

## **CHAPTER ONE: INTRODUCTION**

### **1.1. Conceptual Definitions and Classifications of Hide and Skins**

The term "hides and skins" are often used as if they were interchangeable, but according to the British standard definitions; 'hide' is the raw skin of a mature or fully-grown animal of larger kinds, e.g. cattle and horses and also other large animals. 'Skin' is the skin of a mature or fully grown animal of smaller kinds, e.g. sheep, goats, pigs, reptiles, birds and fishes, or of immature animals of the large species, e.g. calves and colts. Hides are divided according to age and weight of the animal. Accordingly:

Calf skins usually weigh from 0-6 kg., in green condition.

Adult animal hides which are categorized in to three, light, medium and heavy.

Light: Hides from young heifers/bulls with a weight of 6-11kg., in green state.

Medium: Hides from young cows and bull which weigh 11-17kg.

Heavy: Hides from full-grown cows or bulls which weigh more than 17kg.

According to European Guidance, Hides and Skins are the dermal envelopes of animals. They are by-products of the meat industry and are obtained after flaying through the separation of the dermal tissue from the carcass.

- *Hides* are the dermal envelopes of bigger ruminants such as cattle, elks, buffaloes, camels or horses, while

- *Skins* are those pertaining to smaller animal species such as pigs, sheep, goats, rabbits or hares or younger animals like calves, but also fur animals and certain reptiles such as snakes, lizards or crocodiles. Internationally, most hides are derived from cattle (Buffalo in Asia), and most skins from sheep and goats (and to a lesser extent calves). Although there are livestock resources of pigs, horses and donkeys in Africa, they are relatively small in number, and will not be considered in the rest of revised draft report.

### **1.2. Status of Hide and Skin in Ethiopia**

With a population of 45.5 million cattle, 26 million sheep and 21.7 million goats, Ethiopia has the largest livestock population in Africa. Ethiopia offered a wide range processed and semi-processed hides and skins to the world market. Based on the annual off-take rates of 7% for cattle, 32 % for goats and 33% for sheep the annual production of hides and skins is estimated respectively at 2.86 and 16.6million pieces.

In Ethiopia hides and skins contribute much to the export earnings from the livestock sector. In addition, it has a large contribution to the leather industry in the country. Livestock hide and skin contribute significant proportion of domestic leather. Hides and skins are the basic raw materials for the leather industry. Currently there are about 27 tanneries in the country and have an average capacity of 4,000 pieces of hides and 30,000 pieces of skins per day. However, they are working under capacity even if the country has a potential to supply around 20 million pieces of hides and skins per annum. The potential supply of hide and skins depend on the scale of meat production, not on the size of livestock population. Thus, the product, i.e. hides and skins, becomes available when meat is needed, not when it is appropriate for leather processing and so it is not primary agricultural commodity. This means that hide and skin supply does not respond to price change .The leather industry processes raw hides and skins and produces semi-processed and finished leather for both export and local consumption. The industries are also sources of employment. This is why the sector needs great attention by the government and all concerned stakeholder.

As a result, the industry in the country has tremendous potential for domestic and foreign exchange earnings and the capacity to attract profitable foreign investment. Though Ethiopia has very good potential to produce substantial quantities of skins over the last 10 years, there are indications that quality of raw hide and skins supplied has deteriorated with an increasing number of poor grades.

### **1.3. Unique Features of Ethiopian Hides and Skins**

Ethiopian HS have good reputations in the international leather market for their unique natural substance of fitness, cleanness, and compactness of texture, thickness, flexibility and strength.

The cattle hides, identified as “Zebu type”, are popular for their fine grain pattern and fiber structure that are well suited for the production of quality upper leather. Ethiopian skins and hides, specifically sheep skin, are well known in the world to produce high quality leather due to their fine grain and compact structure. Ethiopian highland sheep skins in particular, remain highly competitive in international markets for some natural characteristics of clarity, thickness, flexibility, strength and compact texture which make them especially suitable for making of high quality gloves, sport equipments and garments. Goat skins, originating from Wollo in Ethiopia and classified as *Bati-genuine* and *Bati-type* are characterized by thick, highly flexible and clean inner surfaces and are in high demand for the production of fashion leathers. These qualities are the reasons why a great number of leather producing companies in the world are attracted to Ethiopian skins and hides. Skins, hides and leather products are the second leading export item of Ethiopia next to coffee.

### **Livestock Products (Hides and Skins) in Ethiopia**

Ethiopia offers a wide range of processed and semi-processed hides and skins to the world market. Some of the products, such as Ethiopian highland sheepskin, which has gained international reputation for making gloves, are well-known for their quality and natural characteristics.

❖ The high quality Ethiopian hides and skins exports include:

#### **A. Semi-processed hide and skins**

##### **From sheep skin**

- ▶ Pickled sheep skin
- ▶ wet blue sheep skin
- ▶ crust sheep skin

##### **From goat skin**

- o wet blue goat skin

- o crust goat skin

### **From cow hide**

- ▶ crust cow hides

### **B. Finished leather**

finished garment leather  
finished glove leather  
lining/upper leather  
suede leather  
full grain leather  
corrected grain leather  
embossed leather and patent leather

### **C. The export of finished leather and leather products include:-**

- ✓ Leather garments
- ✓ Foot wear
- ✓ Gloves
- ✓ Bags and other leather articles

### **1.4. Sources of hides and skins**

**Major sources of hides and skins:** The hides and skins of domesticated animals are cattle, goat and sheep and these are converted into various type of leather. The supply of hides and skins from these animals are regularly in commercial quantities

The best sources of hides and skins from domesticated animals are cattle hides and sheep and goat skins.

**Minor sources of hides and skins (Domesticated animal):** Hides and skins of other domestic animals e.g. horse and pig are **also tanned in as much quantity as they are available**. Horse, donkey, camel and domesticated pig are minor sources of hides and skins.

**Other sources of hides and skins (None-domesticated animals):** The supply of hides and skins from non-domestic animals skins of deer,kangaroo,are also



tanned but as a limited amount. In addition to these most important types of leather raw materials, the skins of reptiles (crocodiles, lizards, and snakes) and fish (wolf-fish, cod, burbot, dog salmon, giant sturgeon, whales and shark), deer, elk, rabbit, birds, elephant and buffalo are also used.

#### **1.4. Types of raw hides & skins and importance in world market**

Cattle, sheep, goats and pigs provide the majority of hides and skins for the world wide needed amounts for the leather producing industry. The hides and skins of horses, reptiles, lizards and snakes as well as those of fishes are available in smaller quantities and generally not traded worldwide.

##### **Cattle hides**

These raw hides represent about 65 %\* of world's leather production. All provenances and qualities of cattle hides are used for the production of leather, i.e. calf, heifer, cow, steer, bull, ox as well as zebu and buffalo. The hides thickness of 3 - 15 mm, a surface of 0.6 - 5.5 qm and the available quantities make it the preferred material for almost any article that is produced out of leather, e.g. shoes, bags, upholstery, garments and technical leathers.

##### **Sheep skins**

Representing about 17 %\* of world's leather production, all provenances and qualities of sheep skins are used for the production of leather. The raw skins of these species offer an enormous variety of different skin structures. Beside meat, the main product of sheep farming is wool and due to the immense amount of hair roots and fat cells within the skin the structure is relatively weak. Therefore and also because of the thickness of 1 - 3 mm and a size of 0.3 - 1.0 qm, sheep skins are used for articles which do not require high physical properties like tear and tensile

strength or size, e.g. garments, lining, bookbinding leathers. Furthermore shoes are made, but this use requires breeds with a better skin structure.

### **Goat skins**

About 9 %\* of world's leather production is covered by goat skins. All provenances and qualities of goat skins are used for the production of leather. Even though the size of 0.2 - 0.9 qm and a thickness of 1 - 2 mm are similar to sheep skins, the structure of goat skins is very much firmer. Therefore goat skins are suitable for articles which demand distinct physical properties, e.g. shoes, garments, protective clothing, lining and leather goods.

### **Pig skins**

With a share of about 8 %\* of world's leather production pig skins play a minor, but yet important role. In some countries the skin belongs to the daily nutrition, preventing these hides being processed into leather. In general the skins are from adult domestic pigs or wild boar. Pig skins have some histological peculiarities, for instance it is the only animal skin, with hairs penetrating the entire cross section, resulting in "perforated" leathers. The skin consists of 2 areas with different structures with a more compact and tight back part. The special structure of the skins, a thickness of 2 - 5 mm and the size of 1.2 - 1.5 qm. make these skins useful for, e.g. shoes, garments, lining and leather goods. The most useable wild boar skin is the so called Peccary, a water hog located in South America, that is rather small, but due to the living conditions these skins have severe damage. The main use is for garments and gloves.

### **Horse hides**

This group includes the hides of domestic and wild horses, as well as donkeys. The main use is for shoes, garments and technical leathers, while the tighter structured parts can also be used for sole leather.

### **Reptile skins**

Skins of crocodiles, alligators and caymans are to a large extent provided by farms. A distinctive feature of these skins is the bony layer within the skin that forms a protective shield. Especially in the case of older animals this unique feature is pronounced and therefore only younger animals are suitable for the making of leather. These leathers are used for luxury leather goods, bags and also shoes.

### **Lizard and snake skins**

Skins of lizards and snakes have most different surface structures and color patterns, due to the large number of sorts. These leathers are used mainly for leather goods, belts and bags.

