

CHAPTER TEN

Sheep and Goat Products and By-products

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Objectives

The objectives of this chapter are to explain how to:

1. use improved methods of skin preservation.
2. produce skins in quality and quantity.
3. purchase products based on standards.
4. create awareness in buyers, traders and producers.
5. supply raw material to the tanneries.

Expected Outputs

1. Improved awareness by producers, traders and buyers.
2. Improved quality and quantity of sheep and goat products and by-products.
3. Increased transactions based on standards.

10.1. Introduction

A number of products and by-products are produced from sheep and goats. The major ones include meat, milk, skins and manure. Milk, skins and manure will be discussed in this chapter. Sheep and goat meat will be discussed in Chapter 12. The discussion on skins takes the major proportion of the coverage due to the big export revenue currently obtained and the potential for increasing earnings from this product.

10.2. Goat and Sheep Milk

10.2.1. Milk composition

Goat milk is consumed in some parts of the country. Milk from sheep is rarely used. Goat milk is composed of fat, protein, lactose, ash and water. It has a pure white appearance when fresh. Typical figures for milk solids content are given in Table 10.1.

Cows have similar total solids to goats whilst sheep have much higher fat and protein. Milk composition differs somewhat among breeds but these values are representative averages. It has been well documented that goat and sheep milk have important advantages over cow milk for human nutrition.

Table 10.1. Composition of goat, cow, and sheep milk.

Composition	Goat %	Cow %	Sheep %
Total solids	13.9	13.5	19.3
Fat	4.8	4.8	7.6
Protein	3.7	2.8	5.5
Lactose	5.0	4.6	-
Ash	0.85	0.74	-

Source: Devendra and Mcleroy, 1982.

Compared to cow milk, goat and sheep milk have higher protein, energy and fat contents with beneficial amino acids. The higher proportions of short- and medium-chain fatty acids make goat and sheep milk easy for human digestion. Because of this, and the way it forms a fine curd in the stomach, humans can more easily digest goat milk than cow milk. Goat milk is an excellent source of calcium, phosphorus and chlorine. It is also believed that goat milk will not cause cow-milk-allergy (CMA) in many patients because of its species-specific proteins.

Goat and sheep products include liquid milk, powdered milk, cheese, yogurt, ghee and ice cream. As much as 50% of goat milk production is made into cheese world-wide. Their milk and dairy products can meet a significant portion of the daily nutrient requirements of humans in the world. In addition, goat and sheep products greatly diversify the diets of people and are considered as delicate treats in many developed countries. More importantly, they provide food security, needed nutrition and can be an income source.

10.2.2. Milk yield

Goats: Non-dairy breeds in the tropics have daily milk yields of up to 0.5 liters while specialized dairy goat breeds could give 2–4 liters per day. The milk production of goats is affected by different factors, including body size, weight, parity, stage of lactation, udder size, litter size, nutrition, breed and kidding season.

Sheep: A good dairy ewe produces about 1 kg (1 liter) of milk each day for about the first three months, and an outstanding ewe can produce 2–3 liters per day. Typically, milk yield rises after lambing and reaches a maximum within one or two months. Thereafter, milk yield slowly falls and drops. The same factors affecting milk production mentioned for goats also apply for sheep.

10.3. Sheep and Goat Skins

Ethiopia has 23.62 million sheep and 23.33 million goats. Hides and skins, leather and leather products are supplied to domestic and export markets and contribute significantly to the Ethiopian economy by providing 14–18% of the foreign exchange earnings. These earnings, however, are but a small portion of the potential income in view of the huge animal resources available. The main constraints to increased utilization of hides and skins are low quality and lack of grading/selection of the raw hides and skins purchased. About 80% of the hides and skins in Ethiopia are produced in rural areas. An extensive training and extension service is important in improving the quality of the raw materials entering the tannery industry. Additionally, it is essential to create facilities and make available the tools and equipment necessary for improved collection and enhanced quality of hides and skins available.

10.3.1. General structure of skins

The terms “skins” and “hides” have differences in meaning. The distinction is one of size and substance or thickness. Smaller and lighter skins derived from sheep, goats or pigs are termed “skins”. In some species, the deciding factor will be the type of animal rather than size alone. For the purpose of this handbook, skin is defined as an outer covering from goats or sheep.

The skin histology of animals normally used in leather production is similar but species differences are readily observed. There are, for examples, differences in the relative amounts of the component tissues and their arrangement in different types of skin and in different places in the skin. The component structures of the skin are capable of flexing, stretching or contracting with the movements of the body.

An animal’s skin has a number of functions, the most important being to:

- provide a light, durable covering for the body;
- assist in the regulation of body temperature;
- prevent or minimize possible injury to internal organs;
- provide a barrier to bacterial infection; and
- provide a waterproof covering for the body while allowing moisture to leave the body, e.g., through perspiration.

The general structure of mammalian skin is illustrated in Figure 10.1. This figure shows the skin before removal of hair or the cornified epidermal/outermost layer of the grain side by dehairing as occurs in the leather-making process.

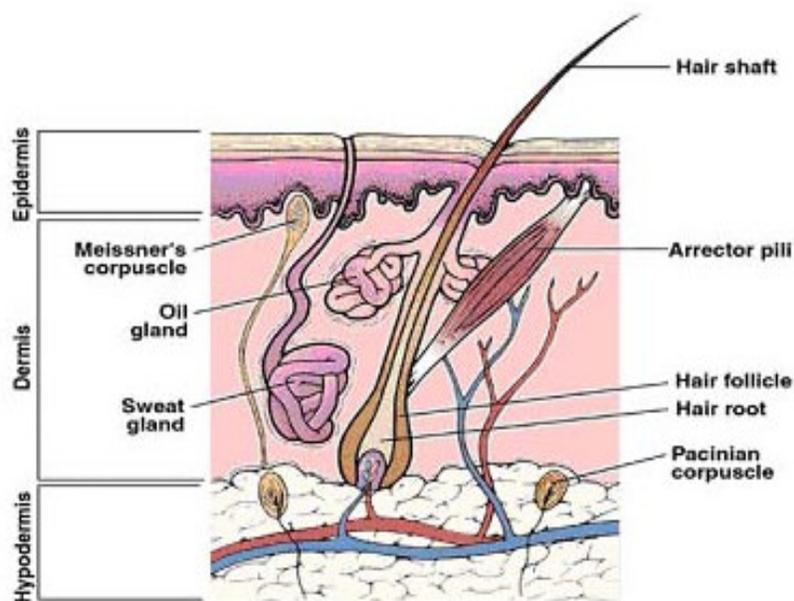


Figure 10.1 Main components of the mammalian skin

There are three layers to the skin, of which two, the epidermis or outer layer and dermis or middle layer, are important in leather making. The third layer is the flesh layer and is composed of meat, fat, etc., and is removed in the tanning process. The most important layer for leather production is the dermis that is composed of a network of finely interwoven bundles of tissue. The dermis is composed of the grain layer, the corium layer, and the junction or layer where the grain and corium meet. The skin also contains

structures and components such as hair, pores, sebaceous glands, hair erector muscles, white collagen, yellow fibers (elastin), blood vessels, sweat glands, hair root capillaries, hair follicles and underlying muscle sheath.

