats dry and protected from wild animals. Direct draughts should be avoided (Figure 6.16). If cold breezes are not a problem, houses can be almost open-sided, perhaps with a wall high enough to prevent goats jumping out. The roof
should be high. Adult goats produce much heat from their rumen and do not need to be kept warm. Kids do not have a functioning rumen and do need to be kept warm. A simple kid box or basket can keep them warm and out of draughts, while allowing the air to circulate around them.

Concentrate efforts on preventing pneumonia by ensuring that the air is always fresh. Also be aware of other causes of respiratory problems: lungworms, CCPP, PPR, melioidosis, oestrus ovis, drenching pneumonia, dusty or mouldy feed or hay. Most pneumonia is caused by Pasteurella bacteria or Mycoplasma infections. Both can be treated with antibiotics. Tetracycline is the antibiotic of choice, or sulphadimidine. Antibiotics must always be given as a full course: for five days, or at least two days after signs of recovery.

6.4.7 Caseous lymphadenitis

Caseous lymphadenitis is caused by the bacterium Corynebacterium pseudotuberculosis. It is a common sight in goats kept in Africa, the Americas, the Middle East, and Asia. Although it may appear a relatively unimportant disease, it can build up to be of major significance in a large flock, causing important losses of production.

Symptoms
One abscess (or more) may develop on an external lymph node, commonly under the throat, behind an ear, at the point of the
shoulder, in front of a hind leg, or inside the hind legs. The lump will grow and eventually burst (Figure 6.17). A more serious form of the disease involves the development of internal abscesses, often on the lungs, causing pneumonia and loss of condition.

**Treatment and control**

It is most important that the Corynebacterium bacterium does not infect the goat house, pens, and area surrounding the owner's house. Once these areas are contaminated, it is very difficult to eradicate the disease and it will become a chronic problem in the flock. Enlarged abscesses, with a raised soft centre, should be opened before they burst, in order to control subsequent contamination. First move the affected goat out of the goat house away from other goats; then clean the abscess with soap and water, or an antiseptic. Stick a needle into it. If blood comes out, stop immediately, because a blood vessel may have been severed. If pus comes out, continue and incise the abscess with a sharp, sterile blade, making a downward cut to allow the pus to drain out. Drain the pus on to a cloth, paper, or other material that can be burned or buried. Do not allow the pus to come into contact with the ground, or it will contaminate it. Wash the abscess with water or mild alcohol. Use dressing forceps and cotton wool to clean the inside edges of the abscess, and check for any remaining pus. Finally, wash with iodine or other antiseptic (Figure 6.18). Burn or deeply bury the pus drained from the abscess. Try to keep the goat isolated until the wound is dry and healed, before returning it to the flock.

Do not attempt to open small hard lumps, because they are not ready to be opened. Wait and see how they develop: they sometimes disappear by themselves.

Control of caseous lymphadenitis is achieved entirely through good hygiene, because antibiotic therapy is always unsuccessful.
Figure 6.18 (a) Open the abscess by lancing downwards in a vertical direction

CHRISTIE PEACOCK

Figure 6.18 (b) Allow the pus from the abscess to drain on to paper or cardboard, which should be burned or buried afterwards

CHRISTIE PEACOCK

Figure 6.18 (c) Clean the drained abscess thoroughly with an antiseptic

CHRISTIE PEACOCK
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This is not a trivial disease. It can build up into one of great importance if the owner is careless and allows it to. New-born kids, if born in a contaminated area, may easily pick up the bacteria through the navel immediately after birth.

6.4.8 Brucellosis

Brucellosis in goats is caused virtually exclusively by Brucella melitensis. In the presence of cattle, goats can become infected with Brucella abortus, but this is rare. The main effect of brucellosis is abortion, normally in the fourth or fifth month of gestation. Occasionally mastitis can be caused by brucellosis. In bucks the testicles may become swollen, causing infertility. Brucellosis is particularly serious, because it can be transmitted to humans by consumption of fresh, infected milk or by handling infected goats.

If brucellosis is suspected, a competent laboratory must carry out a blood test or preferably culture material from an aborted foetus, from the stomach of the foetus or placenta. The simple Rose Bengal or milk ring test is useful in identifying infected flocks, but does not accurately identify infected individuals. The new Enzyme Linked Immunoassay (ELISA) tests are simple to perform and 99 per cent accurate. There are two tests: the Indirect ELISA and the Competitive ELISA. The Competitive ELISA can be carried out in the field beside a goat. The lack of accurate testing facilities in many countries makes eradication difficult.

There is no treatment for brucellosis, but there is a vaccine (Rev1). Any goat confirmed to have brucellosis should be culled immediately. Great care should be taken in destroying any aborted foetus and associated material. Brucellosis should always be suspected in cases of abortion, and thorough hygienic procedures followed. Any person associated with aborting goats should, ideally, wear gloves, because these organisms can penetrate the skin. Milk should always be boiled before it is consumed by humans.

6.4.9 Mastitis

In a goat with mastitis, the udder is inflamed and becomes swollen, hot, and painful. The inflammation may be caused by several different bacteria: mainly Staphylococcus spp, but also Streptococcus spp, Pasteurella haemolytica, and Corynebacterium pseudotuberculosis (caseous lymphadenitis), as well as mycoplasma (see contagious agalactia, 6.5.6.). Mastitis may show two forms: clinical, when symptoms are visible, or sub-clinical, when infection is present but milk and udder appear normal. In either case, milk production is reduced: by as much as 25 per cent in
sub-clinical cases, and as much as 100 per cent in clinical mastitis (although this is poorly documented in goats). It is more common in goats that are milked by machine or hand than in those that are only suckled by their kids. Mastitis is usually caused by milking in a dirty environment, rough handling of the udder, or forcing goats to lie in a dirty, wet environment immediately after milking. In some cases it may develop during the last few weeks of gestation.

Treatment involves the infusion of antibiotics into the teat canal (Figure 6.19). The main antibiotics used are penicillin or ampicillin for most infections. Tetracyclines may be useful for infections caused by *Streptococcus* spp or *Corynebacterium pseudotuberculosis*. Normally antibiotic applicators are available only for cattle mastitis. These applicators usually have nozzles that are too big for easy insertion into a goat’s teat; if they are not used with great care, they may damage the teat. Do not drink milk for at least seven days after treatment with antibiotics. Always wash the teat with soap and water and ideally an antiseptic before inserting anything into the teat. If intra-mammary infusions are not available, and in severe cases, antibiotics should be given by injection. The teat should be milked out two–three times a day and the milk thrown away. Bathing with hot water will reduce the pain.

It is important to put effort into preventing mastitis, because for most small farmers its treatment is difficult, even impossible in the absence of antibiotics. Once it has affected a doe, she may lose the use of one or both teats; or at the very least milk production will be reduced.

All milking should be done in the cleanest possible environment. For most smallholders the purchase of a commercial teat dip is not possible. Cleaning the udder with soap and water before and after milking is feasible in most systems. Allowing the kid to suckle out
both teats will also ensure that there is no milk remaining in the teat canal, which is the route of the initial infection. Feed goats in a clean dry area immediately after milking, so they remain standing until the teat canal is tightly closed.

Do not use milk from goats with mastitis for human consumption. It is usually recommended that kids do not suckle a dam with mastitis, but it may not always be feasible to insist on this.