### **Fish skins**

There are 2 different types of fish skins. Skins of sharks and rays have a tough siliceous layer on the surface, while the more sensitive skin of fishes like cod, pollock or haddock is covered by scales. Due to the weak structure, size and texture of the surface these leathers they are preferably used for trimmings of fashionable garments.

## **1.5. Utilities of Hides and Skins**

The history of livestock production and hides and skins they provides are strongly linked with the history of human development. The first attempts to use hides and skins may have involved no more than collecting the hair, fur or wool and using it to form soft bundles to make mattresses and pillows. Some of the application of dried

hides and skins include manufacture of personal armor, shield musical instruments, upholstering chairs and etc.

Fur and hides find their main use today as clothing, particularly coats. They are valued for their warmth, and as a status symbol. Rabbit fur is a popular material to make hats, coats and glove linings.

Hides have also been used to build canoes and tents, as simple windowpanes, and as material for writing. Many drums, especially hand drums have their skin made from hides.

There are also other miscellaneous uses of hides and skins.

- ✓ trimmings are used to make dog chews or incorporated into animal feed
- ✓ some may be eaten by humans-example pigs
- ✓ materials dried in the form of gelatin which are widely used as a thickening or setting agents in food industries
- ✓ highly refined gelatin are used in the pharmaceutical industries to make capsules and in the photographic industries to make films

Crude form of gelatin is also used as an adhesive. A research conducted by Kagunyu and his colleagues, in Kenya show that hide and skin used as a source of various materials which includes; making ropes, building houses, making milking containers, drums, seat covers. Muslim communities use them as praying mats among others.

## **CHAPTER TWO: Components of the mammalian skin and hide**

### **Terminology**

**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.

**Corium:** One of three parts of the dermis

**Grain layer:** The top portion of the dermis

**Collagen:**

### **2.1. Physical characteristics that affect leather quality**

The quality of hides and skins for the production of different types of leather is determined by the following characteristics.

**A. Thickness over the Surface:** - determines the type of leather that can be produced. For example:

- Soles- are produced from heavy and thick hides
  - √ Uppers- are produced from light and medium
- Clothing, footwear (lining), chamois and gloves- are produced from sheep and goats skin.

Thickness of hides and skins also determines the limit of their tensile strength.

**B. Evenness of the thickness over the Surface:** - is also important to cut size of the leather. If the thickness is more even, then it is easier to cut out the leather, but

every skin is not at all of even thickness, varying in two directions: Longitudinal – going along the backbone and Transverse – going across the backbone, i.e. goes from backbone to the bellies

**C. The Weight:** - is important for processing and in general, skins of an average and of uniform weight are selected for one type of leather. The weight of the skins also determines the thickness of the skin.

**D. The Density:** of the skins is an important property which is determined on the bases of its size, thickness and weight. The density also determines the diffusion or penetration of the chemical into it.

**E. The Presence of Defects:** is probably one of the most important characteristics of skin for leather manufacture. If they are numerous and especially if the butt area is damaged extensively, it means that its quality has deteriorated considerably and the value of the raw material has decreased very much. Apart of the defects inflicted to the skin during the live, other ones can be added during slaughtering, preservation, storing and transportation.

## **2.2. structure of hides and skins**

**Structure of Hides and skins are classified in two parts.**

(1) Anatomical structure

(2) Chemical structure

### **(1) Anatomical structure**

The hides and skins are mainly consists of three layers

(A) Epidermis/outer layer

(B) Dermis/corium layer

(C) Hypodermis/ flesh

## A).Epidermis

It is comparatively thinner than corium. Its thickness is only 1—2% of the total thickness of the entire skin. It divided itself into two layer of cells - the Outer or Horny layer and inner or soft layer. Epidermis is protective outermost portion of the skin. There are two layers of epidermis, the living basal layer, which is next to the dermis, and the external stratum corneum, or horny layer, which is composed of dead, keratin-filled cells that have migrated outward from the basal layer. The melanocytes, responsible for skin colour, are found in the basal cells. The substance responsible to give colour to the skin is called melanin which is formed by oxidation of “dopa” **by enzyme dopa oxidase**. The reticular is sensitive to bacterial and chemical attack and can be decomposed or transformed very easily. The epidermis has no blood supply and depends on diffusion from the dermal cells for its metabolic needs. The dead-cell layer of the stratum corneum provides the protection from water loss that allows vertebrates to dwell on land. Keratin, produced in migrating epidermal cells, forms the basis of nails, feathers, beaks, and other epidermal derivatives. In humans, epidermal fragments are constantly shed, but the “skin,” or stratum corneum, of a snake is ordinarily shed all at once in a period of ecdysis. The epidermis is the outer most covering of skin carpeting the hair follicles that go deeply into the dermis. The other epidermal structures that have their base in the dermis are sebaceous and sudoriferous glands.

The hair has two parts:

- ✓ The root- is contained in the follicle. At the base of the follicle is the bulb, which contains cells as well as blood vessels.
- ✓ The shaft - is the long projection part that extend to the outside

Near to where the hair leaves the skin surface, the ducts of the sebaceous glands enter to the hair sheath and lubricate the hair. The hair is also equipped with involuntary muscles called arrectorpili muscle that enables it to bristle (stand). During constriction, this muscle compresses the soft tissue of the sebaceous glands forcing out their oily secretions

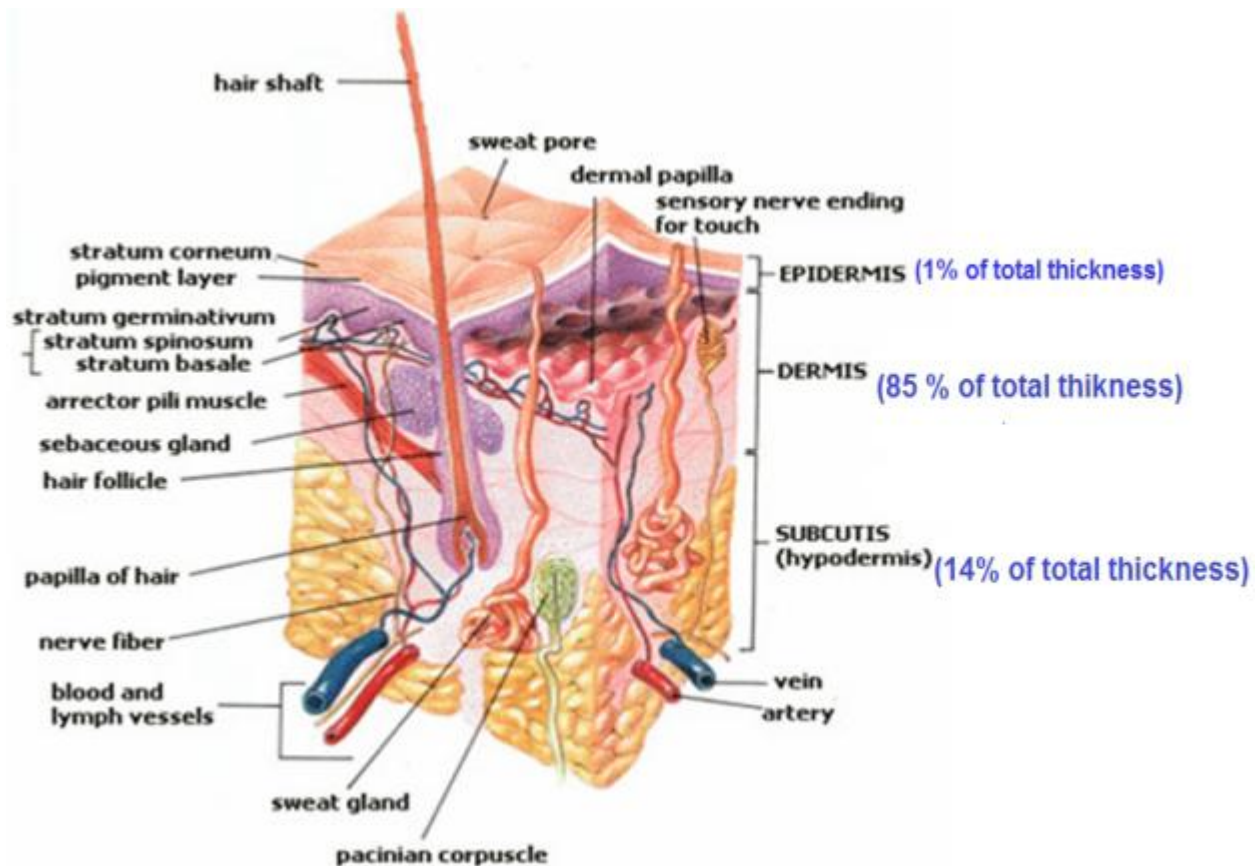


Figure. Cross-section of a skin

## B).The Dermis

The Dermis is a layer of skin between the epidermis and subcutaneous tissues. It is divided into two layers, the superficial area adjacent to the epidermis called the papillary region (grain layer) and a deep thicker area known as the reticular dermis (the fiber network or Corium). The dermis is tightly connected to the epidermis through a basement membrane. Structural components of the dermis are collagen (which provides strength), elastic fibers (which provides elasticity) and extra fibrillar matrix (previously called ground substance). It also contains Mechanoreceptors that provide the sense of touch and heat, hair follicles, sweat glands, sebaceous glands, lymphatic vessels and blood vessels. Those blood vessels provide nourishment and waste removal for both dermal and epidermal cells.