10.3.2. Production of skins

Ethiopia has a large potential for production of small ruminant skins, having 12.6% of the sheep and 11.6% of the goats raised in Africa. Annual off take rates have been estimated as 33% for sheep and 37% for goats. One constraint to skin production is high mortality with rates estimated at 11.4% and 11.6% for sheep and goats, respectively. Lamb and kid mortality rates are even higher. A negligible amount of skins are obtained from animals that die. The potential number of skins available for marketing can be estimated as 8.9 million sheep skins and 5.3 million goat skins.

Table 10.2. Quantity of skins supplied to tanneries in 1994/95 (Ethiopian Calendar).

Products	Supply (million) to:		% of total supply to tanning industry
	Tanning industry	Traditional tanners and other users	
Sheep skin	8.9	1.17	88
Goat skin	5.3	2.08	72

Source: Computed from MOA, 1997/98 and MEDAC, 1999.

Ethiopia exports semi-processed hides and skins at pickle, wet blue and crust levels of processing and exports some finished leather products of different standards. There are about 20 tanneries engaged in processing hides and skins. Only 6 of these have the facilities to produce finished leather. About 5% of the finished leather is supplied to domestic industries for the production of shoes, leather garments and hand bags. The rest is exported to international markets in the form of similar products. In 2004, the export value of 9,218,103 kg of leather and semi-leather products was reported as 362 million Birr. Most tanneries are not operating at full capacity and could increase utilization of existing processing capacity should more quality raw skins be available.

10.3.3. Factors affecting skin quality

10.3.3.1. Care during the life of animals

Skins in Ethiopia have greater economic return than most agricultural products and by-products. As a result, small ruminants should be given due care from birth to slaughter. Management practices should ensure the health of the animal and reduce the likelihood of injuries that could damage the skin. Treatment and vaccinations should be given on time as required. Treatment against ticks should be given through regular dipping or spraying. Providing proper feed and watering sites will help prevent sheep and goats from damaging their skins while searching for feed in the bush.

Fatigued animals, especially after a long trek on foot or rail, should be allowed to recover prior to slaughter or incomplete bleeding may occur. Removing the skin is also difficult in fatigued animals leading to more chances for the skin being cut. Animals should have free access to drinking water for at least 24 hours before slaughter and either held off-feed or given very little feed.

10.3.3.2. Care during slaughtering and flaying

Humane methods of slaughtering animals are encouraged; however, exact practices in Ethiopia differ according to local culture, customs and religious practices.

Stunning

Stunning is the practice of rendering animals unconscious just before slaughter. Proper stunning procedures reduce the chance of stained carcasses and blood splash. The following stunning options are available:

- Mechanical instrument (Captive bolt pistol) that traumatizes the brain so that the animal loses consciousness instantaneously.
- Electrical stunning.
- Use of carbon dioxide gas.

The animal must be killed as soon as possible after stunning by bleeding.

Religious slaughter

Religious slaughter methods include *Shechita* by Jews, *Halal* by Muslims and *Jatka* by Sikhs. The major blood vessels and the throat are severed by a transverse cut in the shechita and halal slaughter methods. In Jatka the animal is decapitated with a single stroke using a sword. The halal method of slaughter is of importance due to the Muslim target market for Ethiopian sheep and goat meat.

Bleeding

Whatever the slaughter procedures, bleeding is best performed with the carcass hoisted by the hind legs while leaving the forelegs to kick in the usual reflex action. Animals must be stunned prior to hoisting. For sheep and goats, some flayers prefer to complete most of the bleeding on the floor adjacent to a drain. When sheep and goats possess long hair, much more care must be taken to avoid contamination with blood and dung, and bleeding on a definite slope is to be preferred. In either case, final bleeding is best carried out after suspension of the carcass.

Ripping

- One long and straight incision from the jaw to the anus along the center line of the belly.
- Four circular cuts around the shanks at the level of the knee and hock joint.
- Two cuts on the inside of the forelegs, knees to the breast bone.
- Two cuts on the back of each hock joint to a point mid-way between the anus and scrotum.

Flaying

Flaying in sheep and goats can be done by first making a small incision on the inside of one of the hind legs. Air is blown into the incision to effect separation of subcutaneous tissues between the skin and the carcass. After this, vigorous pummeling is also done.

In many countries, skinning is done in case form to obtain a good quality skin and also to use the skin later as a water bag. The hind legs, including a small portion of the skin covering the abdomen and edges of the butt round the rump, are flayed with knife and fist while on the floor. The carcass is hoisted by the hind legs and the skin removed by pulling and fisting. Sometimes, the belly skin is removed using a knife leaving the surface of the carcass with close serrated scores. But in many countries a knife is not used in the final phase. The flayer uses the weight of his foot with downward pressure to remove the skin from the neck and forelegs.

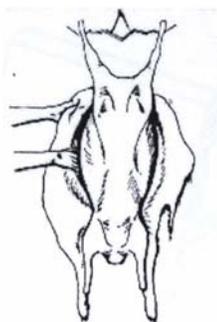


Figure 10.2. Flaying of goats and sheep using a fist.

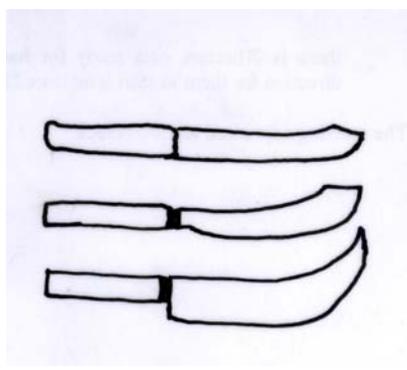


Figure 10.3. Proper ripping and flaying knives.

In other systems, the carcass is cut down the center of the belly and on the inside of each leg. The foreleg incisions join the center incision at the breast and the hind leg incisions follow the line of the rump to the anus. The bellies and legs are then flayed on the floor and finished on a hoist, if possible.

Appropriate flaying methods

- Incision: Blowing air into the cut in the hind leg. Relevant in case one wants to use as water bag.
- Flayed with blunted curved knife following ripping lines.
- Hoisted by the hind legs and skins removed by pulling and fisting.
- Mechanical flaying.
- Hand flaying machine.

Activities after flaying and before preservation

It is very important for the flesh side of any flayed skin to be as clean as possible. This is particularly important for skins that tend to have appreciable attachment of subcutaneous fatty tissue after flaying.

It is a good practice to wash skins on a firm surface in conjunction with brushing to remove extraneous material, e.g., blood, at this stage of preparation and handling of skins.

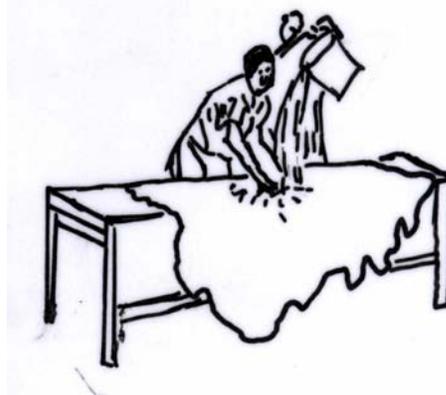


Figure 10.4. Washing of the flesh side before preservation.