6.4.10 Foot problems

Foot problems are relatively common in goats. Most problems are caused by bacteria infecting the foot, but the attachment of ticks between the claws of the feet can also cause severe lameness. The main pre-disposing factors to bacterial infection are prolonged wetting of the feet, making them soft and soggy, together with over-growing of the horn of the feet. A cut or tear between the claws can also allow infection to enter. Affected goats will infect the soil, from where other goats can pick up the infection. The main symptoms are lameness and a bad smell from the foot. Treatment involves trimming back the infected horn until healthy horn is found. Ideally the foot should be sprayed after trimming with an antibiotic spray, or dipped into an antiseptic solution such as formalin (10 per cent) or copper sulphate. Take care to remove and destroy all infected trimmings, because they can infect the soil and other goats. If several goats in a large flock are infected, the whole flock should be made to walk through a foot bath of copper sulphate or formalin, to prevent further infection. It is hard to design a foot bath that goats cannot jump over. Care must be taken to lead them slowly through the bath, ensuring that their feet are dipped in the solution. Make sure that they do not drink it.

Foot rot is an important disease of goats, particularly grazing goats, which may rapidly lose condition if they cannot graze properly. If they are unable to keep up with the flock, they should be kept at home and feed should be cut and carried to them.

Foot trimming

The horn of goats' feet constantly grows and will be worn down on hard, stony ground. However, not all goats walk long distances on rocky ground, so some goats, especially housed goats, need their feet to be trimmed regularly. It is easiest to trim feet with a pair of specially-made foot trimmers; if they are not available, farmers should be encouraged to use a small knife.

6.4.11 Orf

Orf is a common sight in goats, so it is included in this section on common diseases. It is caused by a virus and it is highly infectious.
Orf causes sore patches around the mouth, usually starting at the corners of the mouth. An affected kid may spread it to the mother’s udder. Does with painful teats will not allow kids to suckle, and these kids may die of starvation. Adult goats that are affected will not eat properly and may lose condition. There is no treatment for orf. Antibiotic sprays or powders will prevent any secondary infection from any open sores. Feeding soft feeds, such as tree leaves or sweet-potato vines, will help the goat to eat and stop it losing condition. Affected goats should be isolated, but this may not always be possible. Immunity will develop over time. Owners should be warned that humans can become affected with the sores.

6.5 Other goat diseases

The common diseases of importance to goats in the tropics have been described, together with measures that can be taken to treat, control, or prevent them. There are other conditions that can develop, either occasionally or in particular circumstances. A brief guide to these less common diseases is given below, presented according to the parts of the body most affected.

6.5.1 Diseases of the digestive system

Acidosis
Acidosis is a digestive problem caused when goats eat too much easily digestible energy (starch or sugar), such as that found in grain or root crops, without sufficient fibre accompanying it. The pH of the rumen becomes very acid. There may be bloat, diarrhoea, and great pain, shown by grinding teeth. The rumen stops functioning and, if not treated, the goat will die in one–two
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days. It is rare for goats in the tropics to develop acidosis, but it can occur if goats are unsupervised and scavenge in areas where grain is stored, or when there is a sudden change in the diet due to the sudden availability of a new feed-stuff. Treatment is difficult and involves the use of a stomach tube to put oil, charcoal, and sodium bicarbonate in the rumen. Mild forms of acidosis may be called indigestion.

Bloat
Bloat is caused by the goat eating high levels of highly digestible protein, which may be found in alfalfa or clover. There is a burst of microbial activity, releasing too much methane gas, which becomes trapped in a foamy froth inside the rumen and cannot be expelled. The main sign of bloat is a swelling of the rumen on the left side. The goat will be in great pain and have difficulty breathing. This is an emergency. Make the goat stand and walk. In the absence of commercial remedies for bloat, force the goat to drink one cup of vegetable cooking oil. If the bloat does not respond to the oil, it is necessary to release the gas immediately by puncturing the rumen. There is a special device, a trocar and cannula, which allows this to be done efficiently. If a trocar is not available, a sterilised knife or a sharp piece of bamboo (or something similar) can be used to open and hold open a hole in the rumen to release gas. However, unless this is done very hygienically, most goats will die from later infection. Bloat is rare in the tropics, because most tropical legumes do not have high levels of digestible protein.

Bluetongue
Bluetongue is a relatively rare viral disease of goats in Africa, Asia, and the Americas. It is transmitted by a small biting midge. Most goats in areas of infection do not show any symptoms, but occasionally previously unexposed goats, such as imported exotic goats, will show signs which can be confusing. A high fever is followed by a nasal discharge, salivation, and licking. The discharge will dry and encrust the nose. The lips will swell and become tender, sometimes bleeding. The encrusted lips may look a little like orf. A swollen blue tongue may be seen. Death from emaciation may occur. Mortality rates up to 20 per cent are common, occasionally rising to 90 per cent. Control measures are seldom necessary, but consider vaccinating any exotic goats imported into an area where bluetongue is endemic.

Colibacillosis
Colibacillosis is a severe diarrhoea of young kids, caused by the bacterium Escherichia coli. Watery diarrhoea, dry mouth, and a
stomach full of gas are the main signs. The kid quickly becomes dehydrated and will soon die, unless given fluids. Quick action must be taken to replace the lost fluids with salt, sugar, and clean water, or with oral rehydration salts (ORS), and to kill the bacteria with oral or injectable antibiotics. Kids develop colibacillosis if they have not received enough colostrum immediately after birth and are then reared in a dirty environment. This may occur because of the death of the dam or simply through poor management. Kids must be kept in the cleanest possible surroundings.

**Enterotoxaemia**

Enterotoxaemia is caused by a toxin produced by rapidly growing bacteria (*Clostridium perfringens*, mainly type D) in the small intestines of kids and adults; it is usually brought on by a sudden change in diet. There are two main types of the disease. The first affects young kids and adults; the second is more commonly found in immature goats (1–12 months). Sudden death may occur without any previous symptoms. In very young kids there will be severe abdominal pain, diarrhoea, and death. Adults may have diarrhoea, may stagger, and may finally lie on their side in convulsions. The only successful treatment is to administer an antitoxin. The toxins may, in some cases, be absorbed by powdered charcoal. Only goats that are well fed are affected by enterotoxaemia. There is an effective vaccine which should be given to the pregnant doe six weeks and four weeks before she kids. Kids should be vaccinated after weaning.

**Johne’s disease (paratuberculosis)**

Johne’s disease is a chronic, progressive wasting disease, seen in goats two–five years old. They gradually lose weight, and milk production declines. The disease is caused by a bacterium, which can be picked up from the soil or by kids suckling infected milk. Stress, such as giving birth, may trigger the disease. The bacteria interfere with the absorption of nutrients. There is no treatment. To control the disease in a flock, infected goats should be culled. Imported goats should be tested for it before importation.

**Salmonellosis**

Infection with salmonella bacteria causes profuse diarrhoea, watery, foul-smelling, yellow to greenish-brown in adults and kids, and abortion in pregnant does. The soil of pens can become infected and may need to be replaced with clean soil. Thorough disinfection of houses or movement to a new house may be required to break the cycle of infection. Treatment with oral antibiotics, tetracyclines, or sulpha drugs is effective in most cases, together with good nursing.
6.5.2 Diseases of the respiratory system

*Oestrus ovis*

The nasal bot fly, *Oestrus ovis*, is occasionally a source of irritation to goats. The fly deposits larvae in or near the nostril of the goat. The larvae migrate into its sinuses and grow to 3–4 cm long, causing a thick nasal discharge, sneezing fits, and irritation. Eventually the mature larva will be sneezed out of the nasal passage and fall to the ground. There it will burrow into the ground, pupate, and re-appear as a fly. Very rarely the larva remains trapped inside the head of the goat and dies there, leading to infection of the sinus and possible death of the goat. The flies will irritate grazing goats and disturb their grazing. In most cases this condition can be ignored, provided that it does not interfere with feeding. Ivermectin, at 0.2 mg/kg, is highly effective against all stages of the larvae.