### Components of the Dermis



## **I. Stratum papillare (grain layer)**

Grain layer is also known as **corium minor**. It is top of the corium about one fifth of the total thickness. This layer has a characteristic, **grain pattern due to the presence of hair follicles**. The grain pattern depends upon the density and structure of the hair follicles. The papillary region is composed of loose connective tissue. This is named for its fingerlike projections called *papillae*, that extends toward the epidermis and contain either terminal networks of bloodcapillaries or tactile Meissner's corpuscles. Fibers in the upper surface of the layer are very closely packed to protect the delicate tissue.

This is the part that the tanners exploit to produce firm grain of finished leather. This layer contributes much for the aesthetic appearance of leather. In its lower part, the papillary layer gradually becomes free from other tissues and merges imperceptibly into the fiber network layer. If the fibers are entangled in the boundary zone, a defect called “loose grain” may be resulted.

## **II. Stratum reticulare (the fiber network or Corium layer)**

This is the main layer of hides or skins constituting about 98% of its thickness. The hair papilla contains nerves and blood vessels. Due to the blood circulations of animal's body a lot of cells are produced. The reticular region lies under the papillary region and is usually much thicker. It is composed of dense irregular connective tissue, and receives its name from the dense concentration of collagenous, elastic, and reticular fibers that weave throughout it. These protein fibers give the dermis its properties of strength, extensibility, and elasticity. In addition to the structural proteins, the layer is made up of none structural (inter-fibrillary) proteins that makes the skin hard and horny cementing the fiber structures when dried. Also located within the reticular region are the roots of the hair, sebaceous glands, sweat glands, receptors, nails, and blood vessels.

## **C).Hypodermis /flesh layer**

The hypodermis, also called the hypoderm, subcutaneous tissue, or superficial fascia is the lowermost layer of the integumentary system in vertebrates. -: This

layer is found below the dermis layer. It is the loose connective tissue lying between the hide or skin and the actual body of the animal. At the time of flaying a part of this tissue remain attached to the hide or skin. The flesh is removed in fleshing operation after liming.

Types of cells that are found in the hypodermis are fibroblasts, adipose cells, and macrophages. The hypodermis is used mainly for fat storage. It is a layer of tissue lies immediately below the dermis of vertebrate skin. The hypodermis consists primarily of loose connective tissue and lobules of fat. It contains larger blood vessels and nerves than those found in the dermis. In some animals, such as whales and hibernating mammals, the hypodermis forms an important insulating layer and/or food store. Curring of a skin, the preparation for tanning operation, can be hindered if too much fatty, or muscle tissues are left on the skin.

## **2. Chemical composition of hides & skins**

The chemical constituents of hides and skins can be divided into four main groups,

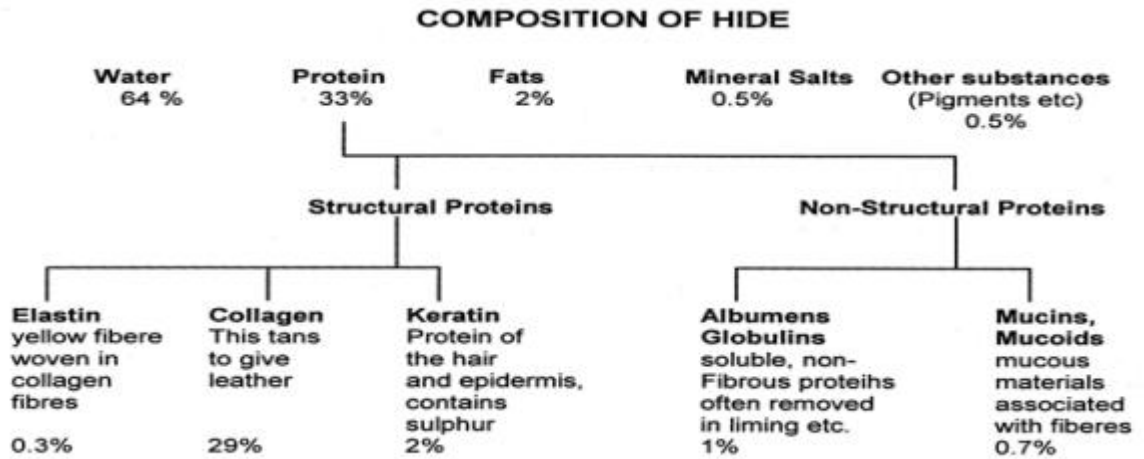
Such as,

1. Protein - 19 % to 33 % on the green weight
2. Water - 60 % to 70 % on the green weight
3. Minerals - 0.36 % to 0.5% on the green weight
4. Fatty matter - 2 % to 30 % on the green weight

The relative proportions of these materials vary from skin to skin depending upon the

species, age, breed, feeding and other habits of the animals.

**Figure 1.** Components of the cattle hide



Coloring pigments are trace in amount. The relative proportions of these materials vary from skin to skin depending upon the species, age, breed, feeding and other habits of the animals.

Animal hide/skin contains a great variety of microorganisms, which are derived from air, water, soil, manure and extraneous filth. These organisms produce proteolytic and collagenolytic enzymes resulting in disintegration of hide/skin. Leather quality depends upon the presence of **protein** in raw material. Therefore, it is extremely important to preserve proteins in hide/skin at their source.

### 2.1. Protein composition of hides and skins

Protein is the most important and second most abundant component of hides and skin. The skin proteins are broadly classified into two , fibrous (structural) proteins that include keratin (2% of the weight of green skin), Elastin (0.3% of the total protein in the skin) and Collagen (30% of the weight of green skin) and the globular (non-structural) proteins that include albumin and globulin (together account for 1% of the weight of green skin) and mucin (0.7% of the weight of green skin).

Fibrous proteins are distinguished from globular proteins by their filamentous, elongated form. Most of them play structural roles in animal cells and tissues, holding things together. Fibrous proteins have amino acid sequences that favor a particular kind of secondary structure which, in turn, confer particular mechanical properties on the proteins.

**Keratins:** are the major proteins of hair and fingernails and also compose a major fraction of animal skin. Their secondary structure is composed predominantly of  $\alpha$ -helices. Keratins are the most visible proteins and are removed during the tanning operation.

**Collagen:** This is the most important proteins in hides and skins and occurs in them in the largest amount. It is the protein constituents of the white fibres of the corium and forms about 30.33% of the weight of the whole fresh skins. Composition of dried collagen is----

Carbon—50.2%, Hydrogen - 6.4%, Nitrogen - 17.8%, Oxygen and Sulphur - 25.4%

Collagen is a complex protein containing various amino-acids. It is insoluble in organic solvent, water and dilute acids and alkalies at ordinary temp. It is collagen which combines with tanning substances and is converted in to leather.

It is also the single most abundant protein in most vertebrates - up to a third of the total protein mass. Collagen fibers provide the matrix of bone on which mineral constituents precipitate. The fibers constitute a major portion of tendons and a network of collagen fibers is present in skin. The triple-helix tropocollagen molecule is the basic unit of the collagen fiber.

Collagen is the protein that form complicated weave throughout most of the thickness of hides and skin providing considerable strength both before and after tanning. Hence it is the part that makes up the leather after tanning operation. Collagen fibers, almost like heavy rope, are composed of progressively smaller and smaller strands - some times referred to as fibrils and filaments respectively which are ultimately formed from triple helical structures called tropocollagen. The general structure of collagen fibers is generated by the aggregation of many thousands of tropocollagen molecules linked up end- to-end and side-by-side until relatively huge structures are created.

**Elastin:** A protein that coil and recoils like a spring within the elastic fibers of connective tissue and accounts for the elasticity of structures such the skin, blood vessels, heart, lungs, intestines, tendons, and ligaments. Elastin functions in

connective tissue together with collagen. Whereas elastin provides elasticity, collagen provides rigidity to connective tissue. Elastin is normally no longer made after **puberty** and aging begins. Elastin is also a protein found in connective tissues—but a different type of protein than collagen. It has the actual property of being elastic. **It's responsible for allowing tissues in the body to “snap back” to their original shape after being stretched or contracted.** For this reason, it's often compared to a rubber band.

It is made by linking many soluble tropoelastin protein molecules. *Tropoelastin* is a specialized protein with an irregular or random coil conformation made up of 830 amino acids. Elastin is a protein in connective tissue that is elastic and allows many tissues in the body to resume their shape after stretching or contracting. Elastin helps skin to return to its original position when it is poke pinched.

Elastin is also an important load-bearing tissue in the bodies of vertebrates and used in places where mechanical energy is required to be stored. It serves an important function in arteries as a medium for pressure wave propagation to help blood flow and is particularly abundant in large elastic blood vessels such as the aorta. Elastin is also very important in the lungs, elastic ligaments, the skin, and the bladder, elastic cartilage. In the skin *elastin* is found in corium (fiber network layer) providing its elastic characteristics.

## **CHAPTER THREE: Hide and skin production system and Marketing**

### **3.1. Introduction**

Archaeological studies have shown that hides and skins have been used since antiquity as clothes, vessels, bedding, and possibly structurally in ancient dwelling places. At present, leather is used in various applications. Hides and skins, raw materials for the tanning industry, are renewable and easily perishable resources. Their production is dependent on the rearing, management and disposal of the livestock population. The availability of hides and skins through slaughtering or death of livestock is of particular importance to the leather industry. Hides and skins could be obtained from fish, birds, and reptiles as well as wild and domesticated animals. The most important sources are cattle, sheep and goats. According to MEDaC (1999), the livestock population of the country has risen to 34.1, 30.54, and 21.11 million head of cattle, sheep and goats, respectively, in the year 1998/99, up from the 1993/94 figures of 31.45, 27.5 and 19.76 million head of cattle, sheep and goats, respectively. The annual average growth rate was 1.2, 1.4 and 0.5 %, respectively.

