University of Gondar
College of CVMAS
Department of Animal production and Extension

Hides and Skins Management and Processing (HSMP)

AnPS3105

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For III Year Veterinary Medicine Students

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Chapter -1 : Introduction

Definition of Terms

- Hide - External integument of large animals. e.g. cattle
- Skin - external integument of small animals. e.g. Sheep, goat, rabbit etc.
- Brining - an immersion of hide and skin (HS)in to saturated salt solution for preservation
- Collagen- major protein of HS which is made into leather
- Dermis- is the middle layer of HS
- Epidermis- is the outer layer of HS
- Hypodermis- inner layer of HS
- Flaying- is the removal of HS from carcass of the animals
- Flesh- the tissue adhering to the flesh side of HS
- Fleshing- is the removal of flesh from HS(Fat, meat, connective tissue). A mechanical operation that rids the hides of excess flesh, fat, and muscle found on the inside (flesh side) of the hides.

Terminologies Cont'd

- Grain- the visible surface of dermis. The outer or hair side of a hide or skin. Also the pattern of the outer surface after the hair or wool and epidermal tissue have been removed.
- Corium- is the non-visible surface of dermis
- Grading- classification of HS based on quality, weight, etc.
- Leather - HS which has been processed
- Tanning – the process of changing HS into leather.
- Peri- slaughter – a period around the time of slaughtering
- Pre-slaughtering – period before the time of slaughtering
- Post- slaughtering- the period after slaughtering
- Putrefaction- spoilage of HS
- Trimming- is the removal of irregular flaps from edge and corners of HS
- soaking – rehydration or cleaning of HS using some chemicals
- Liming- removal of epidermis
- Splitting- reduction of thickness of HS
- Bating- enzymatic softening of HS
- Embossing – ornamentation (coloring)of HS.
- Basification- fixation of tanning

Terminologies cont…

- Belly- the part of HS from the underside of the animal
- Blue HS- HS that have been chrome- tanned but not finished.
- Brand- a permanent man made mark on the hide for animal identification usually made with a hot iron
- **Curing-** The treatment of raw hides and skins after flaying to retard bacterial action and putrefaction
- Slats - skin after wool/fleece is removed
- Pelts- wool /fleece left on

HS…

- Hides are broadly defined as the external integuments of large animals, while skins are provided by smaller animals. cattle hides and goat skins are examples.

- hides and skins may be obtained from many other species of domesticated and non domestic animals.

- HS derived from non-domesticated animals are commonly referred as "gameskins" , example; skins of ranched animals such as mink may be considered as special category of gameskins, irrespective of their size and expression " gamehide" is not used.

- fur skins some time times referred to as Pelts.
- HS constitute 7-13% of an animal's body weight.

1.1. Classifying Hides and Skins

D/ce b/n hides and skins

Difference due to (consideration for difference);

- size
- substance(thickness)
- Type of animal (source)

- larger and heavier "skins" being termed as " hides" e.g. those derived from cattle, horses, buffalo and camels
- Smaller and lighter derived from sheep, goat or pigs are termed as." skins"

D/ce b/n hides and skins…

- Classification of HS is based on source (difference to breed), size, thickness, topographic variations across the whole surface, component tissues and their arrangement
- In some species, type of animal rather than size alone. In cattle , The size of whose hides are subject to wide variation between geographical regions :-
  - The area (in sq. feet <20 in India,
  - average 26 in all Africa,
  - in Australia 34, in western Europe and North America 40.

Functions of HS

(i). Provide a light, durable covering for the body

(ii). To assist in regulation of body temperature

(iii). To prevent or minimize possible injury to internal organs & provide a barrier to bacterial infection

(IV). To provide a waterproof covering for the body while allowing moisture to leave the body through it e.g. perspiration

(v). To be capable of flexing, stretching or contracting with the movements of the body and its parts.

- The component structures of the skin are designed to meet those requirements.

Sources of hides and skins …

- The animals which provide HS for the tanning industry are Chordates; characterized by the presence of a back bone in the skeleton. The chordates further subdivided in to five classes : mammals, amphibians, reptiles, birds and fish.
- Most of the tanning industry's raw materials derived from mammals and domestic animals in particular. Cattle hides (70%), Sheep skins 20% and goat skin make up 10%.
- Cattle . Camel …. Horses
- sheep .. Ostrich…
- goats …. Buffalo
- Pigs …. Wild fox
- 35% world cattle herd is held by six countries Argentina, Brazil, Ethiopia ,India , Mexico and Pakistan.
- In 1995 .. Brazil (93m) and India (182m) alone accounts 25% of world herd.