6.5.3 Diseases of the reproductive system

*Chlamydial abortion*

Chlamydial abortion, also known as enzootic abortion, causes abortion late in pregnancy, and still-born kids. The doe often retains the placenta, giving rise to subsequent infection. Chlamydial abortion tends to cause a wave of abortions in newly infected herds. The use of antibiotics (long-acting tetracycline at 20 mg/kg every 10–14 days) on all pregnant does can stop the spread of infection through a large flock. Control is achieved through burying aborted foetuses and other birth tissues, and separating infected from uninfected goats. There is also an effective vaccine, given one month before mating.

*Dystocia*

Dystocia, discussed in detail in 7.4.4, is a general term to describe any difficulties during kidding. The kid may not be in a normal position (front leg back, head back, etc.); or the doe is very young and has a small pelvis; or the kid is very large, or dead before birth.

*Metritis*

Metritis is the inflammation of the uterus. It may be caused by a retained placenta, by retained kids, or from trauma and infection of the uterus after a difficult kidding. The signs of metritis are fever and depression, normally with a bad-smelling vaginal discharge. A course of oxytetracycline should be given if these signs are observed after birth.

*Prolapse*

Sometimes, after a difficult delivery, the doe's uterus may fall outside her body; this is known as a prolapse. The rectum or
vagina may also prolapse. In all cases, specialist veterinary help is required to replace the tissues inside the body. If a vet is not available, it is best to slaughter the goat.

6.5.4 Diseases of the blood, lymph, and immune system

**Anthrax**

Anthrax is a killer of goats. It is caused by a virulent bacterium picked up from the soil. The goat may die suddenly without any signs of disease, or it may develop a high fever and depression, with the mouth and eye becoming dark purple; there is sometimes bloody diarrhoea. After death, blood will seep from the body openings. If anthrax is suspected, do not open the body. If the carcass is opened, the whole area around it will become contaminated with bacteria for many years. If caught early, anthrax can be treated with penicillin or tetracyclines in large doses for five days. Normally it is discovered too late for effective treatment. There is an effective vaccine, which should be given annually in areas where anthrax occurs. Carcasses should be burned or deeply buried.

**Trypanosomiasis**

Trypanosomiasis is a blood parasite transmitted by the tsetse fly. It is widespread in the more humid parts of Africa and is of great economic importance to cattle. Fortunately goats are not so badly affected by trypanosomiasis as cattle are, and indigenous breeds of goats in endemic areas appear to have developed high levels of tolerance to the disease. It is still not clear whether this is because the fly does not bite goats as much as cattle, or whether there is a physiological tolerance to the blood parasite. The main symptoms are chronic weight-loss and accompanying weakness. If affected goats remain untreated, 10–15 per cent will die. There are injectable treatments for trypanosomiasis, such as ‘Berenil’, ‘Novidium’ ‘Samorin’, and ‘Ethidium’. In areas where trypanosomiasis occurs, there is often a black-market trade in drugs, which are often bought and sometimes misused by farmers and pastoralists. The drugs are expensive, so poorer farmers are tempted to split a single dose between animals; this results in under-dosing. Repeated under-dosing in an area can render the parasite resistant to the drug, leaving livestock vulnerable to the disease.

The relative tolerance of goats to trypanosomiasis gives them an important role in livestock development in tsetse-infested areas. In some areas, goats may be the only species of domestic ruminant which can safely be kept. If tsetse-control measures are impractical, and the disease is too expensive for farmers to treat, consideration should be given to the wider use of possibly trypano-tolerant breeds of goat to supply meat and milk.
6.5.5 Diseases of the muscles and skeleton

Akabane disease

Akabane disease is a viral disease, transmitted by biting midges. It leads to the birth of abnormal kids. Infected pregnant goats may abort, give birth to stillborn kids, or deliver kids with rigid joints and wasted muscles. Kids may be blind and in some cases are brain-damaged. There is no treatment for the disease and no way to control the midges. There are effective vaccines against the disease.

Caprine arthritis encephalitis (CAE)

Caprine arthritis encephalitis (CAE) is a virus disease of goats that is distributed worldwide, with a higher prevalence in milking breeds of goats kept in confinement in developed countries. Few indigenous tropical breeds have been exposed to CAE, so all goats imported from Europe, North America, or Australia should be certified as having come from a CAE-free flock. In adults the goats show signs of arthritis, with enlarged joints causing lameness, and a gradual loss of condition. In kids of 2–4 months, CAE causes paralysis to ascend from the hind legs up the body, leading to deranged behaviour, blindness, and head tremors. Kids become infected through drinking infected colostrum and milk, so the only way of controlling the disease is to separate kids from their mothers at birth and rear them artificially.

Foot and mouth disease

Foot and mouth disease (FMD) is an important viral disease of cattle, but is much less severe in goats. Goats become dull, and develop a mild fever and blisters on the mouth and tongue and between the toes. Affected goats are lame and sometimes unable to stand. There is no treatment, but there are effective vaccines against the most common strains. Use the vaccine for the strains in your area. The local government veterinary office must be told if FMD is suspected. In some countries, affected stock have to be destroyed.

Navel ill

Navel ill, or joint ill, develops after infection enters the new-born kid through its navel. Symptoms may be seen immediately, or may be delayed for one month. The main symptoms are fever, painful joints, and a swollen, tender navel stump. If the kid is very young, less than two weeks, treatment with penicillin, tetracyclines, or sulpha drugs may be effective. In older kids, treatment will have little success. It is very important that kids are born in a clean place; ideally the remains of the umbilical cord and the navel area should be treated with an antiseptic, such as tincture of iodine.
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Physical injury

Although goats are sure-footed, agile animals, they do suffer from a variety of physical injuries. They are sometimes attacked by dogs or wild animals; they may cut themselves on sharp objects while out grazing, or in their own house or pen. Goats are very prone to fractures and dislocation of their legs in feeding racks and troughs. Bucks that have not grown up together may fight to establish a hierarchy when first introduced. They can damage each other badly if they have fully-developed horns. The removal of horns and disbudding of horn buds from kids are not recommended and in most cases there is no need. Goats not kept in confinement may need their horns for protection against predators. Disbudding of kids should be performed by a veterinarian using a hot iron. It is cruel to perform this without a local anaesthetic such as lidocaine. However, inexperienced personnel may cause greater damage to the kid by the misuse of the local anaesthetic, so it is not a recommended practice unless carried out by those with experience. Adult goats, if they are aggressive, may have their horns sawn off 15 cm from the base. Do not cut any lower, or the blood supply to the horns may be severed, and severe, even fatal, bleeding may occur.

Young goats are often able to recover from broken bones if a simple splint is made to support the bone and the goat is allowed to rest and not made to walk far. Two small pieces of straight wood should be cut to the length of the whole broken bone. These splints should be strapped tightly on either side of the broken bone. Be careful not to cut off the blood supply. The splints should be removed and re-applied every week, and the broken limb checked for healing. Check the skin and soft tissues regularly, to be sure that the splint is not rubbing and damaging them.

6.5.6 Diseases of the mammary gland

Contagious agalactia

Contagious agalactia is a disease caused by Mycoplasma agalactia. The disease may be seen in acute and sub-acute forms. The most common form is sub-acute, when mastitis develops and milk production declines. The milk has a characteristic yellow-green colour. There is sometimes a more severe sub-acute form with mastitis and hot, swollen joints. This joint swelling can occur in males and non-lactating females. Sometimes there is an eye infection as well. Mortality may reach 15 per cent. In the acute form there is a high fever and emaciation; milk production stops and the goat will die within one week. Contagious agalactia is controlled through good hygiene, disinfection, and separation of infected goats. Treatment with antibiotics is not recommended, because it can result in the treated goat becoming a carrier. An effective vaccine is available in some countries.
6.5.7 Diseases of the eye and skin

Fleas and lice
Fleas normally affect only kids, and usually poorly fed kids. They may irritate the kids, causing them to scratch themselves repeatedly; they will also suck blood. The net result is that kids will not grow and thrive. Lice can commonly be found on adults. Most of the acaricides listed in Tables 6.13 and 6.14 will kill fleas and lice, but they should be administered very carefully to young kids, which are very sensitive. Powdered acaricides are safest for kids. Thorough cleaning and treatment of housing may also be necessary to prevent re-infestation.