Based on annual off take rates of 7% for cattle, 33% for sheep and 35% for goats, the potential production is estimated at 2.38 million cattle hides, 10.07 million sheepskins and 7.38 million goat skins in 1998/99. This raw material of the leather industry is mainly derived from local areas of the country where basic amenities for slaughtering and subsequent marketing are either not in existence or lacking. Additional sources of hides and skins include slaughter slabs, municipal slaughterhouses, the limited number of export abattoirs, and meat and meat product processing plants. The wide dispersion of the slaughtering points across the country, along with the lack of proper slaughtering amenities has a negative impact on the volume and quality of hides and skins entering the formal market chain. As a result, all available raw materials is not recovered; a considerable proportion is wasted before reaching the tanneries, the final consumers of the raw hides and skins.

Up until 3 to 4 years ago, hides, skins, leather and leather products provided for the second largest amount of foreign exchange earnings following coffee and accounted for 14 to 16% of the country's total foreign trade revenue. Recently, its share has dropped to nearly 7% due to a decreased price for leather in the international market and the deterioration of the raw material quality. Considering the development potential and economic importance of hides and skins, in the last 2 to 3 decades the government has launched different development programs aimed at increasing the supply and improving the quality of the raw material. Despite these development interventions, hides, skins and the leather industry are still constrained by the poor quality of raw materials, lack of an efficient market structure, a weak extension service, competition from local/rural tanning industries, and a lack of price incentive for production of good quality raw material.

### **3.2. Production of hides and skins in Ethiopia**

The estimated annual production of HS, which stood at 2.2 million hides, 9.08 million sheep skins and 6.92 million goat skins in 1993/94, rose to 2.38, 10.07 and 7.38 million pieces, respectively, in the year 1998/1999. The main sources of hides and skins are in rural areas where the major proportion of slaughtering is carried out at the household level or in backyards that are not equipped with any amenities

for undertaking and following proper slaughtering, ripping and flaying procedures. A considerable number of the raw material is derived from slaughter slabs constructed either by local communities, regional governments or HS development projects. Municipal slaughterhouses, local and export abattoirs and meat and meat products processing plants are other sources of HS. According to the information obtained from regional agricultural bureaus during a field survey conducted by the livestock marketing authority staff in 1999, there are 113 municipal slaughter houses, 53 rural slaughter slabs, 5 meat and meat products processing plants and 5 export abattoirs in the country.

In the absence of accurate and reliable data on the slaughter rate on these premises, the generally accepted estimates of the 1980's reveal that urban slaughterhouses account for only 20% of the production of hides while the remaining 80% is accounted for by rural areas. At the number of municipal slaughterhouses, rural slaughter slabs and export abattoirs has increased, their supply of hides is expected to increase as well. The current estimate of the hide supply from rural areas falls in the range of 50 to 60% of the country's annual total production.

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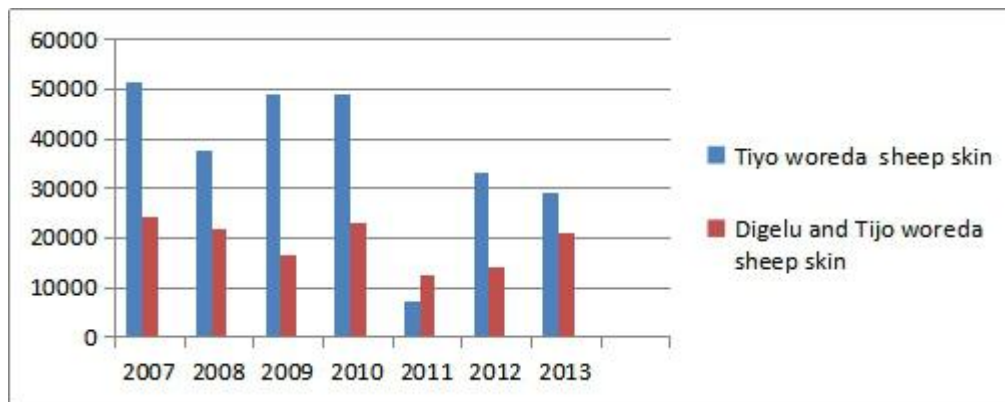
### **3.2.1. Trend and Supply of raw hide and skins in Ethiopia**

Concerning with trend of availability the product (butchers, middle men and abattoir) revealed that the accessibility of sheep skin and goat had been decreasing from time to time due to decreased slaughter rate. Traders replied that even if the availability of the product weren't constantly decrease the general trend of availability of the product decreased when compared to in the last seven years



(Figure 1) .The supply of hide and skin was mostly in special festivals. The supply of the product is highest in festivals like Ethiopian New Year ('*Addis Amet*'), Easter (*Fasika*), the finding of the True Cross ('*Meskel*'), Christmas ('*Gena*'), Epiphany ('*Timket*') and Ramadan in order of their highest supply ranked as 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup>, 4<sup>th</sup> and 5<sup>th</sup> respectively.

**Figure 2.** Trend of sheep skins in Tiyo and Digelu-tijo Woreda (Source: Woreda offices of Agriculture)



### 3.2. Export performance of hides and skins

As indicated earlier, until recently the export of hides, skin, and leather and leather products was the second largest source of foreign exchange earnings of the country next to coffee. During the year 1989/1990 the share of HS in total exports and in livestock and livestock products exports was 17.6 and 91.9%, respectively.

The increase in value of HS as compared with livestock and livestock products is partly attributable to the relative fall of livestock and livestock products exports and to an increase in international market prices for hides, skins, leather and leather products. From the year 1992/93 onward, the share of hides, skins, leather and leather products export in both livestock and livestock products export and total export has shown a continues drop from 98.7 and 14.2% in 1992/93 to 87.3 and 6.8%, respectively, in 1999/2000. The decrease in the value of HS is partly attributable to the drop in demand for Ethiopian leather and leather products as the result of the Asian economic crisis. The quality deterioration of sheepskins registered during this period has also contributed to the fall of HS export value.

### ***3.3. Marketing system and Market chain hide and skin in Ethiopia***

In broad terms, marketing system may be defined as the totality of product channels, market participants and business activities involved in the physical and economic transfer of goods and services from producers to consumers. Marketing system operates through a set of intermediaries performing useful commercial functions in chain formations all the way from the producer to the final consumers.

The marketing of hides and skins starts at the producer/consumer level and passes through a chain of middlemen until it reaches the tanneries (Figure 2 below). The market chain for raw hides and skins consists of the primary producers/consumers, who are the initial sources (individual meat consumers, rural slaughter slabs, municipal slaughter houses, abattoirs, meat processing plants), agents of traders, collectors, local tanners, regional medium/small traders, regional/Addis Ababa big traders and tanneries. The individual consumers who kill animals in their backyard sell the HS either to agents, collectors, or directly to regional small/medium traders. After preservation by air-drying or wet salting, the HS are passed on to big traders and then to the tanneries. The tanneries can be supplied directly from the slaughter premises, regional big traders or Addis Ababa big traders as well.

The tanneries process the hides and skins received from their suppliers either in the green (fresh), air dried or wet salted states to semi-finished or finished stages for both local and export markets.