Sources of HS…

Source	Hides	Skins
Mammals	Cattle	sheep
	Buffalo	Goat
	Horse	Pig (eastern Europe)
	Elephant(African)	Impala
		Rabbit
		Mink
Reptiles		Crocodiles, Alligators, Caymans, Lizards, ,snakes , Tortoises , Turtles
Amphibians		Frog , Toads
Birds		Ostrich
Fish		Shark

- Cattle hide – best known type of mammalian hides used by the tanning industry. They are the largest type of raw material used routinely in the tanning industry and used to make almost every type of leather.
- about 6mm in thickness and considered to be good raw material for leather manufacture. Principal attraction in cattle Hide:- conformation of the collagen fibers= large, thick and strong & form a dense compact network. Pattern of fibers in the grain surface = attractive ; visual appearance of the grain surface – regular
- Calf Skins - smaller, lighter and thinner than hides. Max wt. 16kg, area of 24 dm2 . Attractive feature of leather made from calf skin is the appearance of the grain. Papillary layer of calf skin is thicker & constitute about 33% of the thickness of the dermis. In all animals, the collagen matures and become physically and chemically stronger during the course of its life.

Sheep Skins

- are smaller than hides, wt. depends on amount of fleece present at the time of slaughter. Average weight is 3-7kg.
- Physical and chemical characteristics are affected by the heavy growth of wool. Wool fibers often penetrate half the thickness of the skin & disrupt collagen and weaken the structure of the skin.
- The surface pattern of sheep skin consist of a mixture of coarse hair follicles and larger proportion of smaller and finer secondary hair follicles.
- " Leather quality is inversely proportional to the abundance of wool (or hair)on the raw material".

Goat Skin – 3rd principal source of raw material for the tanning industry, providing 24% of pieces in 1990, or 3% of the weight.

- Papillary layer constitutes about 50% of the thickness of dermis but it doesn't seriously weaken the skin.
- The pattern of the grain surface of goatskins usually consists of a mixture of primary and secondary hair follicles.

1.3. Traditional and modern utilization of hides & skins

- Shoes
- Garments
- Leather goods

Traditional

writing materials

- Linked with the history of human development
- Manufacture of personal armour, shields, musical instruments (such as drums) and upholstering chairs.
- raw HS are of little use in natural state and spoil quickly
- dried HS are hard and durable and widely used
- dried HS are often hard, brittle, and adversely affected by wetting . Improved and increased utilization of HS therefore was dependent up on development of superior techniques such as dressing, and tanning.

Traditional & modern appln …

- Dressing ---improves softness of HS
- Tanning ---increase HS resistance to water

Dressing immerse HS in water containing a salt (KAlSO4 or NH4AlSO4) a source of oil and an inert filler.

These materials diffuse into the skin and promote softness and suppleness after the moisture has been removed by drying. Not suitable to processing due to skins becomes wet.

Tanning

Tanning – desirable for processing. Tanning synonymous with leather manufacture one of the crucial step in processing which changes HS to leather.

- mineral tanning based on use of chromium salts

current application of HS…

- ginning machines separate seeds from cotton made of leather
- clothing
- Foot wear
- agricultural and industrial goods made from leather
- a range of items including gloves, belts, hats, protective(fire resistant) clothing, cups, buckets, etc.
- less obvious examples sword handles, gas meter diaphragms, drive belts, strops, etc.

Current application of HS

- …parchment..Vellum until 20th century
- Dog chews – feed formulation for dogs
- Food for human- skin of pig on a peace of bacon.

- Gelatin subjecting HS to high Temp during which releases a water soluble material which is used as a thickening or setting agent in the food industry.

- Highly refined type of gelatin are used in pharmaceutical industry to make capsules and in the photographic industry to make films.

- principal raw material in the manufacture of leather.

Chapter 2
Physical and Chemical Characteristics of Hides and Skins

2.1 Physical characteristics of hides and skins

- mainly concerned with surface area of HS
- Histologically HS have 3 layers. These are different in function, composition, and thickness.

(i) Epidermis- the outer most layer of the skin

- very thin invaginated by hair root
- they are removed during conventional tanning
- used to manufacture specially hair on leather and wool goods
- In cattle 0.5-1% of total thickness (0.02-0.04 mm).
- The epidermis carpeting hair follicles which have their origin deep in the dermis.
- it consists of two sub-layers Viz. corneous and reticular.
- The corneous sub layer is the outside part which is formed of dead cells.