Goat pox
Goat pox is caused by the same virus as sheep pox. It can be severe in kids. Early signs are a clear nasal discharge, standing with an arched back, fever, and standing hair. One or two days later many small nodules will appear all over the body, clearly visible on the less hairy parts of the body. Eventually scabs will develop on the lumps and last for 3–4 weeks. Mortality can be as high as 80 per cent, usually from the development of pneumonia. There is an effective vaccine, which should be given annually. If goat pox is suspected, it should be reported to the local government veterinary office.

Malignant oedema
Malignant oedema is a particularly bad infection of a wound. The wound may be a simple cut or a wound from castration. The tissue around the wound starts to die and rot through the invasion of Clostridial bacteria. The goat may die within two–three days, depending on the severity of the infection. Early treatment with penicillin, tetracycline, or sulpha drugs can effect a recovery. There are vaccines against clostridial infections.

Melioidosis
Melioidosis is a bacterial disease that was thought to occur only in South-east Asia but has now been reported in Africa, Australia, and Europe. The symptoms are vague, and the disease is hard to spot. There may be an intermittent fever and coughing, with or without a nasal discharge. The eyes may become watery as well. Sometimes joints become swollen and there may be abscesses in lymph nodes, lungs, and other organs. Nervous symptoms may also be seen. There is no effective treatment. Control is difficult to achieve, because there are often symptomless carriers where the disease is endemic. The lymph-node abscesses can make it difficult to differentiate melioidosis from caseous lymphadenitis. Infected goats can be identified conclusively by blood tests or cultures. If it has entered a large flock, culling infected goats may
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be considered, and even culling any that have been in contact with infected stock.

**Pink eye**
Various organisms can infect the eye. In most cases the infection will clear up by itself, but infected goats should be kept separate from the rest of the flock when possible, because many of the organisms are highly infectious. The first signs of infection include a watery eye, swelling of the eyelids, and dislike of bright sunlight. Later the centre of the eye may become cloudy. In most cases this white patch on the eye will clear up, but sometimes it will ulcerate, resulting in blindness in that eye. Antibiotic eye ointments will, in most cases, speed up recovery. Alternatively, oxytetracycline given under the skin (subcutaneously — s.c.) should help the goat to recover. If pink eye develops into a serious problem in the flock, it is simplest to treat all affected goats and those in contact with them with a course of long-acting oxytetracycline.

**Ringworm**
Ringworm is a fungal disease of the skin. The first signs are rough circular areas on the skin, often on the head and neck. The hair will fall out, usually in a roughly circular pattern. Ringworm is not a serious problem, but care should be taken, because it can affect humans. Special fungicides, such as ‘Defungit’, can be purchased to control ringworm; there are simpler alternative treatments, such as washing the affected areas with iodine (2–7 per cent) two–three times a week. Another treatment suggested is to make a paste from the anthelmintic thiabendazole and rub it into the affected area. Ringworm must be differentiated from mange, because different treatments are required; see 6.4.2.

**Streptothricosis**
Streptothricosis, also known as dermatophilosis, is a bacterial skin disease of goats, found particularly in the humid tropics. Large spots appear, mainly on the head, ears, and legs. The hair becomes matted with the clear fluid oozing from the spots. The spots tend to merge into large scabs. The bacteria causing the infection may enter the skin through long periods of wetting, which softens the skin, or through biting flies, ticks, or wounds. Treatment involves giving large doses of antibiotics (penicillin, streptomycin, or long-acting tetracyclines). Control is achieved through controlling factors which predispose the goat to infection, such as ticks or exposure to rain.

**Warts**
Goats appear to be rather prone to warts. Warts are most likely caused by a virus which enters the skin through a scratch or wound. There appear to be three main types: those affecting the
Goat health

head (and gradually spreading over the body); those affecting the lymph nodes (which can lead to tumours); and those that affect the feet, leading to foot rot as a secondary infection. Warts grow slowly; most goats shed their warts after about six months. Warts appear to be most common during drier seasons.

Warts can be cut, burned, or frozen off; but if this is inexpertly done, the warts will spread and become a major problem, even causing death. It is normally best to leave them alone. Treatment with 10–20 per cent salicylic acid ointment in a stable base such as Vaseline has been found to be effective. It is best to apply the ointment at least twice at an interval of 3–4 days. It is important to provide good nursing in order to prevent secondary infections of the wounds. Maggots may develop in the wart lesions. Systemic antibiotics such as oxytetracyclines may prevent secondary infections of lesions. A predisposing factor for warts is exposure to sunlight. A wart can lead to carcinoma and eventually to skin tumours. The main complications are foot warts, which may lead to foot rot and severe lameness and the formation of tumours.

Warts are controlled by isolating affected goats and avoiding physical injuries. The use of a vaccine has been reported as successful in some cases. It is made by grinding up a wart and suspending it in saline solution (8 grammes of salt in one litre of distilled water), adding oxytetracycline, and injecting it into the skin, not under the skin.

**Wound dressing**

If a goat is wounded, the wound should be cleaned with either a saline solution (salt and water) or a dilute antiseptic such as Savlon. Make sure that all foreign material is removed and that the wound and wound edges are clean. The use of forceps and cotton wool ensures cleanliness but may not always be possible. Ideally the wound should be left uncovered to dry and heal. An antibiotic spray or antibiotic powder should be applied to the clean wound. Insect-repellent, applied around the edges of the wound, may prevent development of maggots in open wounds.

6.5.8 Diseases of the nervous system

**Listeriosis**

Listeriosis, or circling disease, shows three forms. One affects the brain, causing the circling symptoms; the second one may cause abortion; and the third, which is rare, causes blood poisoning. In the form that affects the brain the goat will die quickly, normally within 48 hours. Affected goats show lack of coordination, circling behaviour, high fever, and partial paralysis of the face, such as drooping eyelids, mouth, or ear. Intravenous injections of penicillin or tetracycline antibiotics in the early stages may be helpful, but most will die. Isolation of infected goats is important.
Listeriosis may come from poorly made silage. The organism can be passed in the milk of infected goats, and the disease is transmissible to humans.

Rabies
Rabies may, rarely, affect goats if they are bitten by a rabid dog or vampire bat. Urban scavenging goats are, perhaps, more liable to rabies infection than rural goats. There is no treatment and the disease is always fatal. The main cause for concern is transmission to humans through handling a goat with rabies. It is always a fatal disease in humans. The main symptoms are confusion, standing apart from other goats, and eating unusual objects such as wood or metal. The goat may have saliva dripping from its mouth, and staring eyes. Laboratory diagnosis is necessary to confirm the disease. People should exercise extreme caution when handling any goat that shows any sign of nervous symptoms. Avoid contact with saliva and other body secretions, and wash hands immediately after handling the animal.