How to flesh

- Use a curved-edge flaying knife
- The excess tissue can gently be removed by keeping the knife at a low angle and without exerting heavy pressure.
- Care should be taken to avoid cutting or damaging the skin.
- A wooden horse with sloping side will probably be found easier to work upon than a large table.
- Exotic skins should be suspended and scraped for cleaning and defatting.
- Suspend skins for defatting and, by scraping instead of cutting, remove the fat using a sharp curved-edged knife. As far as possible, the fat on the flesh side should be completely scraped off as fat will not permit proper curing and subsequent tanning.

- Flesh before tissue and meat dry up.
- Wash skins by pouring water over them after they have been spread out as flat as possible, over a wooden “horse.” Use a firm “scrubbing brush” or coarse broom and make vigorous strokes down the skin to remove blood, dirt, etc., as the water is applied.
- Fleshing and washing can be conducted satisfactorily using a wooden “horse” as shown in in Figure 10.5. However, a large, curved top table (Figure 10.6) can be used if a “wooden horse” is not available.

Another method of fleshing uses a “fleshing beam” and a “fleshing knife.” A fleshing beam is a piece of wood over which the hide is draped for scraping. A common type of fleshing beam can be fashioned out of a 15-cm wide board 1.75–2 m long. One end should be cut to a blunt point and all edges rounded and smoothed. Legs are attached near

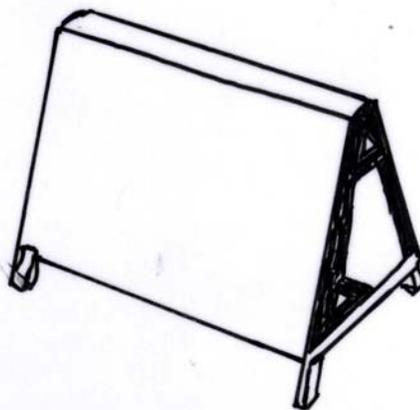


Figure 10.5. Wooden horse for fleshing.

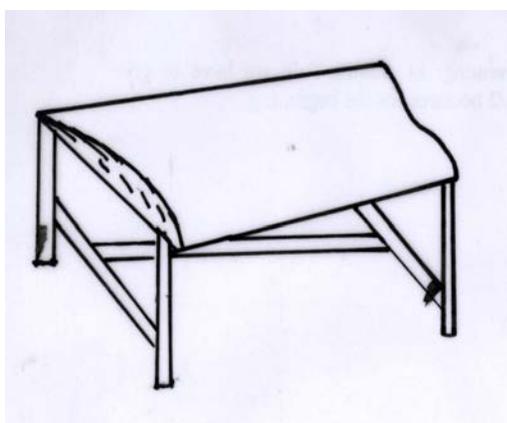


Figure 10.6. Curved-top table used in preparation of skins.

the pointed end so that the fleshing beam slants upward from the ground to waist level. While this is the most common type of beam, others such as rounded logs can be used. A fleshing knife is a blade with a handle on both ends allowing even pressure to be exerted as the blade is pushed down the hide. Blades should be dull as the goal is to push and scrape all fat, meat and membranes off the hide, leaving only the skin.

To flesh a hide, spread it over the pointed end of the fleshing beam and let it drain briefly. Push downwards, scraping off unwanted material using the fleshing knife. To make fleshing easier and lessen the chance of cutting the hide, it is important to flesh with the lay of the hair. The legs should be fleshed towards the belly and the hide from the tail pushing towards the neck.



Figure 10.7. Fleshing beam.



Figure 10.8. Fleshing using a fleshing knife

10.3.4. Preservation methods

Preservation prevents putrefaction and keeps skins in good condition until they are processed in tanneries. Being protein in nature, skins are susceptible to attacks by bacteria or mold that leads to putrefaction in hot and humid climates. Dust, dirt, soil, water, blood, fodder, etc., are sources of infection apart from microorganisms that could be transmitted by air, insects, or contact with diseased animals. The weight of a fresh skin is about 60% water, ideal conditions for bacteria to thrive. The protein matter hydrolyzed by bacteria leads to loss of skin substance resulting in poor-quality leather.

Curing creates conditions whereby bacteria are prevented from destroying skins. The type of curing used depends on weather conditions, availability of materials, location of tanneries, and so on. For instance, some drying techniques do not work during the rainy season, and salting is preferred. In all techniques, the natural water is removed so that the low percentage of moisture makes the bacteria ineffective and as soon as this condition is reversed, bacteria become active again.

In tropical countries, it is advisable to begin curing within four hours of flaying depending upon outside temperature. Raw skins should be sent to the curing facility in closed carts and protected from exposure to the sun and without being rolled. Skins can be dried with or without a frame, in the sun or in a shed.

Wet salting, dry salting and brining are other methods of skin preservation. There are also more recent techniques not yet universally applied.

10.3.4.1. Principles of preservation

The following points should be considered in undertaking skin preservation:

- Point of application of the treatment and how long preservation is required.
- Methods of application and any extra equipment and handling involved.
- The cost-effectiveness of the treatment for the required period of preservation.
- The effect of salt and other chemicals in causing pollution.

The following are some of the common drying preservation techniques

- Air drying
 - Suspension drying
 - Line/wire drying
 - Skin drying sheds
- Salting
 - Wet salting
 - Dry salting
 - Brining

Air drying

Drying of skins can be done in different ways. The techniques include drying on the ground, using suspension/frame drying, drying by suspension over cords or wires, and tent and parasol drying. Drying depends on the temperature, relative humidity and movement of air. For example, a skin can be dried in three hours in a dry atmosphere.

A fresh skin placed in warm surroundings will dry more rapidly in moving air. Even if the air is humid but moving, it will dry a damp skin. Therefore, it is bad practice to hang a skin in a closed space with solid walls

and no air movement, as this leads to putrefaction. Air currents should move freely in drying skins even if the air is hot. If a skin does not dry in 2–3 days, the chance of putrefaction is very high. Air drying can be done in the following ways:

a. Suspension frame drying: This can be practiced in different ways depending on local conditions and availability of skins. The best option is to frame-dry under a shed. While frame-drying in the open is cheaper, it is better to use a shed where suitable cross-ventilation occurs. Shed drying also allows for close supervision as well as protection from theft and control of damage from vermin. Drying sheds can have regular frames made of wood or metal pipes that are permanently fixed. Large frames meant for hides, 3 m × 3 m, can be adapted for skins by partitioning allowing four skins to be stretched (Figure 10.9).