Cont'd…

- The reticular sub layer is constituted of a tissue of high metabolic activities that renew it self the cell tissue for the high metabolic function. This part of epidermis is very sensitive to bacterial and chemical attack.

Dermis - thicker layer of connective tissue and other tissues which constitute the true leather forming substance of HS.

- It is divided in to two parts

(a) corium minor or grain layer- also called sub-epidermal papillary layer - the top of the corium constitute about 1/5th of the total thickness of corium and differs structurally from main part.

- It has a characteristics grain pattern which is actually the pattern of hair follicles depending on the structure of HS
- Uniform through out the growth of animals 0.7-0.9mm (30x) thicker than epidermis.
- Contributes much to the aesthetic appearance of leather.

Cont'd ….

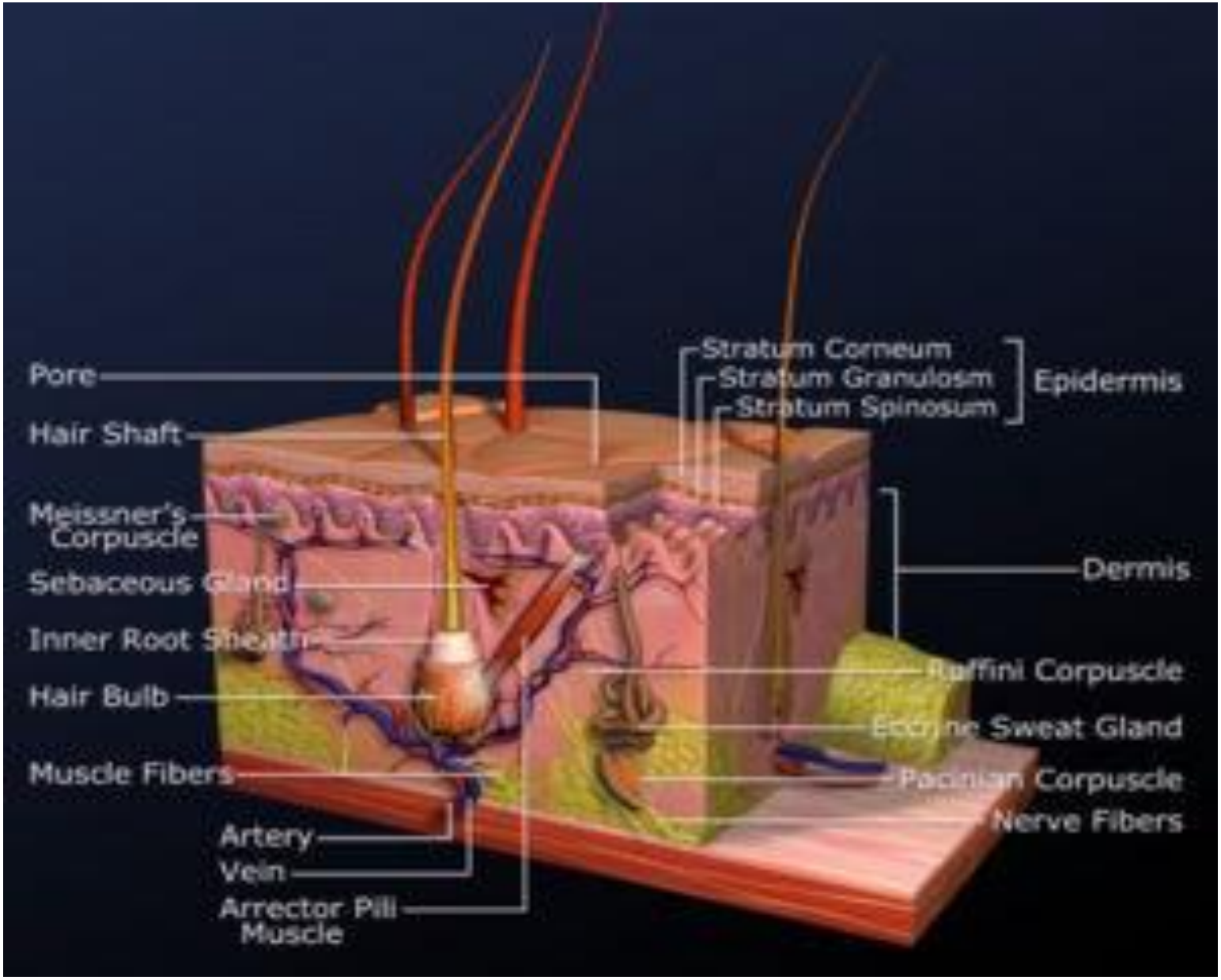
(b) Corium major or reticular layer (fiber net work layer)- is the lower and main region of dermis & forms major part of the leather.