Scrapie
Scrapie is caused by a virus-like organism; it is mainly a disease of sheep, but it can affect goats. It is now widespread in the tropics through the export of affected sheep from Europe. It has a very long incubation period, two–four years, so it is seen only in mature adult goats. There is no treatment and the disease always causes death two–six months after the first signs. Symptoms appear very slowly; they include general nervous signs, a wobbly walk, and dull hair. As the disease progresses, the goat will show the characteristic sign of trying to scratch itself at the base of the tail. This itching will creep up the body. If the goat is scratched, it will indicate its pleasure by twitching its lips. The only form of prevention is to purchase goats from scrapie-free flocks. Once established in a flock, the disease may be impossible to eliminate without destroying the whole flock.

Tetanus
Tetanus is a well-known disease of humans and animals. It is caused when a bacterium (Clostridium tetani) enters the body through a wound. Signs of tetanus may appear one–two weeks after a goat is wounded. The legs become stiff and the animal stands with straight legs. The whole body becomes stiff when the goat is frightened; the nostrils flare open; and the eyelids droop. There is no effective treatment, and most goats die. There is an effective vaccine. Tetanus is associated with some routine management procedures such as open castration, so animals should be vaccinated before these procedures are carried out.
6.5.9 Diseases of nutrition and metabolism

Grass tetany
Grass tetany, or grass staggers, occurs when the forage consumed has low levels of magnesium. It may occasionally occur if goats are grazing very fast-growing pastures. Goats with grass tetany show nervous signs at first which can look like milk fever (see below). They may tremble and be unable to stand. Treatment involves the use of drugs containing magnesium.

Milk fever
Milk fever is caused by an acute shortage of calcium in a doe just before, or just after, kidding. It is quite rare. The doe will become very weak, perhaps unable to walk, and may have difficulty delivering her kid. She may have an abnormally low temperature. This disease should be considered an emergency. In a severe case, if left untreated, the doe may enter a coma and die. Treatment involves the slow intravenous injection of calcium borogluconate (25 per cent). An injection of 50-100 ml should be given cautiously, as the heart may be affected. Milk fever is rare in goats in the tropics, but may occur in high-yielding dairy goats.

Mineral deficiencies
Table 6.15 presents the symptoms of the most important mineral deficiencies, together with the main source of the mineral to correct the deficiency. Mineral deficiencies are rare in most goats grazing in the tropics, if they are able to select a wide range of feed. Localised mineral deficiencies do occur, such as the well-known deficiencies in copper, zinc, manganese, and cobalt in plants grown on the soils of the Rift Valley in East Africa. If they are known to occur, the appropriate supplements should, ideally, be fed. However, in practice it is often hard to do so. Common salt should be offered regularly, particularly in very hot climates.

Vitamin deficiencies
Table 6.16 lists the most important vitamin deficiencies and their symptoms likely to encountered among goats in the tropics. Young, growing animals have a much higher demand for vitamins and minerals and are therefore more likely to exhibit signs of their lack. Provided that it is supplied with the necessary ingredients, the goat itself can successfully synthesise many vitamins.

Poisonous plants
There are several plants that are reported to poison goats if eaten. In most cases goats appear to know which plants are poisonous and avoid them, unless they are very hungry. The most common plants reported to poison goats are as follows.
### Table 6.15 Mineral-deficiency symptoms

<table>
<thead>
<tr>
<th>Mineral</th>
<th>Deficiency symptoms</th>
<th>Source of mineral</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Major minerals</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calcium</td>
<td>Deformed bones (rickets)</td>
<td>Milk, green feed, fish/bone meal, limestone</td>
</tr>
<tr>
<td></td>
<td>Retarded growth</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Milk fever</td>
<td></td>
</tr>
<tr>
<td>Phosphorus</td>
<td>Rickets, stunted growth</td>
<td>Milk, cereals, fish/bone meal</td>
</tr>
<tr>
<td></td>
<td>Soil eating, deformed bones, low milk yield, poor fertility</td>
<td></td>
</tr>
<tr>
<td>Magnesium</td>
<td>Weight loss, excitability</td>
<td>Bran, cottonseed/linseed cake</td>
</tr>
<tr>
<td>Sodium</td>
<td>Loss of appetite, slow growth</td>
<td>Common salt, fish/bone meal</td>
</tr>
<tr>
<td>Sulphur</td>
<td>Salivation, baldness</td>
<td>Protein in feeds</td>
</tr>
<tr>
<td><strong>Minor minerals</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cobalt</td>
<td>Weight loss, weakness</td>
<td>Vitamin B₁₂</td>
</tr>
<tr>
<td>Copper</td>
<td>Anaemia, weight loss, poor appetite, nervous signs</td>
<td>Seeds</td>
</tr>
<tr>
<td>Iodine</td>
<td>Goitre, poor hair, birth of dead kids, poor growth and fertility</td>
<td>Fishmeal, seaweed, iodised salt</td>
</tr>
<tr>
<td>Iron</td>
<td>Anaemia, poor appetite</td>
<td>Green forages</td>
</tr>
<tr>
<td>Manganese</td>
<td>Difficulties in walking, deformed forelimbs, poor fertility</td>
<td>Rice/wheat bran</td>
</tr>
<tr>
<td>Selenium</td>
<td>Weak muscles, difficulties in walking</td>
<td>Vitamin E</td>
</tr>
<tr>
<td>Zinc</td>
<td>Stiff joints, salivation, swelling of feet, low libido</td>
<td>Cereal grains</td>
</tr>
</tbody>
</table>

- Lantana (*Lantana camara*): a common ornamental species in the tropics which often escapes from gardens and colonises large areas if left unchecked. It is not liked by goats, except during severe dry periods, when it may be consumed. Large quantities have to be consumed before any symptoms are shown. The plant is reported to make the skin sensitive to light (photosensitisation) and may cause severe diarrhoea, even resulting in death.

- Castor bean plant (*Ricinus communis*) contains the poison ricin in the leaves and stems as well as the bean.
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**Table 6.16 Vitamin-deficiency symptoms**

<table>
<thead>
<tr>
<th>Vitamin</th>
<th>Deficiency symptoms</th>
<th>Source of vitamin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vitamin A</td>
<td>Poor appetite, weight loss, night blindness, poor hair coat</td>
<td>Browse, leafy hay, sweet-potato vines</td>
</tr>
<tr>
<td>Vitamin B₁</td>
<td>Blindness, nervous signs</td>
<td>Synthesised in rumen, supplied from brewer’s yeast</td>
</tr>
<tr>
<td>Vitamin B₁₂</td>
<td>Weight loss, weakness</td>
<td>Synthesised in rumen, supplies cobalt to rumen</td>
</tr>
<tr>
<td>Vitamin D</td>
<td>Weak, deformed bones</td>
<td>Synthesised by skin, obtained from hay, fish meal</td>
</tr>
<tr>
<td>Vitamin E</td>
<td>Weak muscles, difficulties walking, poor fertility</td>
<td>Grains, leaves of green forage</td>
</tr>
</tbody>
</table>

- Solanaceae family, including the Thorn Apple, Sodom’s Apple, etc. are all poisonous but are rarely eaten.

- Mimosine is found in many legumes, including leucaena, which is toxic to most goats if consumed in large quantities (greater than 50 per cent of the diet). There are goats in some countries, such as Indonesia and Hawaii, that are very tolerant of high levels of mimosine in the diet. A procedure has been developed to inoculate mimosine-intolerant goats with rumen micro-organisms from tolerant goats, enabling them to consume high levels of mimosine-rich legumes.

- Cassava has a high level of hydrogen cyanide in the skin which can poison goats. Cassava should never constitute more than 50 per cent of the diet.

  The sudden death of a goat from an unknown cause is often attributed to poisonous plants, for want of any other cause. In reality poisonous plants only rarely kill goats. Evidence of the suspected plant should be looked for in the rumen contents while carrying out a post-mortem examination. It should be a large part of the rumen contents to make a convincing case for poisoning.