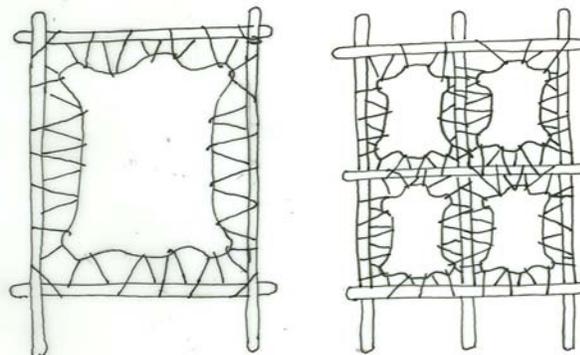


Figure 10.9. Frame drying of skins.

Suspension frame drying in the sun is acceptable provided that the temperature of the skin does not reach the point of degradation of collagen. Sun drying makes skins crack when folded and become very difficult to soak in the tanneries. Sheep skins are very sensitive to heat damage. Suspension frame drying has the following advantages:

- It allows free flow of air on both sides of the skin.
- If not in a shed, rain drains off the surface and does not collect in puddles on the skin.
- Sun rays strike obliquely not directly.
- It permits the skin to cool off rapidly from the large exposed surface area.
- Neither hair slip nor putrefaction begins as there are no folds or points of contact between the skin and any solid object. But during the rainy season, due to still air and high relative humidity, some percentage of skins may putrefy.
- Better grading possibilities.
- Dried skins can be stored for a longer period of time than salted skins.
- Transporting dried skins is cheaper as the weight is only half that of the salted skins.
- Corrosion is avoided as opposed to the case of salted skins where containers and transporting vehicles may become corroded.
- It is less expensive as salt is not purchased.
- Less worry of environmental contamination as compared with disposing used salt.

The following problems are associated with suspension frame drying

- Difficulty in rehydrating dried skins including extra cost and potential loss of skin substances leading to holes.
- Uneven shape by improper stretching during drying.
- Loss of surface area by the cuts for lacing and consequent trimming.

One has to make sure the skins are not overstretched. The method of stretching and securing to the frame is called lacing. The best lacing materials are strips from waste hides. Ropes are commonly used. Often, the slits made by knives are very long and an area inside the skin is wasted. It is better to use a punch for lace holes.

b. Suspension drying over cords or wire: This technique is employed where wood is scarce. Skins are suspended symmetrically along the backbone with the hair or wool hanging down over a wire not thicker than one's little finger. The overhanging sides of the belly and flanks must be prevented from touching each other and the shanks from folding inwards. Sticks or straw can be used to adhere to the wet flesh, ensuring that every part of the skin is free and open to the air (Figure 10.10).

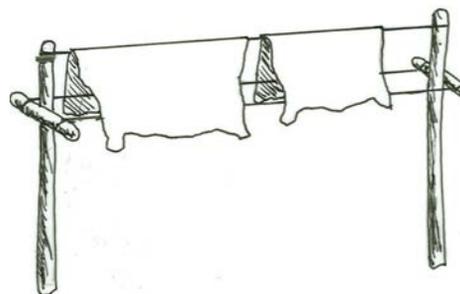


Figure 10.10. Suspension drying over cords.

The drying time is the same as frame drying. If the hair sides smell of goat during drying, all is well. If a portion of the skin is in contact with the pole it will not dry properly and will become putrefied. This is the main drawback of this technique.

c. Ground drying: This method, in which skins are placed directly on the ground, is the worst technique to use. It produces dried material of the most appalling quality, and consequently of the poorest value to the producer. Because of the lack of air circulation between skin and soil, moisture is trapped under the skin and the physical damage is irreparable. Much of the damage caused at this stage may not be fully seen until processing.



Figure 10.11. Ground drying results in serious, irreparable damage to skins.

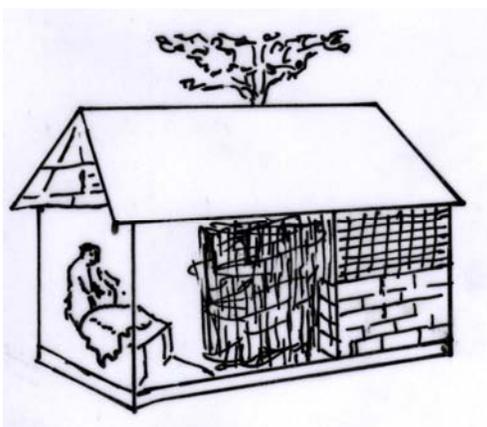


Figure 10.12. Skins drying shed.

d. Skins drying shed: Drying sheds have three sections:

1. Working area with a sloping floor where skins are prepared on tables for suspension.
2. Drying area: calculated taking into account seven days needed for drying. So for 40 skins daily, you need 70 3 × 3 m frames divided so as to hold 4 skins each.
3. Storing area: a slatted wooden platform raised 25 cm off the floor.

For a capacity of about 200 sheep and goat skins a year, the shed should measure 10 × 14 m, have a cement floor and a corrugated iron roof. The sides should be open and further corrugated iron sheet protecting the area where skins are stored. There should be 48 wooden frames (3 × 3 m divided for 4 skins each) giving 192 skin capacity fixed at a height of 0.5 m from the floor, and a

distance of 30 cm between frames. The frames, tables and wooden horses will be arranged in an area set for washing of skins where there is also a proper drainage facility.

A cement wall, 2 m high, should separate the wet area from drying area. The storage area will be protected by corrugated iron but windows should be provided to ensure circulation of air (Figure 10.12).

Salting

a. Wet salting: The skin is spread on the floor or a wooden pallet and common salt is uniformly applied on the flesh side equal to 30–40% of the green hide weight. A second skin is now spread on the first one with the flesh side up and salt applied in the same manner. A pile of about 100 skins may be made or to an approximate height of 1 m. (Figure 10.13 to 10.15).

The salt absorbs water from the skins, and the brine (mixture of salt and dissolved fluids) is allowed to drain. The stack is allowed to cure for about five days. It is then opened and put in a new pile with the top skin going to the bottom, applying additional salt wherever necessary. Again, the skins remain for five days in the pile. The skins are then removed and excess salt removed from the flesh side and the grain side to keep it clean.

Bacteria are not destroyed in this technique but a condition is created where they become ineffective. Salt absorbs about 20% of the water from the skin. Some salt is absorbed by the skin to the extent of 13–17%. In smaller skins, the percentage of salt used based on green weight is higher. Rock salt, lake salt and sea salt can be used. Any salt used should have a sodium chloride content of 94–95%.

The salt should not be too fine or too coarse. If too powdered; the salt flows out as brine and is not absorbed to the desired extent. The suggested size is two to three millimeter grain. Rock salt is the most ideal salt for curing but sea salt is most commonly used. The main disadvantage of wet salting is the formation of “red heat” which makes the flesh side of the skin red through the action of halophilic (salt-loving) bacteria and other organisms that have salt tolerance.

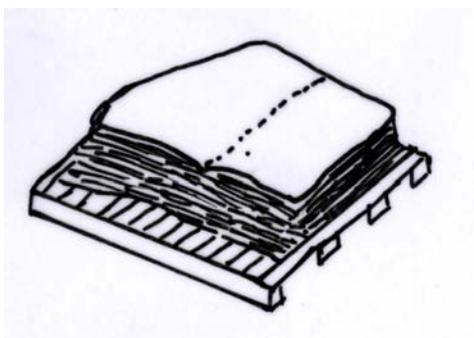


Figure 10.15. Salted of skins on a pallet.

c. Brining: Green fleshed and washed skins are soaked in brine (salt solution) for 24 hrs.