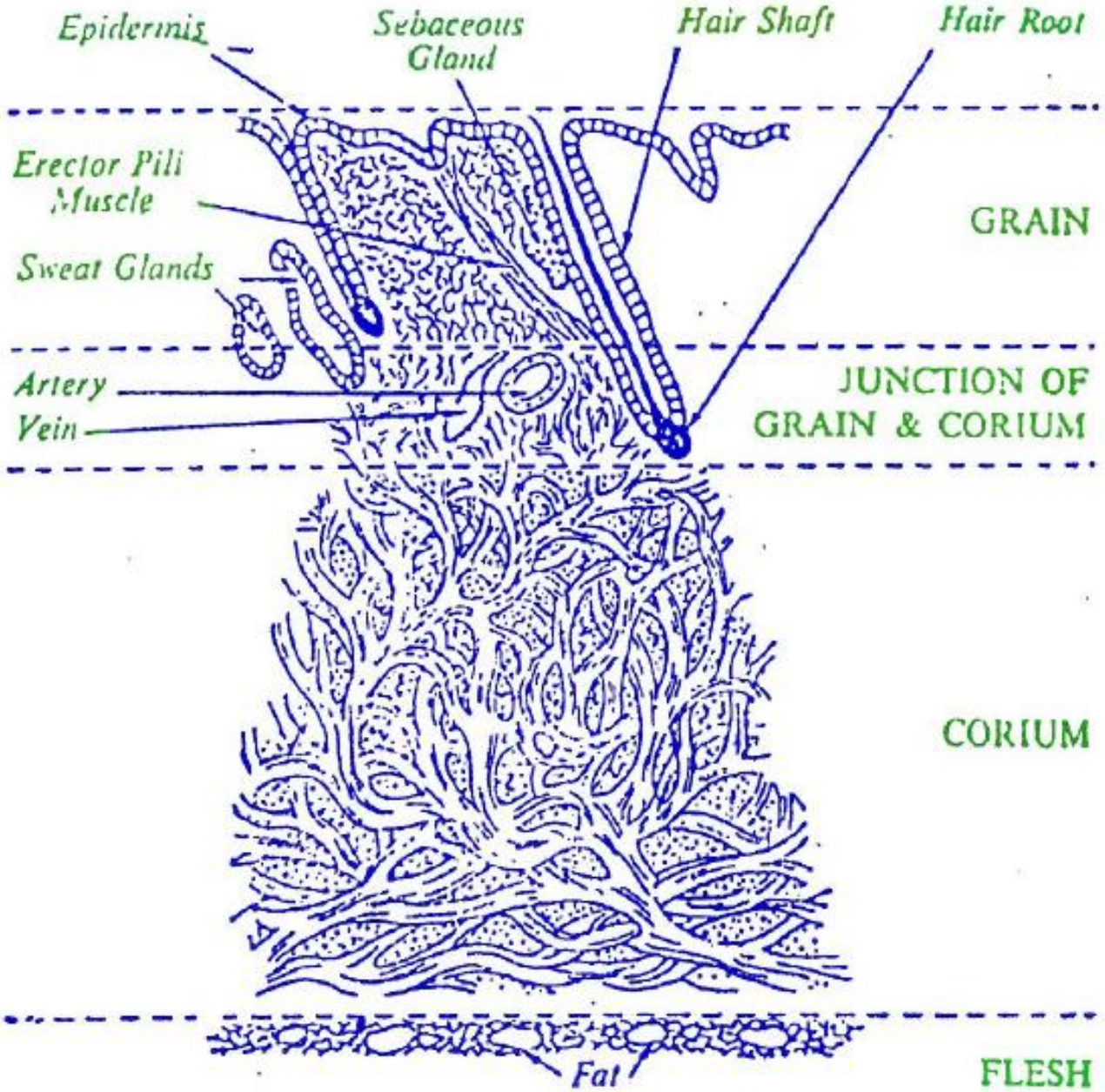
- is main part of corium appearing as net like fibers of connective tissues .
- The entire corium is an interwoven structure consisting of several fibers grasped together.
- The fibril again consists of several protofibrils. In practice, the corium or true skin is that portion of the hide or skin which is called pelt, and from which the hair has been removed.