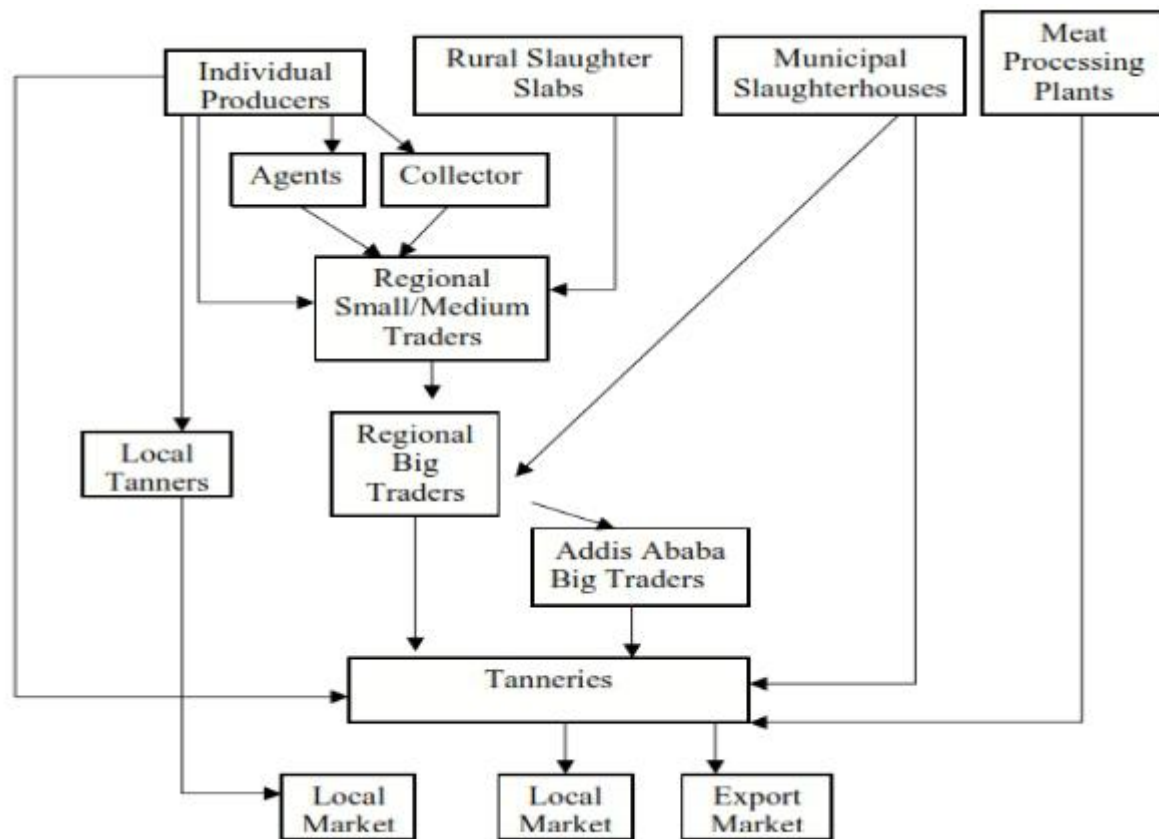


Figure 2. Market structure for hides and skins in Ethiopia

### 3.4. Marketing Problems of Hide and Skins

#### A). Poor infrastructure, remoteness and lack of market information

Poor infrastructure increases transport and other transaction costs and is a major limitation to the marketing of hides and skins. These characteristics magnify the effects of inadequate information-sharing, from which markets in pastoral areas are suffering. Wholesalers cannot *receive reliable market information from the tanneries on future price trends*. This is critical since wholesalers lack any sources of information on the international price and the tannery does not guarantee a fixed purchasing price. It buys skins based on the international price at the time of the wholesalers' delivery, not at the time of the wholesalers purchase from collectors. There is usually a time lag of around 2 to 3 months for delivery from merchants to the tannery since wholesale merchants have to keep the skins stored in salt until a large enough number has accumulated for truck transportation (Kagunyu *et al.*,

2011; Wayua and Kagunyu, 2008). As a result, the risks of international price changes are shared between the tannery and merchants. The poor transfer of knowledge, skills and information is further manifested by limited interaction of the farmers with extension officers due to poor road networks and resources. Considerable progress has, however, been made in the provision of communication systems such as mobile telephone facilities (Mas and Morawczynski, 2009).

*b).Lack of capital*

Finance for initial capital outlay, expansion and working capital remain a major constraint. Setting up a modern slaughter house or a tannery is an expensive undertaking. There are very few financial institutions or banks that are willing to lend money to hides and skins traders as they do not have acceptable collateral; livestock is not accepted as a security for loans and the land tenure in pastoral areas is such that there are no individual title deeds (Wayua and Kagunyu, 2008).

***c).Unfair competition from unlicensed dealers***

There are very many unlicensed dealers who do not pay the license, permits and market service fees and so can set the market price at any value. This demoralizes the licensed merchants.

***d).Inadequate numbers of slaughterhouses and slabs***

The number of slaughterhouses in pastoral areas is very limited. Thus, the majority of cattle, sheep and goat slaughter are carried out in the backyard, resulting in poor quality raw hides and skins.

**E). Low prices of hides and skins.** The current low prices for hides and skins are no incentive for proper handling and curing. The primary producer in the village, the small farmer, receives such a poor return, as compared with the final price, that it gives them no incentive to improve the quality of livestock or their hides/skins.

**F). High transaction levies.** Hides and skins trading is subject to several service fees from the different levels of government. Local councils charge *market*

*service fees* for providing space to conduct the market transactions, i.e. KES 5 and 10 for every skin and hide, respectively. *Transit fees* are charged on hides and skins which are transported from one market to another. Traders could be charged transit fees a number of times when they pass a local or regional border. Hides and skins traders also have to pay *license and permits* to the Department of Veterinary Services (DVS), Ministry of Livestock Development. Transactional costs are barriers to the efficient participation of farmers in different markets. Apparently, there is competition on the issuance of licenses and permits between the DVS and the Country Councils. Due to confusion in the law the sales tax is sometimes charged more than once and sometimes based on an arbitrary price fixed by the tax collector, especially at the county level.

## **CHAPTER four: DEFECTS IN HIDES AND SKINS**

### **Terminologies**

**Sheep skin:** Outer covering from a wool or hair ovine animal

**Goat skin:** Outer covering from a caprine animal

**Defects:** A general term for any damage from whatever cause on raw or cured skins and likely to

depreciate the leather produced from them.

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

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

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

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

**Pattern:** The pattern of skin when laid out flat/ the shape or contour of a flayed skin when laid flat as determined by the position, length and direction of the ripping cuts made during flaying.

**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.

**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.

**Putrefaction:** Bacterial and enzymatic breakdown, rotting.

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

The cutting Opening of the carcass of the animal along the belly from the neck end to the tail end and along the legs.

**Ripping knife:** Knife designed to make the opening cuts on a skin before flaying.

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

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

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

**CLEANING** - removal of all undesirable matter like: hair, flesh, fat and some interfibrillary matter - leaves a concentrated network of high protein collagen fibers, greatly softened and interspaced with water of a skin after flaying.

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

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

**Pattern:** The pattern of skin when laid out flat/ the shape or contour of a flayed skin when laid flat as determined by the position, length and direction of the ripping cuts made during flaying.

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**CLEANING** - removal of all undesirable matter like: hair, flesh, fat and some interfibrillary matter - leaves a concentrated network of high protein collagen fibers, greatly softened and interspaced with water.

### **3.1. Types of defects**

#### **A. Natural defect**

Natural defects are anything that is not caused by men. It can be monsoon damage manifesting itself in putrefaction holes on the bellies of small animals in Asia, or scars made by horns, barbed wire, thorns, insect bites, parasites, illnesses, manure, etc. Some natural defects can be avoided. Substituting barbed wire with electrical fences, vaccinating animals against parasites are remedies which give positive results. Keeping cattle clean from manure improves the hide quality.

#### **B. Man made defects**

Man-made defects are totally unnecessary and with good organisation can be avoided and eliminated. Branding cattle, maltreatment damage the animal's hide (haematomas and worse) can be avoided when it is still alive, butcher cuts and holes, bad shaping can all be avoided at the abattoir level. Putrefaction defects can be avoided at the conservation and transportation level. All these defects will singularly or accumulatively, downgrade a hide or skin and its commercial value. Proper preparation of hides for shipment is in the eye of the buyer part of the manmade defects.

### **3.2. Effect of different factors**

The production of good quality leather depends on the quality of the raw material. Defects in leather implicate higher cost in production and greatly reduce the selling value of leather. In Ethiopia, the economic loss due to hides and skins defect is very high. These defects are encountered from the time the animal is born until the leather processing is completed. It is practically impossible to find out perfect animal hide or skin. Defects come from carelessness in breeding, feeding, living condition, diseases, parasites, handling, slaughtering, preservation, storing and transportation.

The origins of raw hides' and skins' defects are classified in to three major factors namely pre-slaughter, peri- slaughter and post slaughter defects. Sometimes factors



affecting the quality of hides and skins are categorized into two, i.e., ante mortem factors (defects) and postmortem defects

### **A. Pre-slaughter defects**

Most hides and skins are affected by the pre-slaughter defects accumulated during the life of the animal. The commonly observed pre-slaughter defects can be natural (poor nutrition, age and sex, breed and climatic effects), Mechanical damage (brand marks, scratches, horn rakes, yoke marks etc), or defects due to Diseases that can be viral like Small-Pox, Rinder-Pest, fungal like Ring Worm or parasitic like Tick-Damage, Louse Infestation, Mange etc.

**Poor nutrition:** - Emaciation is the thinness and friability of hides and skins derived from animals suffering from prolonged and bitter starvation, leathers which are produced from such hides and skins are noted for their **dryness and flabbiness**. Diet plays an important role in the health of the animals and also in the quality of the raw material. Poor nutrition causes an animal to be smaller, the skin thinner and of poorer substance, lacks elasticity and feel dead. The effect of diet is more pronounced in goat skins due to the fact that many goats are pastured on poor land. Thinness and lack of plump substance resulting from poor nourishment make it necessary to set many goat skins for manufacturing of lining leather.

**Age and sex:** The male cattle or bulls, especially the older ones have thicker heads and shoulders which might cause trouble in handling. The skins from male **goats and sheep** will be heavy with a coarse grain. In sheep skins the main difference is that the female skins have finer grains and always lighter but with greater tensile strength than the male one. Age differences also contribute to the inferior qualities in leather. The skins of the young animals have fine and compact structures and tight grain patterns, while the skins of older animals have tougher and coarser grain surface. "Old grain" is the term used by tanners to describe the rough and calloused skin of very old animals; in these hides wrinkles are very developed. Age does not only have natural influence on the skin but also as the animal gets older, the skin also accumulates scars from brands, disease parasites, scratches, etc.

**Breed:** Desirable or undesirable characteristics of hides and skins can be attributed to certain breeds. Sheep skins show more undesirable breed characteristics than goat skins. The best quality skins are plump or stout and have dense uniform structure and usually have surface areas that are small in proportion to their weight. Fine wool sheep breeds, such as Merino, produce skins that are thin, have pin hole grain and are extremely ribby. These skins produce only the cheapest type of leather. The skins of hair sheep have a high proportion of fat in the upper part of the corium and on the flesh side of the skin. In goats, the skin becomes coarser as the animal grows. Skins from goats in the highlands are poor in substance, spread and open grained.

**Climate:** the climate on which an animal is raised has an effect on the substance of its skin and on the grain of the leather. Animals raised in warm climate have a short hair and the leather produced has superior substance, smoother and finer grain patterns, whereas animals raised in cooler climate or higher altitudes grow longer wool or hair, and the leather made are of poorer substance and coarser grain patterns. These effects of climate, especially on substance is more pronounced on sheep and goat skins than on cattle hides.