*Pregnancy toxaemia*

Pregnancy toxaemia may occur in goats in the tropics that are very poorly fed during pregnancy and which are carrying twins or triplets. The uterus expands as the foetuses grow, reducing the capacity of the doe to consume a large quantity of forage. The multiple foetuses themselves also make a high nutritional...
demand on the doe. If the forage is of very low quantity, she is in double trouble: she has a critical shortage of energy and will have to mobilise whatever body reserves she has. This rapid mobilisation of body reserves at the end of the pregnancy results in the production of ketones as a by-product; these are toxic in large numbers. The main symptoms are depression, weakness, poor balance, and eventually inability to stand. If the condition is caught in the early stages, good feeding with a grain concentrate will help. If it is caught late, the doe is most likely to die in a few days. Intravenous glucose, together with good feeding, may save her, but the chances are slim.

6.5.10 Diseases of the liver

Rift Valley fever

Rift Valley fever (RVF) is a viral disease, transmitted mainly by mosquitoes but occasionally by ticks. It is found only in Africa. The disease usually appears in occasional epidemic waves. Usually the first sign is abortion. In younger goats the signs are a fever, unsteady walking, vomiting, and a profuse nasal discharge. Milk production drops and sometimes stops altogether. Mortality rates are high among kids, but lower in adults. There is no treatment. Control is through the control of the mosquito and the housing of goats in mosquito-proof houses.

6.6 Treating and investigating diseases

6.6.1 Treatment and nursing of sick goats

Sick goats, like sick people, need special care and attention if they are to recover. All too often, unwell goats are neglected and treated like the rest of the flock. The stress to a sick goat from having to go out grazing long distances, or not having access to clean water, may make the difference between death and recovery. Any goat that is ill, particularly if it has a fever, should be allowed to stay at home in a cool, quiet place. It should have access to green feed and clean water. Goats are not good patients. They tend to sink into a depression from which it is often difficult for them to recover. Psychological support and encouragement will help them to recover.

How to give injections

Pneumonia is the main disease for which non-professionals might need to give an injection of antibiotics. If using reusable plastic or nylon syringes, sterilise them and reusable needles by first cleaning them in soap and water and then boiling them in water for 15–20 minutes. Disposable needles and syringes are more convenient, but are expensive. Before injecting into any site, clean it with alcohol or an antiseptic. There are three sites for injection.
• **Intramuscular (i.m.)** is the most common injection method. Use a 18-gauge needle, 2–3 cm long, to inject antibiotics deep into a large muscle. In small, young goats a smaller 20-gauge needle should be used. The best site is the neck muscle just in front of the shoulder, or the fleshy part of the shoulder itself. Hit the muscle two or three times with your fist to accustom the goat to the procedure and prevent it from clenching its muscle as the needle enters. This can lead to muscle stiffness and discomfort. The needle should be inserted quickly, straight into the muscle. Before injection, draw out the plunger slightly to check that the needle has not entered a blood vessel. If blood enters the syringe, withdraw the needle and try again in another place. No more than 5 ml of drug should be administered in one site.

• **Subcutaneous (s.c.)** injections are given under the skin, usually in the skin just behind the shoulder or in the neck. A short needle, 1–2.5 cm, should be used. Pull out a fold of skin and insert the needle at an angle towards the body of the goat.

• **Intravenous (i.v.)** injections are given into a vein. This may be needed in an emergency, in order for antibiotics to enter the bloodstream as quickly as possible. Intravenous injections should, ideally, be given by a veterinary professional.

6.6.2 Procedure after death

If a goat dies, it is helpful to carry out a simple post-mortem (after death) examination to try to find out the cause of death. This may be important in identifying infectious diseases and preventing their spread to other goats in the flock. Many farmers cut open the carcass of animals which die and look inside, and this is good practice. It is also useful if extension staff are able to carry out a simple post-mortem examination and learn how to record systematically what is seen. Extension staff should teach farmers to look out for the key signs of specific diseases and report them when seen.

In order to carry out an effective post-mortem, it is important that the size, colour and texture of normal organs are known, so that any abnormalities can be observed and recorded. Visits to a slaughterhouse, or to butchers who slaughter goats will enable extension staff to become quickly familiar with the appearance of the organs of normal goats.

How to do a post-mortem

First find a convenient site, away from the owner’s house and other livestock, and in a place where the dead goat can subsequently be burned or buried at a depth of at least one metre. You must be aware of the potential risks of contaminating the
area around the post-mortem site. Never perform a post-mortem near any water supply, or close to grazing areas. Dig a small hole beside the carcass, into which organs and fluids can be placed.

Ideally, post-mortem examinations should be carried out wearing rubber gloves. Alternatively thin plastic bags can be used to cover your hands. However, in the field they may not be available. If they are not available, check your hands for any cuts or bruises. If you have any cuts, do not perform a post-mortem. Get someone else to open the carcass and examine the organs while you watch.

Obtain a detailed case history from the owner of the goat (see 6.2.3). This, combined with an examination of the outside of the carcass, will help to direct your attention to the organs most likely to be involved in the disease described.

Ideally you should have someone to record the findings of the post-mortem as you describe them.

Post-mortem diagnostic key

1. **Observe the dead goat.** If there are any dark bloody discharges from the mouth, nose, or anus, then **DO NOT OPEN IT**, as it may have died of **anthrax**. Anthrax is a very dangerous disease. If the body is opened, the whole surrounding area may become contaminated.

2. **Touch the body to check for any gas under the skin.** Does it crackle under the skin? If yes, there might have been **clostridial infection**, such as **malignant oedema**. Check the body for any external abnormalities. Check for ticks. How severe is the infestation? If there are any ticks, take samples. Check all legs for **foot rot** and **wounds**.

**NOTE:** If the body is stiff, swollen, or bloated, **DO NOT OPEN IT**, because too long a period has elapsed after death to be able to determine the cause of death. Do not bother to carry out a post-mortem on a goat that has died more than 12 hours before, because the internal organs will have already started to decompose.

3. Lay the body on its back or side and cut the skin in a line along the centre of the abdomen and chest. Remove the reproductive organs (testicles or udder). Pull the skin back. Bend back top foreleg and hindleg.
4. Open the body by cutting the ribs along the line of the backbone and cutting the ribs along the chest and removing the rib cage.

5. Tip the body up and look at the fluids. Are they bloody or yellowish? Do there seem to be a lot of fluids? If yes, suspect enterotoxaemia.

6. Remove the whole digestive tract without opening it, by tying the top and bottom ends of the tract with string, so that the contents of the tract do not spill out. If you do not have string, you can tie the intestine itself in a knot. Remove the tract and keep it for later, with the liver and the spleen.

7. Check the heart for fluids inside the outer membrane of the heart. If there are lots of fluids, then heartwater might be the cause of death.
8. **Cut the top of the trachea and remove it with the lungs** and keep them for later.

9. **Look for the kidneys**, which will be in some fat at the back of the abdominal cavity. Extract the kidneys from the fat, remove and keep them.

10. **Check the bladder**. Open and observe the colour and quantity of urine. Check inside the bladder for any haemorrhage, dots of blood, or lines of blood. If yes, suspect poisoning.

11. **Look for the spleen** attached to the rumen, close to the liver. Check the length and edge of the spleen. Is it sharp or blunt? A normal spleen is firm, with sharp edges. Feel the consistency. If the spleen is enlarged and soft with a blunt edge, then the cause of death was possibly anaplasmosis. If the spleen is very swollen and lymph nodes are swollen, suspect trypanosomiasis.

12. **Check the liver** for size and consistency: hard, springy like dough, or fragile? Cut across the length in 2-3 places and press. If liver fluke are present, dark-coloured fluke will pop out. Run a knife blade on the surface of the liver to feel for any spots of dead (necrosed) tissue. If there are greyish/yellow areas, these may be the migratory tracts of liver fluke.