(iii) Hypodermis (subcutaneous tissue)- it tends to contain more fatty and muscle tissues.

- The adipose tissue is the tissue left adhering to the flash side of the hide of skin. It consists chiefly of fat cells, containing tallow like fats, with a few scattered fibers

➢ The appearance of the finished leather is determined by the quality of the papillary layer, where as the mechanical properties are governed by the quality of the fiber net work layer.


Pore
Hair Shaft
Meissner's Corpuscle
Sebaceous Gland
Inner Root Sheath
Hair Bulb
Muscle Fibers
Artery
Vein
Arrector Pili Muscle
Stratum Corneum
Stratum Granulosm
Stratum Spinosum
Epidermis
Dermis
Ruffini Corpuscle
Eccrine Sweat Gland
Pacinian Corpuscle
Nerve Fibers



Cross-section of skin

Physical structure of HS

- related to Thickness at particular location - stratigraphic composition obtained from studies using histological techniques
- related to whole surface area – topographic differences.

- to conduct histological composition of HS, cut it to a very thin section 5-20µm and examine them microscopically.
- The three layers clearly visible in HS are :

1. Epidermis – outermost layer, very thin but invaginations by hair roots, push parts of it deep into the underlying dermis.
2. Dermis- the thickest part of most HS and used to make leather. It has two layers i.e. grain – the visible part of dermis and corium- non visible part of dermis
3. Hypodermis- is the inner layer of HS and found underneath of dermis and attach HS to the carcass of the animal.

- The three layers that comprise the structure of most H or S differ considerably in their composition and function.

Physical structure cont'd

Hypodermis consists mainly adipose tissue, with high levels of fat to provide insulation characteristics. Areolar tissue help to connect the HS to underlying carcass.

- It is not used to make leather & it must be removed during the preparation HS for the tanning industry.

Epidermis consists of many component layers of different types of cells and is characterized by the presence of high levels of the protein keratin.

- It contains little or no collagen, it is not used to manufacture leather. It would therefore be removed during conventional tanning operations. How ever, it is retained in the manufacture of specialty hair-on leathers, fur garments and wool-on goods.

Dermis- used to manufacture leather.

Cont'd

- Grain layer (Papillary layer) - the surface originally adjacent to the epidermis is very characteristic of leather and every effort should be made to protect it from any type of damage.

- is contoured surface of papillae which apparent throughout the upper layer of the dermis.
- Papillae- formed by invaginations of hairs or wool fibers into the upper layer of dermis. It is characteristic of a particular type of HS.

- It is formed by very fine collagen fibers of about 1.0μm in the upper surface of the dermis. Whereas, collagen fibres on the flesh side of HS and leathers are relatively course (20.0 μm diameter) and form a more open porous structure called suede.

Cont'd

- Collagen fibers tend to vertically oriented
- Closer to the hypodermis the collagen fibres tend to be horizontal. This region of the dermis is commonly referred to as the reticular layer.
- Reticular Layer - is consisted entirely of fibers which are interlinked to form a complex fiber-network only of which the characteristic qualities of leather depend.

- Elastin fibers complete the structure of skins given the elasticity. These are thin, easily stretched and pulled under slight loading.
- Collagen fibers are the principal fibers in the derma, are thin threads interlaced with each other.
- Reticulin fibers are very stable and thin. They pierce through the derma resembling a net on the surface of the grain.

2.1. Chemical characteristics of HS

- Major components of fresh HS described as moisture, volatile material or water
- Fat components of HS w/c may contain significant proportion of oil.
- The most abundant component is the water (moisture volatile material).
- Water is physical and financial burden in the transportation costs of fresh HS. Major factor in spoilage of HS.

Chemical composition fresh cattle Hide

Component	Composition (% mass)
Water	65
Protein	30
Fat	4
Ash	1 Total 100%

Chemical composition Cont'd

Water

- Despite superficial appearances water in HS is not all the same and biochemists usually distinguish b/n at least three types

1) Surface film of moisture on the flesh side
- Smallest proportion of the total water (<10%) disappear when surrounding air is dry
2) Viscous gel .. 2nd and most abundant type of water (80%) and dispersed through out the greater part of HS. It is found in combined form of viscous gel with glycosaminoglycan (such as hyaluronic acid or dermatan sulphate)
3) water very closely bound to (associated with) various constituent proteins --- (about 10% of total)

Cont'd

Ash – least abundant component of fresh HS. It represents inorganic, mineral compounds found in association with organic tissues.