**Mechanical damage:** These defects that lower the quality which is originated by mechanical damage could properly be called defects of carelessness because every one of such defect can be eliminated and these include brands (used to differentiate or identify the animal on the range or sometimes in belief of curing the animals from diseases) grain scratches and tears (which is the most common and economically battering damages of hides and skins made on living animals by sharp objects like barbed wire, nails goals and patch forks, thorns, cactus plants, horns etc) collar and yoke lashes (these are defects caused by a collar or a yoke. such damage is mostly found on draught animals on the shoulder or in the upper neck portion near the hump resembling wounds), whip lashes (these are defects on hides and skins caused by lashes or with a whip or stick. they can be seen in the form of scars on the grain surface of the hides and skins).

**Defects due to Diseases:** Many diseases can affect the quality of hide and skins. The commonly noticed ones can be (viral, fungal, and parasitic)

## 1. Viral

**Lumpy Skin Disease:** - is highly infectious skin disease of cattle caused by a herpes virus and is characterized by the sudden appearance of nodules on all parts of the skin. During the course of the disease, the affected portion of the skin becomes hard and dry, and separates from the surrounding normal tissue.

**Smallpox:-**at first small red spots appears on the more tender parts of the skin such as the inner thigh, the abdomen and the sides. The red spots develop in to blisters from pin point to pea sized and turn in to sores. The animal is urged to scratches or rubs the sores on rough objects and secondary infection may develop. Mostly sheep and goats suffer from the smallpox. Grain surface of skins damaged by the smallpox hollow resembling tiny dots.

**Rinder-pest:** - hides of rinder-pest affected animals are thin and poor in quality.

## 2. Fungal

**Ring Worm:-**is a fungus infection attacking the hair and its roots. It appears on the hair side in the form of circular patches varying from 0.5 to 4cm in diameter. The patches are usually covered with scabby matters and are partly or completely bald. Lesions are most common seen on the head, ears, neck and shoulders. The lesion is often circular with hairless areas and the development of a thickened and crusty skin.

The scars are clearly visible to the tanner being shiny and circular in appearance.

## 3. Parasitic

In Ethiopia external parasites damage livestock skins, sheep skins by cockle an irritation caused by sheep ked (*melophagusovis*) and sheep louse (*bovicolaovis*), goat skins by sarcoptic mange caused by mites (*sarcopitic scabies*) and some are damaged during slaughter while relatively few are spoiled during preservation.

**Tick-Damage:-**the damage is caused by blood sucking parasite-ticks. They usually adhere to the inner part of the hide such as the dewlap and inner parts of the legs.

The defect has the shape of tiny holes or unhealed scars. These holes can be seen on the grain surface of the finished leather resembling tiny spots and hollows. While developing and growing in to the adult organism, the males move about rapidly causing the host animal to rub and scratch. Secondary infection leads to far more extensive damage. Badly tick infested animals have poor health and provide hide with lack of substance. The damage to leather caused by tick is so deeply seated that even with grain correction, the scars will persist.

**Sheep Ked (*melophagusOvinus*):**-is a flat brown insect and is blood sucker which measure about 6mm in length and occurs on sheep in most part of the world. Its life cycle is spent entirely on the host and spread by contact between hosts. Its existence on the host caused irritation with resulting scratching, biting and damage to the fleece which is further downgraded by staining by the fleece of the ked. Heavy infestation causes skin blemishes which reduce the marketable value of the skin and of any leather made from it.

**Louse Infestation:-**These arise from attack by a wide range of louse species on cattle, horse, sheep, goats and pigs. These pests include both biting and sucking types such as *lignognathus*, *solenoptes*, *haematopinus* spp. (Sucking lice) and *damalinia* (*bovicola*) (biting lice). Irritation caused by the pests leads to scratching, rubbing and licking by the infested host. The lesions caused by the louse infestations are often almost circular and small size and the extent of damage to the eventual leather depends on the presence or absence of secondary infection. The damage done by biting and sucking lice can usually be eliminated by the grain correction according to the degree of secondary infection.

**Manges:-**are parasitic caused diseases of the animal skin which produce serious damage to the hides and skins. These damages are caused by several varieties of scabies/mange (follicular or demodectic, sarcoptic, psoroptic, etc). These mites multiply inside the dermis or the grain layer. The affected hides and skins present defects like coarse grain lesions and scratch scars and become totally unsuitable for the production of good quality leather.

## **B. Peri- mortum Damages**

**1. Bruising:** Bruising is resulted from rough handling of the animals such as beating animals with sticks, throwing of animals on rough floor and etc resulting extravasations of blood from capillary and finally blood tinged flesh surface. Such hides and skins should be cleaned and dried immediately after flaying. Otherwise it will result putrefaction of the blood tinged and there by the flesh surface of the hide/skin that will finally damage it.

**2. Incomplete bleeding:** In case of incompletely bled carcasses, the cutaneous (skin) blood vessels remain engorged with blood. If cleaning and drying is delayed such blood engorged vessels will be the first site of putrefaction. Unfortunately they are not visible on dried hides/skins. They are observed only when the hides/skins are converted to leather.

**3. Dragged or Rubbed grain:** Such damage is resulted from dragging of live animal or carcass or hides over rough ground that results abrasion on those parts of the body where the bones are prominent. The pulling of the live animal or carcass or hides abrades and removes large areas of the grain and allows sand or any other abrasives to become embedded in the depth of the hide.

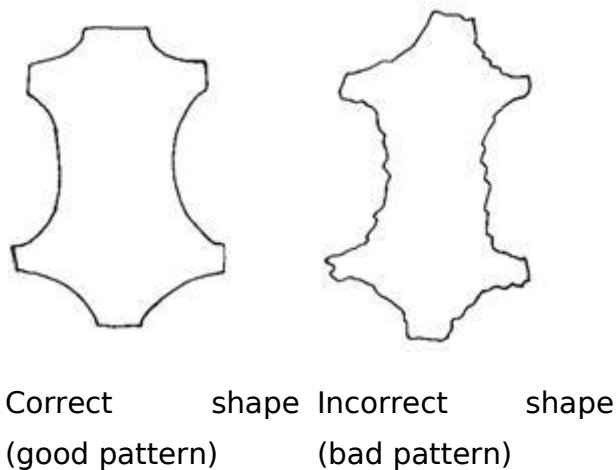
#### **4. Poor pattern/Poor Flaying**

It is meant, the shape or outline of the flayed hide when it is spread out flat. A regular pattern is very important to the tanner because it enables him to get the best cuts and the most useful part of the raw material. It is caused by incorrect line of ripping. The bleeding cuts must be directly at the centre of the throat. If the legs are not ripped open properly, the proportion of the hide in the shoulder, belly and butt section are not proper. Thus belly hide that should have been part of the belly may be on the butt or the shoulder area. "V" cut in the button either side of the tail downgrades the hide, according to the degree of damage to the pattern. It is very important that the bleeding cut, the belly cut, and the leg cut are made as straight. Poor flaying is due to incorrect opening resulting to unsymmetrical shape of hides and skins. Hides or skins of good shape can only be achieved by correct ripping lines. Flay cut, gouge marks and scores are caused during this period through use of sharp pointed knives. This subsequently reduces the quality and use of leather.

**Improper ripping:** Results in small-sized and incorrectly shaped skins

**Small size:** The small size of skins yielded by the hair sheep of tropical and mountain area origin is not considered a drawback because of the skin's superior quality of high tensile strength, compact fiber structure and excellent grain. But small size skins that are downgraded due to poor quality are unwanted by tanneries. To the tanneries, processing these skins represents loss of profit due to the chemicals and labor involved in tanning a skin with a small, poor quality surface unsuited for finishing.

**Incorrect shape:** This is the shape of a skin formed by not following an accepted pattern of ripping before flaying. A bad pattern obviously affects the utilization of the leather produced and reduces the marketability of the finished product.



## 5. Flay Cuts, Gouge Marks and Scores (notch cut)

These flaying defects reduce considerably the value of a hide/skin. These damages can all be avoided since they are caused careless flaying, such as flaying by inexperienced people or use of poor or improper tools.

- **Flay (butcher) Cuts:** are knife cuts and holes that pierce or go halfway or more through the hides.

- **Gouge Marks:** are knife damages on the flesh side of the hide in which small portions of the corium are scooped out.
- **Scores (notch cut):** are knife cuts that do not penetrate halfway through the hide but are deep enough to cause damage in the finished leather.

## **C. Post-mortem Damages**

### **1. Putrefaction**

The main constituent of skin is protein. After an animal's death, skin proteins are exposed to bacterial attack that leads to decomposition. Hair slippage is a sign of putrefaction, usually occurring due to delays in preservation, improper curing, or when dried skins are exposed to rain during transport or storage. If hair slippage is not checked in time, putrefaction starts which can be from both the grain and flesh sides. This leads to decomposition of the grain layer. Lack of air circulation, excess atmospheric humidity, skins contacting frames, ground/soil, poles, or ropes etc. during drying/curing will all lead to putrefaction. High temperatures can exacerbate the problem. Blood is difficult to remove from wool or hair and it aids in bacterial attack along with dung.