It has been the practice in some countries to recover and re-use salt swept from skins before these are shipped or sold, sometimes after mixing with fresh salt. It must be recognized that the risk of contamination



Figure 10.13. Salting skins on a cement floor.



Figure 10.14. Demonstration of salting during ESGPIP training in Semera, Afar region.

b. Dry salting: This technique is very similar to wet salting but skins are dried after the initial salting. This method gives the advantage of both drying and salting. This technique is especially well-suited for preparing skins/hides for export and at the same time overcoming the problem of wet salting. The initial steps are the same as in wet salting; however, salting has to be done without any delay after flaying.

of sound, fresh raw stock in this way is very high. This is generally practiced where salt is either considered too costly for economic use or is not readily available.

Generally, the best preservation method is salting depending on the distance of raw skin production from tanning factories. The second best option is air drying. Air drying takes a long time for processing. Dried skins require soaping and wetting before processing. This process has added cost to the tanneries.

10.3.5. Skin defects

Skins commonly exhibit defects caused by a variety of factors. Defects originating while the animals are alive are called *ante-mortem* defects while those originating after the death of the animal are called *post-mortem* defects. While some defects are common to all animals, some are specific to some species. The most common defects are listed below:

10.3.5.1. Ante-mortem

- Poor substance
- Sore marks
- Barbed wire and thorn scratches
- Rub marks
- Goad marks and whip lashes
- Bite marks from ticks, fleas, lice, leeches, etc.
- Scabies, mange, ringworm
- Pox
- Cockle
- Scars
- Diseases such as trypanosomiasis, streptothricosis, sweating sickness, etc.
- Injection punctures, shearing cuts
- Dung damage
- Natural characteristics of the skin

Defects due to ectoparasites ("*Ekek*")

Mange: This is a skin disease, of which the most common type is follicular or demodectic mange. It is caused by parasitic mites visible only under the microscope.

Scabies: The mites multiply under the skin surface leaving a coarse grain, lesions and scratch marks where the animal scratches itself.

Ticks: Blood sucking parasites found attached to the thinner and tender parts of the skin, the inner parts of the thighs, under the elbow and on the udder and scrotum. Ticks cause small holes marring the smoothness of the grain. Secondary infections may lead to more extensive damage.

Lice: Cause scars and inflammation on the grain surface more or less on regular lines around the rump and down the bellies finishing near the forelegs. These cause small punctures and give a bruised appearance to the grain.

Sheep ked: A flat brown insect that sucks blood. Normally infests sheep and spends all its life on the host. It causes irritation resulting in scratching, biting and damage to the fleece. It causes skin blemishes, downgrading the skin.

Warble flies: Occur in dry and arid regions and are generally absent in moist regions. This is due to the fact that moist soil is not conducive to the growth of larvae into flies. Hairy goat breeds with short and drooping ears are often attacked by these insects.

Cockle: A warty growth in wool sheep seen as rounded nodules scattered through the corium and appears to develop as fleece grows. The disease is due to a nutritional and digestive disorder.

Ringworm: A fungal disease that attacks the hair and its roots with circular inflammation leaving shiny scars.

Pox: An infectious disease forming inflamed spots usually on the udder and other tender parts of the skin. The spots become charged with pus. Apart from lesions, the animals rub the irritating parts causing further infection and damaged grain.

Diseases such as trypanosomiasis, streptothricosis, sweating sickness, etc.: Cause thickening and coarsening of the epidermis and hair follicles, especially in the neck. This causes hair follicles to protrude above the grain, giving a rough finish. Streptothricosis also causes lesions which break spontaneously. These cause blemishes on the superficial grain tissues.

10.3.5.2. Defects occurring during slaughter and preservation

Flaying defects

A large number of skins contain defects due to careless and inefficient use of the flaying knife. Cuts, holes and scores produced through faulty flaying greatly diminish the value of skins. Use of an improperly pointed knife adds to the problem. Flaying on the floor causes more cuts and delays in flaying which makes the carcass cold and more difficult to flay. Other defects are due to unnecessary use of a knife, insecure position of the carcass, bad lighting, and lack of skill. Using a fist wherever possible will improve the quality. If the ripping line is not properly cut, the final shape will not be symmetrical and may affect the usefulness of the skin for commercial production of quality leather, ultimately affecting the value of the leather itself. Improper fleshing allows fatty tissues to remain on the skin, resulting in poor curing both by salting and air drying. In tanning and finishing, improper curing results in patches of different quality leather during later processing.



Figure 10.16. Improper knives used in flaying

Hair slip and putrefaction

The main constituent of the skin is protein that is liable to bacterial attack. The first sign of bacterial attack is hair slip, which leads to further putrefaction. If hair slip is not checked in time, putrefaction starts, which can be from both the grain and flesh sides, leading to the decomposition of the grain layer. The degree of attack depends on the temperature and putrefaction level. At a temperature of 10°C, putrefaction will begin in 3–4 days, whereas in a tropical climate of 38°C, putrefaction will begin within 12 hours.

Often, incomplete bleeding allows blood to remain in skin capillaries, along which bacterial attack is most rapid resulting in the destruction of nearby fibers. This will be evident in glazed leather as vein marks.

10.3.5.3. Defects occurring during storage and transport

Storage damage: To produce high quality hides, storage conditions are as important as proper preparation and preservation. In Ethiopia, a good percentage of skins are damaged during storage and transportation, especially during the rainy season. Problems that occur in rural drying sheds are the major source of damage and loss of skins. Rural drying sheds are highly infested with skin damaging insects, have leaky roofs, and do not use slatted platforms. Skins become damaged and many are totally rejected. While the main portion of insect damage happens in rural drying sheds, insect damage also occurs in tanneries and warehouses of large traders.

Take precautions to avoid damages during storage:

- Eliminate existing insects in all skin storage and drying sheds. Storage places and drying sheds should be washed or painted, whichever is possible.
- Repair all leaking roofs of storage and drying sheds.
- Provide protection for cured skins from rain and sun.
- Use slatted platforms or improvise using wooden poles for storing skins.
- Spray or dust dried skins with insecticide having an effective insecticide content of 0.5% BHC.
- Aerate and turn skins frequently to provide adequate ventilation.
- If there is a delay in shipping dried skins, they should be inspected and redusted with insecticide if necessary.

Storage sheds in rural areas may be improved with available materials. It may be possible to utilize available storage facilities of other government agencies or parastatals.

Rubbing damage during transport: Many types of vehicles are used to transport skins from production sites to markets. Skins are often loaded singly on a truck or tied in loose bundles. Any movement that causes surfaces to rub together can cause considerable damage, especially to the grain, folded edges and corners. Rubbing damage caused during normal transportation by road is more or less negligible, but a certain amount of care is required to ensure protection of bales against rubbing and tearing on the outside surface by adequately covering them with hessian or gunny sacks.