If the liver and spleen are very enlarged, and if the gall bladder is distended with thick, dark green bile, then suspect babesiosis. If it is a kid and the liver is pale and yellow with grey patches, or if it is an adult and the liver is red/brown with dead patches, then suspect Rift Valley fever. To confirm, check intestines for haemorrhage. **Note:** Rift Valley fever is dangerous and can infect people.
13. Check the lungs for **consistency**. Feel each lung for hardness, nodules, and cysts.

Open the trachea and continue cutting into the lung. Check for foam, worms, and blood. Adult worms in the bronchi indicate **lungworms**.

Cut a small piece of lung and put it in a cup of water. If the lung is normal, it will float; if diseased, it will usually sink.

Cut across the length of the lung, press, and see if there is any foam. If there is much straw-coloured fluid, then suspect **contagious caprine pleuropneumonia (CCPP)**. If there is clear fluid and the lower part of the lung is red/purple, then suspect **pasteurellosis**. If there are abscesses in the lung which are oozing pus, then suspect **meliodosis**.
14. Check the kidneys. The kidney will normally start to putrefy 12–24 hours after death. However, if the kidney putrefies within six hours after death, suspect enterotoxaemia (pulpy kidney).

15. Check the digestive tract. First observe the whole tract for any dark patches.
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**Small intestine:** If there is a dark patch, open in that area; if it appears normal, open randomly. Cut open and remove the contents into a container. Cut along the length and check for any attached worms.

Check the inside wall for any blood lines. If they are present, suspect **enterotoxaemia.** Check the contents for any worms. In some cases you may not be able to see the worms with the naked eye. Watch for a wave-like motion in the contents of the small intestines. This is due to the movement of parasites. If the contents are bloody and nodules are present on the intestinal surface, suspect **coccidiosis.**

**Large intestine:** As for small intestine, but carefully check for blood lines: the so called 'zebra markings', which are common in **peste des petits ruminants (PPR).** If the large intestine is filled with liquid faeces, and there was evidence of severe dehydration, suspect **colibacillosis.** If there are obvious haemorrhages, particularly in the caecum and colon, and enlarged internal lymph nodes, then suspect **Nairobi sheep disease.**
Rumen: Cut the rumen along its greatest curve. Remove the contents. Look for worms attached to the wall (small red oval-shaped worms when full of blood). They indicate *Paramphistomum* and are not important.

Check the inside wall; if it rubs off easily, then acidosis might be the cause of death. Check contents for foreign materials (plastic bags, metal objects, etc.); for smell (a beer-like, fermenting smell indicates acidosis); for appearance (if frothy, suspect bloat).

Check the contents of the reticulum for foreign material such as nails, plastic bags, wires, etc.
Check the contents of the omasum for foreign material.
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**Abomasum**: Put contents into a container and wash the flaps of the wall into the container. Look at the wall for blood spots, blood lines, or blood. Look for small white worms with a red spiral pattern attached to the wall; these are probably *Haemonchus contortus*. If you can see many worms, there is a major worm problem.

All post-mortem photographs were taken by JENNY MATTHEWS

16. After the post-mortem the body should not be eaten, but ideally should be deeply buried or burned.

*Taking samples during a post-mortem*

If you have access to a good veterinary laboratory, any organ found not to be normal should be preserved as a sample and taken to a veterinary laboratory for further investigation. When taking samples, always take both the affected part and a normal part of the organ. Samples should be preserved in 5 per cent formalin, or frozen. If this is not possible, they can be preserved in a strong saline solution. They should reach a laboratory within 12 hours. Clearly label the sample, and send it to the laboratory with a copy of the post-mortem examination record.

**6.7 The organisation of goat health care**

In most countries in the tropics, the veterinary services are overstretched and tend to be concentrated in the richer, more fertile areas. It is hard for poorer countries to provide a veterinary service to all livestock producers. Many governments have realised that they cannot afford to continue providing a subsidised veterinary service, so they are starting to privatisate their service. Goats are more often kept by marginal farmers and by pastoralists, in areas where veterinary services are scarce. Even the services that do exist are more concerned with cattle and buffaloes than with sheep and goats. Few veterinarians receive any special training on the diseases of goats, or are encouraged to carry out research on the problems of goat health. For all these reasons it is of fundamental importance in any goat-development
programme that owners themselves are trained to prevent the important diseases and to cope with the major health problems as they arise. Some problems will require the assistance of veterinary professionals if available, and the government veterinary service will always have an important role in controlling infectious diseases through the regulation of stock movement, vaccination, testing herds and flocks, and regulating drug use. The current trend appears to lead towards an increase in the use of private veterinary practice for basic clinical treatment; this trend may leave many marginal goat farmers with even fewer veterinary services than they had before.

Many governmental and non-governmental organisations have found it helpful to supplement the existing veterinary service and establish a more decentralised health-care system, involving the community themselves in looking after the health of their livestock, rather than relying on outside services. In order to achieve this, farmers are trained to be what may be called paravets, community veterinary assistants, basic veterinary workers, or vet scouts. The objectives of this training are:

- to improve the community's access to essential veterinary drugs and services, and so maintain the health of their goats;
- to encourage the paravets to train farmers and pastoralists in the basic health care of their goats;
- to improve disease surveillance through the timely reporting of disease outbreaks in the community.

The paravets should, ideally, work within the existing veterinary system, whether that is a government service or veterinarians operating in private practice. Before paravets are trained, discussions must be held with the relevant authorities, to ensure that they are accepted and will be able to function effectively. There may be regulations governing the use of certain scheduled drugs, such as antibiotics and trypanocidal drugs. Ideally the paravets would have close links with government veterinary staff and might initially be supervised by them.

Paravets may be trained to serve the needs of a defined group of goat owners, such as members of a goat group or cooperative. In the short term, paravets have a useful role in improving the health care of goats. In the long term, the most important role of the paravets is to train their fellow farmers and pastoralists to carry out simple procedures and use basic drugs.

### 6.7.1 Training of paravets

#### Selection of trainees

Ideally, the trainees should be selected by the community itself. They should be willing to serve the community, and be responsible and respected members of the community. They should be
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successful livestock keepers themselves. Paravets may be men or women. Women have been found to be very effective paravets for goats. They should be settled members of the community who are prepared to serve for a reasonable period and are not likely to leave soon after training has been completed. It is not essential that they are able to read or write, although it is a bonus if they can. Illiteracy should not prevent candidates who are otherwise suitable from being trained. Ideally, at least two trainees per community should be trained, so that if one is sick, or leaves the community, one will still remain. Often school-leavers are selected for training, because they are literate. However, unless their paravet role offers them a living, they are unlikely to be interested in serving the community for a long period.

Duties of the paravet
The paravet should, at a minimum, be able to deworm, spray, treat wounds, and castrate goats. They should be able to detect important diseases and report outbreaks to the local veterinary officer. They should also be able to train their fellow farmers in maintaining the health of their stock. In certain circumstances, trainees could be taught to use antibiotics and trypanocidal drugs, provided that the range of drugs and their dosages are small. Each country will have its own legislation governing injectable drugs, and these regulations must be followed.

Training method
The training does not have to be very sophisticated, but should be very practical. There should be an initial training period of, say, 5–7 days. It is important that the training sessions are simple, short, practical, and participatory. ‘Hands-on’ experience is very important in developing skills and building up confidence. The training should take place in the community itself. There is no need, and it is undesirable, to take trainees away from their community for residential training. The most important element in the training is obtaining enough goats to expose the trainees to as many different diseases and conditions as possible in the time available, so giving them as much experience as possible. It is helpful to gather together trainees in one village and call goats to come and be treated; this is a very effective way of seeing many cases. Different villages can be visited each day of the course.