### **2. Damages Due to Insects and Rodents Attack**

- A. **Hide beetles:** There are about 700 species of hide beetles. These are insects which, in larvae and adult form, probably do more damage to stock of hides/skins than other pests together when the hides/skins are stored for more than 10 days without application of insecticides. As it is more voracious, the larvae may result into the extent of complete perforation of the hides and skins. It is advisable to use stones or ricks for construction of stores with liberal application of insecticides.
- B, **Hide ants (termites/white ants):** These are the other distractive insects to hides and skins stored on floor. The risk can be reduced and there by avoided by storing hides/skins on slated platted forms raised above the floor with avoiding contact with the walls of the store. Further more general cleanliness of the store with frequent inspection and handling of goods can undoubtedly help to minimize their destructive effect.

C, **Rats and mice:** Damage caused by rats and mice can reduce a good quality hide to a lower grade even and even to rejection.

### **3. Damages due to baling and transportation**

- A, **Loose baling:** results excessive friction between surface of the hide during transportation that can cause damage particularly on fold edges
- B, **Tight baling:** also causes damages to the hides/skin because of cracking developed along the sides of the folds.
- C, **Effect of binding materials:** wire should not be used as binding materials as they may cut the surface of hides/skins.
- D, **Wetting during transportation:** any sort of moisture abortion by the hides/skin being transported can cause putrefaction.
- E, **Rubbing during transportation:** any contact of the hides/skins with any hard objects including the body of the lorry (track) can cause rubbing damage. They can be protected
- F, from such contact by tightly packing with dry hay.

### **4. Contamination**

When transported with other goods such as paints, oils and etc can affect adversely its quality of being tanned to good leather.



## **CHAPTER FIVE: Preservation of hides and skins**

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

**Putrefaction:** Bacterial and enzymatic breakdown, rotting.

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

### **5.1. Objectives and Principles of Preservation**

#### **5.1.1. Preservation**

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 mould 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.

Preservation is most effective when it is carried out quickly and thoroughly. Cattle hides, for example, should be dried to a moisture content of less than 15 percent within three days. Sheep and goat skins should be dried to a moisture content of less than 15 percent within one day. If drying takes longer bacterial damage is likely to occur. Similarly, hides and skins preserved by salting or brining should be

saturated with salt – sodium chloride – within one day. Properly preserved hides and skins should be free of post-slaughter defects related preservation processes, such as bacterial decay, contamination and adulteration. Dried hides and skins should be flat, smooth and protected against insect damage during long term storage. Salted and brined hides and skins may be rolled, stacked or bagged to facilitate storage and transport.

Most hides and skins must be preserved to protect them during storage and transport until they are converted into leather. Preservation should ideally begin immediately after slaughter and should never be delayed overnight. If freshly prepared hides and skins cannot be delivered directly to the tannery, they must be preserved. They should also be preserved if the delivery to a tannery is likely to be delayed, especially when the tannery is a long way from the butchery, and it may not be possible to deliver the fresh hides or skins quickly enough. Without preservation, the hides or skins would spoil before they were received in the tannery.

Preserved hides and skins may be stored for up to a year while waiting further processing. During this time preserved hides and skins may be collected and transported from remoter parts of a country and undergo grading, sorting and accumulation into large lots pending storage, sale and delivery. Storage usually involves costs such as rent, depreciation and interest charges.

Since the spoilage is mainly caused by bacteria, the preservation procedures are mainly deprivation of the organisms their basic needs and stop them from growing or kill them. The fundamental requirements of most bacteria are: sufficient water, suitable  $P^H$ , suitable temperature, food and oxygen.

#### A) $P^H$

In all living tissues and fresh HSs, the proportion of hydrogen and hydroxyl ions from the dissociation of water is about the same. Hence, the  $P^H$  of HSs is said to be neutral. The rate of growth of damaging bacteria is most rapid at the  $P^H$  of fresh hides and skins. Treating the HS with acids or alkali certainly reduces or eliminates the activity of bacteria. But the corrosive action of these chemicals would cause

unacceptable damage to the quality of leather. Therefore  $P^H$  control is not a suitable way of preserving fresh HSs.

### **B) Temperature**

The rate of growth of damaging bacteria is most rapid at about the animal body temperature in fresh hides and skins. Subjecting HS to high temperature may kill the bacteria but unfortunately makes an irreversible change in the substance of the leather (particularly if temperature greater than 65 degree celcius). Reducing the temperature has less adverse effect on HS and provides some scope for preservation. For a longer period of storage (about 3 weeks), the temperature must be reduced to that of a commercial refrigerator (2-4 degree celcius) or freezer (-18 degree celcius). But both refrigerator and freezing are expensive in terms of the equipment and operating cost.

### **C) Food**

Unfortunately fresh HSs are excellent source of food for bacteria but nothing could be done to deprive bacteria of food.

### **D) Moisture**

Drying and salting are two examples of moisture control of bacterial growth. During drying if the moisture content is reduced to 10% or less. 1. The hide or skin may become brittle and may crack during handling and 2. It will rehydrate only slowly and perhaps and incompletely during the course of tanning operation. The objective of preservation by drying is to achieve a moisture content of 10-20%. Such hide or skin would weigh about 40% of its original fresh weight.

Salt does not preserve hide or skin by killing bacteria. It may indeed kill some bacteria but not enough to sterilize the hide or skin. The water content of a salted hide or skin is typically 45% which, in the absence of salt, would be enough to support bacterial growth.

The preservation of salt is most often in terms of its osmotic effect; but a better explanation involves reference to the activity or availability of water ( $A_w$ ).  $A_w$  is a

measure of the amount of water available for use in metabolic activity. It is not the measure of the total quantity of water present.

The  $A_w$  of pure water is 1.00 and that of hides and skins is about 0.99. Most bacteria grow best in an  $A_w$  close to that of pure water but will tolerate an  $A_w$  of 0.7, while some yeast will tolerate 0.6. During the course of preservation like salting, the high  $A_w$  of fresh hides and skins is reduced, by dissolving large quantities of soluble chemical into the moisture inside the material being preserved.

The same theory can be used to explain the effect in drying. A dried Hide of 12kg may still contain 5 kg of water and yet this is not enough for bacterial growth because the water is unavailable ( $A_w$  is too low). By this bacterial growth is reduced or eliminated and preservation is achieved.

### **Putrefaction**

As soon as a hide or skin is removed from the carcase, it is susceptible to bacterial attack. The bacteria penetrate into the skin via the exposed flesh surface where they can rapidly multiply. Under ideal conditions, a single bacterium can divide every 20 minutes and, therefore, within 24 hours will have multiplied to give a population of 4,000 million.

The proteolytic enzymes which they produce can cause untold damage to the hide or skin. Some typical problems in leather which can be caused by putrefaction are: \* Grain damage \* Weakness \* Looseness \* Staining \* Chrome soaps \* Spue \* Uneven dyeing. In addition, putrefaction can weaken the delicate grain surface and make it more susceptible to the rigours of normal leather production, leading to chemical damage and physical abrasion. **The cause** Soon after flaying the hide is moist, warm and full of protein - an ideal breeding ground for bacteria! The longer these conditions prevail, the more putrefactive damage will occur. Some common causes of putrefaction in hides and skins are:

- 1) A delay between flaying and curing/processing
- 2) Insufficient salting or brining

- 3) Poor penetration of the salt or brine due to heavy fat/flesh deposits
- 4) Insufficient draining of the salted or brined hide or skin allowing liquors to pool and reduce salt concentrations
- 5) Poor storage conditions of the raw salted hide or skin, eg exposed to the elements allowing salt to be washed off or excessively warm conditions
- 6) Prolonged storage, particularly under warm conditions
- 7) Soaking the raw hides or skins without sufficient biocide protection

Sometimes, even when hides have been well salted or brined, bacteria can still grow. These are a particular type of bacteria which are halophilic (salt loving) and are commonly coloured red or purple; affected hides are said to have 'red heat'. Under normal storage conditions for raw hides or skins, red and purple heat bacteria take a relatively long time to grow; around two to three months. Therefore, their presence is an indication that the hides or skins have been in storage for some time. However, at higher temperatures (30-40°C), growth will be more rapid. The warm, humid conditions favoured by red heat bacteria are also favoured by other non coloured spoilage bacteria, so if salt levels are not high enough, putrefactive bacteria may also be present. It was once thought that red heat bacteria caused no harm to the hide, but it is now known that some types of bacteria do produce proteolytic enzymes which are capable of damaging collagen. Although red heat bacteria are aerobic and, therefore, only grow on the surface of the hide or skin, the enzymes that they produce are mobile and can penetrate further into the skin structure. Any proteolytic enzymes which may be produced by purple heat are even more likely to cause damage because they can proliferate within the hide structure.

**Prevention** Rapid and appropriate curing is a key issue in the prevention of putrefaction: the hide should be cooled immediately after flaying in order to dissipate any remaining body heat, and kept cool until the hide is salted. As soon as practicable, the hide should be treated with clean salt, in a quantity equivalent to no less than 35% of the green hide weight. Mechanised agitation will produce a more rapid absorption of salt, while piling will call for a minimum of seven days in salt,

and preferably 14 days, to affect the level of saturation required. When salt penetration is adequate, the remaining salt should be 'biffed' off and a sprinkling of fresh salt applied before the hides are prepared for shipment in accordance with market practice. Once at the tannery, the hides should be stored appropriately. Cool dry storage conditions for hides help maintain a good standard of preservation. Storage in the open, where hides are not covered, can cause the hides to heat up if in direct sunlight, encouraging bacterial activity and drying out. Thermal damage may also occur to hides, particularly if stored in direct sunlight under clear polythene. Under humid atmospheric conditions, salt can absorb moisture from the atmosphere which results in a reduced salt content at the surface of the hide. Salt can also be lost from the hides by drainage of this moisture. Leaching out of salt can also occur where hides are left open to rain.