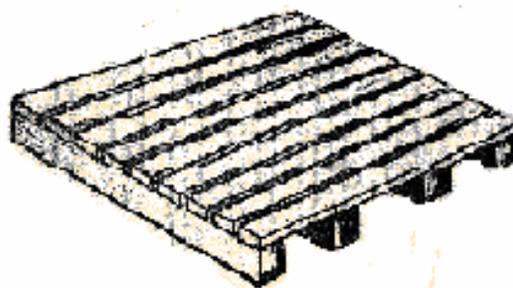


Figure 10.17. A slatted platform.

10.3.6. How to prevent defects

The following defects should be avoided or minimized by taking appropriate measures.

- Diseases: proper, timely treatments, spraying or dipping with required acaricides.
- Timely vaccinations.
- Avoid external injuries to the skin. Take measures to avoid or at least minimize the following damages: brands, yoke and harness scars, scratches, horn rapes, decorations, fighting scars, dung irritations, abscess, vegetation damage (thorns), marks, flay cuts, axe damage, dragging skins, timely preservation, etc. Maintain corrals and housing to prevent scratches and punctures from nails, barbed wire, etc.

10.3.7. General criteria for determining quality of skins

Having a standard system by which the value of a skin can be determined is vital. This is directly related to leather-making characteristics, mainly yield and quality. This standard system is essential both for the seller and buyer in the skin trade. The system is based on various quality grades taking into account all possible defects. The price of a skin depends on its grade and weight range. The principle of grading skins is similar in many countries. The following shows some of the Ethiopian standards related to skins.

10.3.7.1. Grading by appearance (based on defects) ES1201:2005

Skins are graded by their appearance as follows:

- All skin defects are identified.
- Each defect is then assessed according to its importance.
- An assessment is made on the basis of the number of defect units as shown in Table 10.3.
- Each lamb, sheep, kid and goat skin is then graded by its appearance according to the characteristics shown in Tables 10.4 and 10.5.

Table 10.3. Assessment of defect units on skins.

Defects	Defect units allocated on skins
Hand hole, hole(s) caused by beetles, each	2
Weak spot, gash, gouge or channel caused by beetles, each	1
Poor pattern	2
Siding or corduroying, per side	1
Edge soiled with urine or dung	2
Heating or grain damage, per average area of 10 × 15 cm	2
Salt spot, red or purple spots average area of 30 × 30 cm	2

ES: Ethiopian standards, 1201:2005.

Table 10.4. Classification and grading of raw sheep, lamb, and goat skins in relation to defects and useable area.

Grade by defects	Characteristics
Grade 1	No visible defect likely to depreciate the skin appearing beyond 2.5 cm from the edges, useable area of skin from the total area shall be 90–100%.
Grade 2	Defects assessed to a total of 1–3 defect units which are likely to depreciate the skin appearing beyond 2.5 cm from the edges, useable area of the skin from the total area shall be 80–90%.
Grade 3	Defects assessed to a total of 4–8 defect units which are likely to depreciate the skin appearing beyond 2.5 cm from the edges a useable area of the skin from the total shall be 70–80%.
Grade 4	Defects assessed to a total of more than 8 defect units which are likely to depreciate the skin appearing beyond 2.5 cm from the edges an unusable area at the most equal to 50% of the total area.
Rejects	Skins which have more than 50% of the surface unusable.

ES:1201:2005

Table 10.5. Assessment of kid skins in relation to defects and type of hair.

Grade by appearance and hair	Characteristics
Grade 1	Skins with wavy and smooth hair and no visible defects.
Grade 2	Skins with straight and rough hair and no visible defects.
Rejects	Skins with one or more defect units.

ES:1201:2005.

Each pickled skin is graded by its appearance according to the characteristics shown in Table 10.6.

Table 10.6. Classification and grading of pickled sheep skins in relation to defects and useable areas, %.

Grade category	Useable area by %	Description
1	90–100	No defects visible in all quadrants of the pelt which are likely to depreciate the skin appearing beyond 2.5 cm from the edges.
2	75–90	No defects visible in three quadrants; minor defects appearing beyond 2.5 cm from the edges of the pelt which are likely to depreciate the skin.
3	65–75	No defects visible in two quadrants; minor defects appear in the third and fourth quadrant of the pelt which are likely to depreciate the skin.
4	50–65	No defects visible in two quadrants; minor and major defects appear in the third and fourth quadrants of the pelt which are likely to depreciate the skin.
5	25–50	No defects visible in the first quadrant; minor and major defects appear in the rest of the quadrants of the pelt which are likely depreciate the skin.
Reject	Under 25	Major defect visible in all four quadrants of the pelt appearing beyond 2.5 cm from the edges which are likely to depreciate the skin.

ES:1201:2005.

10.3.7.2. Classification by size

Each pickled skin is graded individually into its size category as indicated in Table 10.7.

Sampling, Packing and Labeling

- Sampling lamb, sheep, kid and goatskins are carried out as 100% sampling inspection.
- Lamb, sheep, kid, and goat skins are packed in the form of bundles or bales.
- Each bundle or bale of lamb, sheep, kid, and goat skins should be labeled clearly with the following information:
 - State of skin: a) fresh, b) air dried c) dry salted, pickled, etc.
 - Type and grade of the skins.
 - Size of skins.
 - Any other labeling information required by the purchaser.

Table 10.7. Grading of pickled sheep skin in relation to size.

Classification	Categories by size (square feet)
Extra small	Below 2.5
Small	2.6–3.5
Medium	3.6–4.5
Large	4.6–5.5
Extra large	Above 5.6

ES: 1201:2005.

10.3.8. Standardization and quality control

The principal reasons for heterogeneity of the skins of each of the major domestic species include diversity of breed, age at slaughter, season of kill, standard of animal management, feed supply, flaying methods and equipment, curing method and facilities for storage and transport. In the leather sector, skins must meet standard description and classification, for example, sex, weight, cure and moisture content. Standardization is possible only when standard facilities and equipment are provided and properly organized training and supervision is conducted by qualified personnel at all levels.

One of the important factors in the improvement of skin production as a whole is the system of collection, which is far from efficient or complete. Lack of skin supply is evident almost entirely due to the lack of an effective collection system. A collection system based on incentives to encourage sheep and goat producers to collect and sell skins would result in establishment of its own network of traders in due course after mutual confidence has been established.

Market acceptance of skins is directly related to quality as determined by the criteria previously discussed. In developed countries, descriptive trade standards have evolved and have been codified in many cases and are

often supported by national or international specifications. These are sufficiently respected in trade practice, to facilitate matching sellers' offers and buyers' needs. A similar situation exists in some developing countries. But when heterogeneity prevails, as in many developing countries, values are diminished and lower prices are realized. Therefore, as far as marketing is concerned, there is a need for both improvement of quality and of sorting/grading to achieve consistency in the lots offered to local tanners or for export.

As the greater part of the supply of raw stock comes from the rural areas, small farmers or butchers, the functions of grading, sorting and selection must be exercised in the collection centers. The success depends on the size of the collecting agency. Price incentives are built into the system and the number of middle men between the primary producer and the final buyer is determined not by custom but by necessity. The advantage of improving quality or grading of skins is unlikely to be appreciated. Market value would strengthen the bargaining position of the original sellers.