- high levels of ash in HS may indicate presence of contaminants or adulterants such as excessive dirt.

Fat

- Ether -soluble component of HS
- Subject to considerable variation
- high level of fat may occur inside heavily woolled sheep and pig skins in general.
- Low level of fat is the shark skin

Protein

- include hormones and peptides

1. miscellaneous soluble proteins , enzymes fundamental importance through out the life of an animal.

- Some autolytic enzymes may become significant in dead animals – b/c they are responsible for some of the destruction that occurs in the tissue of HS.

soluble proteins - about 2% of the mass of the fresh HS where as the Insoluble constitute 30% .

Insoluble proteins - two principal insoluble proteins with different functions , characteristics and distribution

- Keratin (2% of fresh hide). It is least abundant insoluble proteins and forms large, continuous sheets across the surface which provide protection to HS against invasion by MOS.

Keratin

- found in the upper surface of HS.
- constitutes the bulk of the structure of hair (fur or wool) & is most visible component of HS.

Collagen

- principal insoluble protein.
- Comprises 95% of the total protein, or 30% of the mass of a fresh HS.
- most abundant insoluble hide protein
- it is the component of HS which is most affected in the tanning process
- Anatomically HS are classed as connective tissues, together with bones, tendons, ligaments, adipose tissues and arteriolar tissues.
- generally, the function of connective tissues is to support, bind, or separate in various ways.
- HS - to support the underlying tissues, separate them from the outside world of the body and protect the animal from invasion of pathogens.
- regulation of body temperature, hence the presence of insulating hair, fur, wool or feathers
- Connective tissues consist of background s/s or matrix interspersed with fibers or cells of a particular types.

Collagen cont'd

- The background s/s in HS is an amorphous material consisting of glucosaminoglycans (some times referred to as mucopolysaccharides or proteoglycans) and the fibers consist of collagen.
- Collagen fibers may not be easily observed **in fresh** HS but clearly visible in **leathers** to the naked eye.
- the fibers form a complicated weave through out most of the thickness of HS & provide strength both before and after tanning.
- laboratory studies have revealed that collagen fibers , almost like heavy rope, are composed of progressively smaller and smaller strands (referred to as fibrils and filaments respectively).
- The basic building block of a collagen fiber is a triple helical structure called Tropocollagen.

Cont'd

- Each of the three polypeptide chains in tropocollagen consists of about 1000 a.a residues. Generally, composition of a.a consists 35% **glycine**, 11% **alanine**, 12% **proline** and 9% **hydroxyproline** residues and the last two a.a are characteristics of collagens.

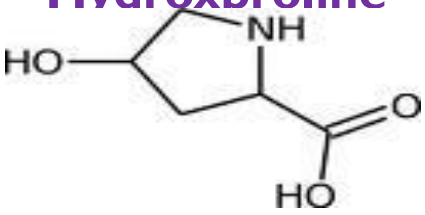
- It may vary according to species but the sequences such as " Glycine-proline-Hydroxyproline" are common.

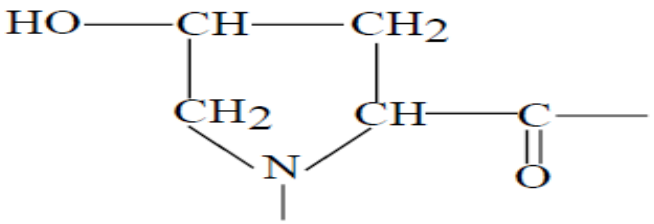
- Based on composition analysis ,at least five different types of chains have been identified. These have been designated as α1 (I), α1 (II) α1 (III)α1 (IV) and α 2.

- Some types of tropocollagen (and hence collagen) consist of three similar polypeptide chains. Type I accounts 80-90% of the collagen of HS & type III accounts for 10-20% (mainly papillary or grain, layer) & small amount of type IV.

- Type III collagen is susceptible to enzyme action and therefore most likely to be affected during course of microbial contamination.

Hydroxyproline





Types of Collagen (Stryer, 1981)

Type	composition	Distribution
I	([(α1(I)2]α2(I)	Hides, skins, bone and cornea
II	[(α1(II)]3	Cartilage, intervertebral disc and cornea
III	[(α1(III)]3	Foetal skin, blood vessels and grain layers of dermis
IV	[(α1(IV)]3	Basement members

The whole Tropocollagen molecule is long but narrow and measures about 300nm by 1.5nm. The general structure of collagen fibres is generated by the aggregations of many thousands of tropocollagen molecules. Aggregation is highly ordered and some times visible to naked eye. Adjacent molecules are covalently bonded together to provide an inelastic structure which is so strong that a fiber of 1 mm diameter can have a tensile strength of 1.0 kg.