## **5.2. Spoilage of Hides and Skins**

### **5.2.1. Causes of Spoilage**

Agents that generate spoilage are: chemical decomposition, autolytic enzymes, viruses, fungi (moulds and yeasts) and bacteria.

Generalized physico-chemical decomposition is a degrading process that may affect any material. All organic matter is susceptible, and wet and warm conditions most likely to promote this process. For fresh HS the damage becomes significant at high ambient temperature for a long time. By the time the process has begun to affect HSs, they would already have been destroyed by other, more active, ones. Dried material is relatively unaffected by chemical degradation, but wet salted HSs may incur significant damage if stored at over 20 degree celcius for a period of months.

Autolytic enzymes are released by most tissue soon after the death of the animal. These can destroy substantial quantities of tissue, but their effect may only become significant after a period of weeks. The damage caused may be difficult to distinguish from the generalized physic-chemical effects.

Viruses are only active in living tissues and so they cannot be responsible for spoilage even in recently dead tissue. They may be however the cause for certain types of pre-slaughter defects that occur in HS while the animal is alive.

Fungi generally grow slowly though some forms can be established on incompletely dried materials, they are not usually responsible for the early stages of spoilage in HS.

Bacteria are usually the principal cause of the initial spoilage of fresh unpreserved or inadequately preserved HS. A bacterium occurs in large numbers on the outer (hair) surface of HS and, during the course of slaughter, even more can be released from the guts.

### **Courses of Spoilage**

The HS of a healthy animal only exhibits bacteria on the outer surface of epidermis. After death and removal of the HS, blood, dirt and bacteria may quickly invade the hypodermis as well.

Contaminating bacteria on the surface layer of the hypodermis and epidermis soon become to reproduce consuming dissolved protein and other suitable food as they do so. When the food on the surface of the HS becomes exhausted, the bacteria may penetrate into the underlying layers. However only the flesh surface is readily for permeable to bacteria. The epidermis of HS provides an effective barrier against penetration of bacteria during the course of the animal's life. This barrier function for some days the animal's death. Accordingly, bacteria usually enter HS through the hypodermis only, the epidermis may only be penetrated if it has been damaged for example by abrasion and disease.

Over a period of time, the bacteria continue to migrate through the dermis until they reach the underneath of the epidermis. Where they quickly destroy the delicate junction between the two layers. The epidermis together with any hair or wool, may then quickly become detached from the dermis.

The speed at which the spoilage of unpreserved HS occurs depends on a number of factors. Some of the most important are :

- / , The ambient temperature: high temperatures promote rapid deterioration, but low temperature discourages it.

- 0, The extent of contamination: higher levels of contaminating bacteria particularly collagenolytic anaerobes, promote more rapid deterioration of HSs.
- 1, The thickness: thicker HSs spoil more slowly than thinner ones.

### **5.2.3. Methods of Preservation of Hides and Skins**

If a fresh animal skin cannot be processed immediately in the tannery, it is stored and preserved in order to halt decay. This must be done quickly to prevent bacterial growth, which usually begins approximately 2 hours after slaughter.–Bacteria can destroy the skin (putrefaction) and render it unusable for making fur or leather. The optimal temperature for storing the skins is between 4 - 7 ° C. Hanging them to drain the blood is also important.

The common preservation techniques used are

- air-drying
- Salting
- **Freezing - cooling**

#### **5.3.1. Preservation by Drying (Air-drying)**

The simplest and oldest preservation process is drying. The skin is thus stretched in the dry air in such a way that air can flow around the hide from all sides. The moisture required for the development of microorganisms is thereby removed from the skins. The skins should dry quickly, but never at too high temperatures (not above 30 ° C) and never in direct sunlight or next to a radiator, since this leads to irreversible damage of the skin collagen! Dried leathers are hard. The skin must not be exposed to moisture during drying (e.g. by sudden rain). Otherwise, the decomposition process is initiated, the skin starts to rot, and insects are being lured.

There are different ways/ techniques of air-drying

- Drying by suspension on frames(frame drying)
- Drying by suspension over cords/wires
- Drying on the ground (sun drying)
- Wall-drying and pole-drying



### **A. Suspension drying on frames(frame drying)**

The best way is to do frame drying in sheds. In Ethiopia, 85% of cattle hides and a small percentage of goat and sheep skins are prepared in this way. It is important that the sheds should have ventilation to avoid spoilage. From hides of larger breeds of cattle the frame should be 2.7 x 3.1m and for smaller breeds 2.7 x 2.4. The large frames can be used for 4 skins. It is most important that the frames are big enough, at least 1\*1 m<sup>2</sup> for skins and 2.5\*2.5 m<sup>2</sup> for hides. As it should be done in the shade it is commonly referred to as 'shade drying'.

Good points about suspension drying are:

- allows free flow of air on both side of hide or skin
- the rain drain of the surface
- the sun rays strike obliquely not directly
- no hair slip or putrefaction as there are no folds nor points of contacts between the hide and any solid subject
- longer storage duration than salted hides
- cheaper transportation

### **B. Drying by suspension over cords or wires**

- where wood is scarce to form frames
- according to the Ethiopian policy all goat skins which are not salted should be prepared by this techniques

### **C. Ground drying**

- hides or skins are placed directly on the ground
- it is most undesirable system practiced in Ethiopia
- Because of lack of air circulation, moisture is trapped underneath and crack when folded because of their hardness and inflexibility.

### **5.3.2. Preservation by Salting**

The salting preservation method primarily drains the skin. It is essential that the salt (chemical: sodium chloride) is fresh. A salt which has already been used for preservation contains too many microorganisms and therefore does not guarantee good preservation when reused. The salt should not contain impurities, due to iron compounds. Likewise, only very small amounts of calcium or magnesium compounds may be present as impurities.

The method of salting is free from cooling, but must be carried out very conscientiously in order to avoid putrefaction of the skin. Sufficient salt is required to completely saturate the skin so as to stop any bacterial growth. For this reason, the rawhide has to be salted with 40 - 50% salt in relation to the skin weight. This equates to more than one centimetre layer of salt on the flesh side of the skin. Therefore, a skin with 40 - 50 kg requires approximately 20 - 25 kg of salt. Salt is a biostat which inhibits bacteria growth and activity by reducing the moisture content in raw skins. Various salt preservation methods can be applied. As a general rule, the hides are spread out, coated with salt, and then stacked on top of each other by inserting more salt. The hides must sometimes be re-salted in case of long-term storage. The process involves sprinkling the skin with solid salt (dry salting) or by treating the skin with salt solutions (wet salting).

#### **A. Wet salting**

This was introduced in to Ethiopia around 1977 and at present about 80% of the sheepskin, 20% of goatskins and 5% cattle hides are preserved using this method. The hide or skin is spread on floor or wooden pallet and salt is uniformly applied on the flesh side with common salt to the extent of 30 to 40% on green weight. The second hide is now spread on the first one with flesh side up and salt applied in the same manner. Curing takes approximately 3 weeks and the piles need to be turned and restocked every 10 days. This salting technique is preferred by the tanners to air drying as tanners find it easier to process wet salted stock and they obtain better results. And also salting is highly beneficial during the long rainy season as hides and skins cannot be properly air dried at that time. Curing by wet salting requires a minimum of 3/4 weeks. The salt used is composed of: about 94-95% pure

sodium chloride, 1% naphthalene (insecticide) and other insecticide and bactericide chemicals.

### **Effect**

- ✓ bacteria become ineffective
- ✓ salt draws out about 20% of the water from hide or skin
- ✓ Some salt is absorbed by the skin to the extent of 13-17%
- ✓ the weight loss compared to green hide is about 10-20%

### **Disadvantage:**

- ✓ Cost of salt
- ✓ Transportation of wet salted stock is more expensive than the dry one
- ✓ Can be stocked for much lesser time compared to dry ones
- ✓ 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

### **Advantage**

- ✓ It is more rapid (process within hours) and uniform
  - but tanneries need extra 2-3 days to rehydrate dried HS
- ✓ better in long rainy season (properly air drying is difficult)
- ✓ It provides greater protection before tanning
- ✓ It requires no washing before soaking back
- ✓ Produces leather of plumper grain; Better quality (hence higher price)
- ✓ less in soaking expenses compared with dry ones

### **B. Dry salting**

Very much similar to wet salting but the hides and skins are dried after the initial salting that gives the advantage of both drying and salting. The quantity of salt

used is 10% less than in wet. With rains, air-drying of salted hides may present considerable difficulties. Dry-salted goods do not require protection from beetles but are very susceptible to damage by wetting. Butchers or farmers who handle only small number of hides can easily practice quick dry salting. The salt is applied and hide is folded with flesh side in. Hide remains in folded condition for two days and taken out and dried.

### **General Advantage's for salt preservation**

Produces higher quality leather when tanned;

It is market-demand oriented, especially for the European Union markets;

Uses very little amount of water in soaking during tannage;

In many cases salt is provided almost free of charge by the exporters;

Livestock farmers and buyers get better incentives for their hides and skins sold  
(See the image: Higher quality leather)

### **5.3.3. Freezing - Cooling**

Freezing is the most straightforward method. Fresh skins are packed in plastic and stored in cooling rooms. Apart from the energy costs of cooling, this method has a lot of advantages. Freezing stops the decomposition process immediately, the shelf life of the stored raw material is unlimited and, if required, the skins can be processed immediately - as if they were coming in straight from the slaughterhouse.