Bargaining position would be the application of quality control, partially by observation, which would define acceptable limits in respect of grading in terms of weight and quality. The application of quality control measurement would be equally important at central collection and at storage sites.

Ethiopian skins have a good reputation in the international leather market for their unique natural qualities of fitness, cleanness, and compactness of texture, thickness, flexibility and strength. The highland sheep skins, known as "Hair Sheep/Selale Sheep," are considered to be the world's finest and have a highly compacted texture. They are excellent raw material for high-quality leather for dresses, gloves, sport gloves and other garments. This unique feature of Ethiopian skins enables them to fetch higher prices in the international leather market.

Goat skins from the highlands are categorized as "Bati-genuine" and those from the lowland as "Bati-type" in the international market. "Bati-genuine" is associated with the highest-quality class goatskins in the world. The particular characteristics of Ethiopian Bati-genuine goat skins are high flexibility and a clean inner surface. They are known world-wide for being excellent raw material for producing high-quality leather.

10.3.9. Marketing of skins

The marketing of skins in Ethiopia starts at the producer/consumer level and passes through a chain of middle men until it reaches the tanneries. The market chain for raw skins consists of the primary producers/consumers, agents of traders, collectors, local tanners, regional medium/small traders, regional big traders and tanneries. The individual consumers who kill animals in their backyards sell the skins either to agents, collectors, or directly to regional small/medium traders. After preservation by air drying or wet salting, the skins are passed on to big traders and then to tanneries. The tanneries and big regional traders can be supplied directly from slaughter premises. The tanneries process the skins received from the supplier either in the green/fresh, air dried or wet salted form to semi-finished stages for both local and export markets.

10.3.9.1. Constraints of skins marketing:

The main constraints adversely affecting the production and marketing of skins are:

- shortage of raw material;
- quality deterioration;
- inadequate numbers of abattoirs and slaughter slabs;
- gap between demand and potential supply; and
- lack of incentive to suppliers motivating them to provide quality raw material.

10.3.9.2. How to get better prices for skins

- Quality is a major problem with a high level of avoidable damage to skins. Improvement of the quality of raw material is vital in expanding trade in the sector. Better-quality skins obtain a better price.
- Price is determined or set by the quality grades of 1–4. Eliminating defects that cause the down-grading and consequent rejection of the raw material will improve price received.

10.4. Manure

10.4.1. Sheep manure composition

The chemical composition of sheep manure is given in Table 10.8.

Table 10.8. Analysis of sheep manure (DM %).

Breed	N	P	K	Na	Ca	Mg
Local	1.87	0.37	1.34	0.017	0.66	0.17
Crosses	1.67	0.37	1.26	0.017	0.72	0.18

10.4.2. The importance and value of sheep manure

The annual collectable sheep manure output of the country is estimated at 1.7 million tons on a dry-weight basis. This corresponds to 31,124 tons of nitrogen and 6,158 tons of phosphorous, equivalent to 556,1279 quintals (q) of urea and 307,914 q diamonium phosphate (DAP). Taking the major nutrients, i.e., nitrogen and phosphorus, the value of sheep manure in the country can be estimated at ETB177.8 million per year (1994 price of 1q DAP equal to ETB 143.35 and 1q urea to ETB 131.15). Had the price of other nutrients available in sheep manure been estimated, the value would have been higher than indicated.

In the highlands, the overall soil fertility is declining and the use of chemical fertilizers is limited. Manure in these areas is normally used as fuel and only rarely as fertilizer. However animal manure, besides containing important nutrients for crops, adds organic material to the soil, which many Ethiopian soils are lacking. Moreover organic fertilizers such as manure do not have side-effects like chemical fertilizers. Therefore, considering the major problems of fertilizer and the rate of manure to sustain crop production, the potential of sheep and goat manure as fertilizer should be exploited. Hence, farmers should be encouraged to use their manures wisely for growing crops. Other fuel sources for areas where there is fuel wood shortage also need to be sought.

Comprehensive studies have not been done on use of manure as fertilizer in Ethiopia. Some studies have shown that goat manure is a highly valued organic fertilizer in the intensively cultivated areas of the eastern Hararghe highlands. Extensive use of goat manure as fertilizer was also reported elsewhere in the intensely populated highlands of the country.

Goat manure as is habitually applied to the soil constitutes a low-cost nutrient source. Its use becomes more relevant to the subsistence producers in view of the increasing prices of inorganic fertilizers following the withdrawal of fertilizer subsidies since the 1980's.

In Ethiopia, the key common inorganic fertilizers are nitrogen and phosphorus. The chemical equivalence of goat manure with inorganic fertilizer can be estimated on these nutrients. The relatively high labor requirements of manure applications are not relevant in the context of the Ethiopian highlands as manure is disposed of habitually in routine barn cleaning and accumulated in small pits near the homestead as compost. In fact, use of goat manure by the small farmer can be considered as having no direct costs. Composted manure is distributed in crop fields soon after ploughing and before final seedbed preparation and seeding. Manure is rarely applied directly to crop fields during the planting seasons. Occasionally, manure is also applied to the roots of perennial crops, for instance, chat (*Catha edulis*).

Manure excreted during grazing is effectively utilized (or not lost) as goats are often grazed around the homestead, crop fields, borderlines and roadsides. Even when goats are allowed to graze freely in the limited

communal pasture and wastelands, the manure is beneficial to the whole community. The general tendency that defecation is commonly associated with certain physical activities such getting up after having laid down, walking and particularly watering means that more manure is collected around homesteads, where goats are tethered and supplied with water and supplementary feeds, etc.

10.4.3. Proper manure composting and utilization

10.4.3.1. Manure composting

Composting manure and other farm waste is an easy, inexpensive method of obtaining high-quality fertilizer. In addition to supplying nutrients, incorporating compost into the soil improves soil structure, texture and aeration. Water-holding capacity is also increased. Compost is easy to make and is an excellent method of using and recycling organic waste on the farm. Compost pile ingredients include grass, straw, leaves, manure, coffee grounds, etc. Some leaves, eucalyptus for example, can be toxic to other plants and should be avoided. Kitchen and food waste can be composted but animal fat, meat, bones, etc., should not be used. Important factors of composting include the carbon:nitrogen ratio, moisture, air, and soil.

The ratio of carbon to nitrogen in a compost pile determines the speed with which micro-organisms will be able to decompose the material. The micro-organisms use carbon for energy and nitrogen for protein production. A ratio in the range of 25–30 parts carbon to 1 part nitrogen is optimal for bacteria. Most compost materials, e.g., straw, dry grass, etc., are very high in carbon and low in nitrogen. These materials must be mixed with materials higher in nitrogen, such as manure, green legumes, etc., to obtain a proper ratio. In general, for vegetative materials, mix an equal amount of high carbon to high nitrogen materials for a proper ratio. Manure, because of higher nitrogen content, takes lesser amounts mixed with high carbon materials to reach the proper ratio. As an example of the value of manure, 1 part sheep manure (14:1 C:N) can be mixed with 8 parts wheat straw (53:1 C:N) to obtain a mixture with an acceptable ratio of 26:1. Chopping or shredding materials increases surface area for microbial attack and decomposes easier.