To assist illiterate trainees, simple pictorial treatment-guides and price-lists can be prepared, to serve as a reminder and assist in recording payments received for the different services given.

At the end of the training, a small graduation ceremony should take place, at which the paravets are presented with a certificate of attendance and their set of drugs and equipment. In this way they are identified within their communities as people with special skills and resources.
The organisation of goat health care

Figure 6.23a (above) A pictorial guide to treating goats, used in Ethiopia

Figure 6.23b (below) A pictorial chart to record treatment given
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After the initial training course, government veterinary staff should closely supervise the newly-trained paravets. A follow-up course should be organised after, say, three months, to allow feedback and discussion of problems encountered. Refresher courses should also be arranged, probably every year, to maintain standards and teach the use of any new drugs that may become available.

Course content
The content of the training should vary according to the major diseases of the area. There is no point in including obscure diseases that are rarely seen. Emphasise the importance of prevention, rather than efforts to cure an already sick animal.

- Animal diseases and management
  - Recognising sickness
  - Care of young, pregnant, and lactating stock
  - Kidding problems
- Examination of a sick animal
  - Taking a history
  - Observing clinical signs, including temperature, to identify infections
- Internal parasites
  - Common internal parasites
  - Effects on animal and clinical signs
  - Post-mortem on purchased animal to demonstrate internal parasites
  - Treatment
  - Strategic control in relation to rainfall pattern
- External parasites
  - Common external parasites (ticks, lice, and mange)
  - Effects on animal
  - Transmission
  - Treatment
  - Control
- Digestive problems
  - Causes
  - Treatment
- Lameness, wounds, and fractures
  - Foot rot
  - Dressing wounds
  - Abscesses
- Infectious diseases
  - Common infectious diseases, including CCPP and PPR
  - Isolation
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Reporting
Vaccination

- Trypanosomiasis (in appropriate areas)
  Clinical signs
  Transmission
  Treatment
  Control

- Care of sick animals
  Feed and water
  Rest
  Isolation

- Procedures
  Deworming
  Spraying
  Dressing wounds
  Castration
  Hoof-trimming
  Measuring medicines and estimating weight
  Administering medicines
  Care of drugs and instruments
  Restraint of animals

- Planning a year of goat health-care
  Vaccination
  Drenching
  External parasite control
  Routine measures (foot-trimming, castration, etc.)

Drugs and equipment required

After training, the paravets should be supplied with basic drugs and equipment in a convenient bag or box. Basic equipment might include:

- Anthelmintics
- Knapsack sprayer
- Flukicide
- Thermometer
- Acaricide
- Burdizzo castrator
- Terramycin spray
- Injectable Terramycin
- Savlon
- Foot trimmers
- Cotton wool
- Syringe 10 ml (for measuring)
- Ophthalmic ointment
- Record book
- Fungicide
- Balling gun for anthelmintic boluses
- Antibiotic powder
- Dressing forceps

The content of the set should vary according to the prevailing diseases of the area and the appropriate control measures that paravets can take. Ticks are not a problem in many areas, so the knapsack sprayer would not be required in all places.
Provision must be made to resupply the paravets with drugs when they have exhausted their supplies. This may be done by an external donor or government veterinary department, by purchasing from a commercial drug shop, or by a community-established revolving fund for the purchase of drugs. It is important to be realistic about the long-term sustainability of the supply of drugs. Recovering the full cost of the drug is the only realistic way of ensuring the long-term sustainability of the programme. In many countries, drugs are in short supply or—if available—are very expensive. Paravets should not start using drugs that they cannot subsequently obtain.

Recording methods
The records kept must have a particular purpose, which will depend on the organisation of the paravet programme. Records can be kept to monitor disease incidence and drug use, and to keep accounts for a revolving drug-fund. The records can also monitor the activity of the paravets themselves. Simple records can be kept by even illiterate farmers.

6.7.2 Organisation, monitoring, and evaluation of paravets
Paravets can operate in several different ways. They can function as part of the government veterinary service, being supervised and supplied with drugs by them. Alternatively they can operate privately, obtaining drugs from the private sector and selling them and their services to client farmers. They are likely to be trained by government veterinary staff, with some NGO or other external support. They will then be supervised by government veterinary staff and are likely, in the short term, to receive drugs from some external source. Paravets may start as virtual volunteers, receiving some remuneration by charging a small mark-up on the cost-price of the drug. However in the long term it is too much to expect them to remain as volunteers. The continuing sustainability of the programme cannot be ensured unless drugs are charged at their full cost. The price charged by the paravets should provide sufficient incentive for them to continue working. Some are likely, at some point in their lives, to find their duties a burden and stop working, while others may develop their own 'practice' and become professional paravets.

The government veterinary staff and the community should be involved in supervising paravets and ensuring that drugs are used properly. In some places, the government veterinary service prefers paravets to sign an agreement, indicating that they will administer only certain authorised drugs and carry out certain specified activities. An example of the agreement is shown in the box opposite.
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I am a member of [Name] Goat Group.

I have received training in deworming, spraying, foot-trimming, wound-dressing, and castration.

I have received the following drugs and equipment from [Name] Goat Group to treat goats belonging to the group members:

- Anthelmintics
- Acaricide
- Terramycin spray
- Savlon
- Cotton wool
- Ophthalmic ointment
- Record book
- Knapsack sprayer
- Balling gun
- Thermometer
- Burdizzo
- Dressing forceps
- Foot trimmers
- Bag

I will work in the future under regulations set by the Veterinary Department and the needs of the community. If I do not keep this agreement, I will return all drugs and equipment to [Name] Goat Group. If I fail to return this equipment, I understand that I may be pursued under the law.

Paravet Leader of Goat Group Veterinary Dept.

Drug shops and revolving funds

If paravets are to provide a sustainable service, they must have easy access to a reliable supply of the important drugs they need. There may already be local veterinary drug shops, from which they can buy their supplies. If there are no drug shops, owners of general stores might be trained and encouraged to stock a small selection of basic veterinary drugs. Alternatively, credit may be given to a trained paravet to start a small drug shop, or the goat group or cooperative may set up their own. These drug shops can also play a useful role in monitoring the performance of the paravets. The shop-keeper or attendant must be trained as a paravet, so that he or she can give reliable advice to any farmers coming directly to the shop.
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In some countries where drugs are scarce, there may be a black market in certain drugs. If black-market drugs are available, paravets must be trained in their correct use, so that they can educate their fellow farmers. Farmers and pastoralists must be encouraged and trained to use all drugs properly, and paravets can play a vital educational role.

Example of paravet organisation: the 'Wasaidizi' of Kenya

In Meru, central Kenya, the Intermediate Technology Development Group (ITDG), supported by Oxfam (UK and Ireland) and working with the Catholic Diocese of Meru, started a community-based animal health-care project. They trained both men and women farmers to be ‘Wasaidizi wa mifugo’, or ‘helpers of livestock’, providing basic health services to farmers in the area. They quickly became known simply as Wasaidizi. ITDG also helped several individuals to start small veterinary drug shops. After seven years of operation, some paravets are earning a small income from the services they provide. The owners of the drug shops, who were also trained as Wasaidizi, found that they could not make a good enough living from selling only drugs, so now they stock some grocery items as well. They report that increasingly farmers are coming directly to the drug shops to buy their drugs, having been trained in their use by the Wasaidizi. The drug-shop owners have developed contacts with drug wholesalers in Meru town and are able to negotiate their own discounts. The drug shops are vital to the long-term sustainability of the Wasaidizi in this area. Source: Grant (1992)

Further reading