The Chemistry of collagen

- Collagen is a protein molecule built of sequential chains of amino acids twisted and bound to form a strong, fibrous molecular structure.

Polypeptide Chains : Procollagen and Tropocollagen Structure

- Collagen's backbone, the polypeptide strand, is formed by a known twenty different amino acids that form a chain of about 100 units in length.
- In the chain, a common sequence of amino acids is glycene-X-proline or glycene-X-hydoxyproline, where X is a range of other commonly occurring amino acid residues.

- Hydroxyproline, an amino acid found in all collagen molecules, is rare in almost all other protein structures and its presence used as an indicator for collagen.

Procollagen and Tropocollagen Structure

- The procollagen structure is formed by the twisting together of three left-handed helical polypeptides into a triple helix with a right handed twist with three amino acid groups per twist.

- From this, the terminal extension peptide groups (found at each end of the polypeptide chain) are removed by specific proteases to form non-helical telopeptide regions thus finalizing the formation of the tropocollagen structure.

- This final quaternary structure is stabilized by multiple hydrogen bonds between the amino and carboxyl groups of adjacent helices.

- Due to the necessity of a tight helical structure, all large functional groups on amino acids are oriented to the outside of the helix.

Fibril and Fiber Structures

- Collagen is a multiheirarchical structure which is further developed from the collagen molecules, resulting in four levels of macromolecular structure:

  - First the molecules pack together into an organized secondary helical structure called a **fibril**,
  - Then those fibrils further organize into larger bundles called **fibril bundles**,
  - then into fascicles, and finally into fiber bundles.
  - Fibrils are the first level of the collagen structure that is visible via scanning electron microscopy (SEM).

Fibril and Fiber Structures…

- The collagen fibril is stabilized by the formation of two types of chemical bonds: **Salt links and covalent intermolecular bonds**.

- Salt links are formed between **acidic and basic functional groups on the amino acid side chains** whose strength is maximized by aligning polar regions of the fibrils.

- Covalent intermolecular bonds are formed by staggering the telopeptide regions (the terminal non-helical areas of the tropocollagen structure described above) with helical portions of adjacent molecules, thus resulting in a long fiber structure with no weak points.

Collagen

- Variations in the biochemistry of collagen(Tropocollagen may have profound affects on the associated **physical characteristics** of HS and leather.
- Hydrogen bod stabilizes the super helix of tropocollagen. This type of bonding is susceptible to heat.
- If HS are maintained at high temperatures, the covalent bonds within the collagen become broken.
- **Shrinkage temperature -** the point at which changes due to excessive heating start to occur in the collagen fibers. The long collagen molecules shrivel in to smaller spheres.
- **Shrinkage temperature** – characteristic of a particular type of HS and lower in materials obtained from younger and immature animals.
- The **relaxation of tension** in collagen is an important characteristic of HS since it is d/t in materials from animals of different ages.

Physical properties of HS…

- HS from younger (immature) animals are generally weaker and exhibit a greater degree of relaxation.
- Melting of Hydrogen bonds that stabilize the tropocollagen, the shrinkage of the collagen fibres and collagen fibers degradation by relaxation are processes of considerable significance and are physical properties of HS.

Source	Body Temp (o C)	Shrinkage Temp. (oC)	Relaxation (%)
Cattle hides	38	-	-
Calf skin	38	65	-
Sheep skin	40	-	10
Lamb Skin	40	-	30
Shark Skin	26	53	-
Cod skin	12	40	-

- HS which have been subjected to temp close to (excess of) the T where these processes occur, become unstable for leather manufacture.
- when collagen is damaged by heat it is irreversibly changed to gelatin.
- Prolonged heating of gelatin provides a sticky material known as glue. With milder trt. Is still used to prepare gelatins for use in foods , pharmaceuticals and photographic industry.