A compost pile must maintain 40–60% moisture for proper decomposition. If the pile is too dry, it will not decompose quickly. If a few drops of water fall from a squeezed handful of the pile material, the moisture content is fine. The pile should be placed so as to drain rainwater to prevent it becoming too wet.

A compost pile needs to be aerated by occasional turning. The micro-organisms doing the decomposition work need oxygen to survive. If the pile becomes too wet or dense, there is little air supply. The pile will not decompose and may produce an offensive odor. Turning the pile, perhaps weekly, will help avoid odors and speed up decomposition.

Soil is used to cover newly placed materials in the pile and as a source of micro-organisms. Ingredients for a compost pile can be layered as they become available, and then a small amount of soil is placed on top to prevent drying out and access to the pile by birds, etc.

As the micro-organisms break down the material, they will generate heat, warming the pile. This is one sign of a properly working compost pile. To check inner temperature, a stick or metal rod can be pushed into the pile. After some time, remove and feel its temperature. The pile temperature should be warmer than the air temperature and can reach up to 50–60°C. This temperature can kill harmful bacteria and weed seeds.

10.4.3.2. Compost use

When the pile has completed composting, the material should have a crumbly, dark brown appearance and a good smell. It is ready for incorporation into soil and to be used as a fertilizer. To improve poor soils, a 4–5 cm layer can be spread on the soil surface and then worked into the upper soil layer.

Table 10.9. Percent nitrogen (N) : carbon (C) ratio and moisture content of common compost ingredients.

Material	% N dry weight	C:N ratio weight to weight	Moisture content % wet weight
Cattle manure	2.4	19	81
Coffee grounds	–	20	–
Corn cobs	0.4–0.8	56–123	9–18
Corn stover	0.6–0.8	60–70	12
Hay, general	0.7–2.0	15–32	
Hay, legume	2.5	15–19	
Horse manure	1.6	30	72
Poultry manure	2.7	14	37
Sheep manure	2.7	16	69
Straw, wheat	0.4	50–125	
Vegetable waste	2.5–4	11–13	

Some common causes for poor composting include the pile becoming too dry, lack of mixing (aeration), or a poor C:N ratio. Checking the moisture content and turning can help revitalize a compost pile. If there is too much carbon in the pile, mixing some additional manure to the existing pile will help. If a pile becomes too wet, it may give off odors and needs to be turned or have dry materials added. This may occur during the rainy season if the pile is not in a well-drained place. A compost pile should not attract flies or rodents but the presence of other types of insects (millipedes, etc.) in the pile is normal. Ants and/or termites can be a problem with compost piles. Keeping compost piles heating properly will help.

10.5. Hair (Rough Wool)

The annual production of hair/wool in Ethiopia is not quantified and documented. Hair/wool can possibly be produced from highland and lowland coarse wool sheep. Among the Ethiopian sheep breeds, only the highland Menz sheep produce wool. Farmers produce up to 1 kg of coarse wool from a Menz sheep annually.

Breed, system of husbandry, and harvest of wool/hair is crucial in the production of quality hair/wool. The amount sheared is determined by breed.

The hair/wool produced can be sold as a raw material to factories, handicraft cooperatives and/or individuals. Locally produced coarse wool could be used to make blankets, carpets and local dress such as *Bernos*.

10.6. Conclusion

- Sheep and goats are largely slaughtered in backyards. This makes it very difficult to produce high quality skins. The scattered and limited number of slaughter premises in the country has aggravated the problem.
- Improper preservation techniques lead to poor quality skin. Better methods are needed to increase the recovery rate of skins.
- Alternative use and sometimes misuse of raw material before reaching the market reduces the number of skins reaching tanneries.
- Strengthening the extension system along a system of quality-based pricing should lead to a better supply.
- There is a need for an appropriate development program to increase the contribution of skin to leather and leather products production. The program should focus on improving the quality and increasing the recovery rate at the central market.

- Milk is an important product from goats, particularly for home use. More attention to research and extension on goat milk is warranted.
- Manure is a valuable commodity for use as a fertilizer. Composting is a beneficial activity to prepare manure and other vegetative waste for use to increase crop production.

Glossary

Abattoir: A slaughterhouse having proper facilities for all aspects of slaughter with the necessary equipment for proper handling of meat, skins and other animal by-products in an appropriate manner.

Corium: One of three parts of the dermis.

Correct pattern: A standard pattern for a flayed skin when laid out flat, which is adopted by the trade, and which enables the tanner to cut maximum area of good leather from a hide/skin.

Curing: The treatment of skins with common salt or by air drying to prevent putrefaction.

Defatting: The removal of unwanted fatty (adipose) tissue from the flesh side of a fresh skin during fleshing.

Dermis: The layer of skin under the epidermis consisting of the grain, corium, and junction.

Epidermis: The superficial, cellular structure covering the grain layer of a skin.

Flay cuts: Damage caused by careless use of a knife during flaying, sometimes cutting through the skin.

Flaying (skinning): The removal of a skin from a carcass.

Flaying knife: The knife used to sever the subcutaneous tissues when removing the skin from the carcass.

Flesh side: The inner side of a skin next to the body of an animal in life.

Fleshing: The removal of the residual connective and adipose tissues from the flesh side of a skin after flaying.

Fresh (grain, raw) skin: A skin which has received no treatment.

Gouges: Knife damage to the skin during flaying, taking out scooped portions of the corium.

Grain layer: The top portion of the dermis.

Hair slip: Loosening of the hair within the follicles of the skin, an indicator of putrefaction.

Off-take: The proportion of a herd killed, on average, during a given period, e.g., off-take in developed countries may be up to 35% but is frequently not higher than 10–15% in many developing countries.

Pattern: The pattern of skin when laid out flat.

Pelt: Skin from which hair or wool has been removed, may be limed, bated, pickled or tanned.

Pickling: Process involving the saturation of dehaired skins with a dilute acid solution and a strong solution of common salt, either as an end itself or as a preliminary stage before chrome tanning.

Poor pattern: The pattern of a skin, on being laid out, does not conform to the standard or correct pattern adopted by the trade, more simply, it is asymmetric and parts of it are displaced from the accepted position. The fiber structure is abnormal in the part transposed by the asymmetric cutting.

Putrefaction: Bacterial and enzymatic breakdown, rotting.

Ripping: Opening of a skin on a carcass, following an accepted pattern of cutting, before flaying.

Ripping knife: Knife designed to make the opening cuts on a skin before flaying. It can also be used for slaughtering, bleeding and other operations. N.B: Is similar to a flaying knife but has a straighter cutting edge.

Salt stains: Indelible stains on the grain surface or deeper, caused by negligent curing.

Scores: Knife damage to skins during flaying by cuts that do not fully penetrate through the skin.

Shank: The portion of a skin which covers the leg of an animal.

Trimming: Removal of unwanted portion of a skin.

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