Characteristics	Collagen	Gelatin
Water solubility	Insoluble	Soluble
Structure	Highly ordered	Random
Tensile strength	Very high	Very low
Utility in leather manufacture	Very useful	Not useful

Chapter 3 : Slaughter and flaying operation

3.1. Slaughter and bleeding

3.2. Flaying

- Hide and skin management includes
  - Slaughtering,
  - Flaying and
  - Preparation (washing, Fleshing, Trimming, Perforating, Lacing, drying and re-trimming) of hides and Skins

Slaughtering

- **Humane methods** of slaughtering animals are encouraged; however, exact practices in Ethiopia differ according to local culture, customs and religious practices.
- kill the animal quickly, knife must be long, pointed and very sharp *(45-50* cm for large animal).
- rest the animals in **holding pens** for 12-24hrs with access to water only
- animal should be restrained by tying it to fixed object , casting pen
- The humane method of slaughtering is swift and minimizes pain or suffering of the animal.

Stunning

- **Stunning** – is the practice of rendering animals unconscious just before slaughter to minimize the pain.
- Proper stunning procedures reduce the chance of stained carcasses and blood flash. The f/f stunning options are available :

1. Electrical stunning - electric shock of low voltage and high frequency.
2. In pigs anaesthetized by smothering them in **CO2**.

3. Mechanical instrument (captive bolt pistol) that traumatizes the brain looses consciousness instantaneously.

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

Methods of slaughtering

- **Four methods of slaughtering are**

1. **Severing the spinal chord in the base of the head** – not widely used and accompanied by severing of the blood vessels of the neck or sticking , to remove blood from carcass.
2. **Decapitation** as in the jhatka method used by sikhs- not stunned before hand and not widespread method.
3. **Severing the blood vessels of the neck** normally by cutting the throat – most widely method of slaughtering . It is used through out the world and forms the basis of religious procedures such as **Halal method** used by Muslims and **Kosher method** of Jews.
4. **Sticking** – the bleeding of stunned animals

Bleeding

- During *Bleeding* the animal should be suspended by its back legs from an overhead rail, or laid in cradle.
- keeping the animal off the floor in this way facilitates handling in general, makes blood collection easier , and is more hygienic.
- when the animal stopped bleeding, the removal of the HS may begin.
- Bleeding should be as though as possible , since inadequate bleeding spoils the meat and causes HS defects. Any blood left in the hide/skin will act as a medium for growth of the bacteria which causes putrefaction.
- The first stage consists **insertion of special cutting lines known** as **ripping** . It involves the insertion of cuts in specially designated parts of HS. The knife used to make these cuts must be straight bladed and sharp tipped**.**
- The same knife used to cut the animal's throat may be suitable for this purpose.

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.

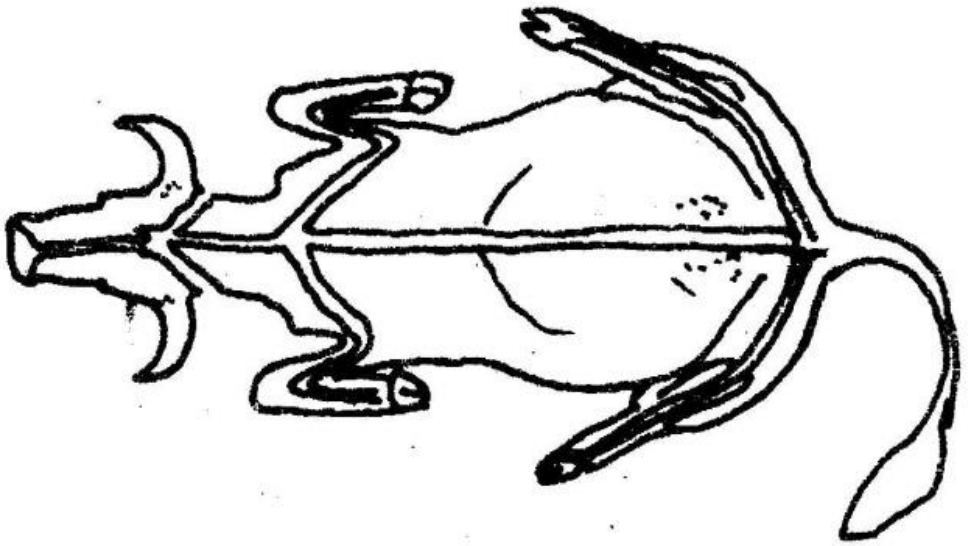
- For sheep and goats, some flayers prefer to complete most of the bleeding on the floor adjacent to a drain.
- When sheep and goats possess long hair, much more care must be taken to avoid contamination with blood and dung, and bleeding on a definite slope is to be preferred.

- In either case, final bleeding is best carried out after suspension of the carcass.

Ripping

- The general pattern of recommended **ripping** lines widely accepted through out tanning industry provides :

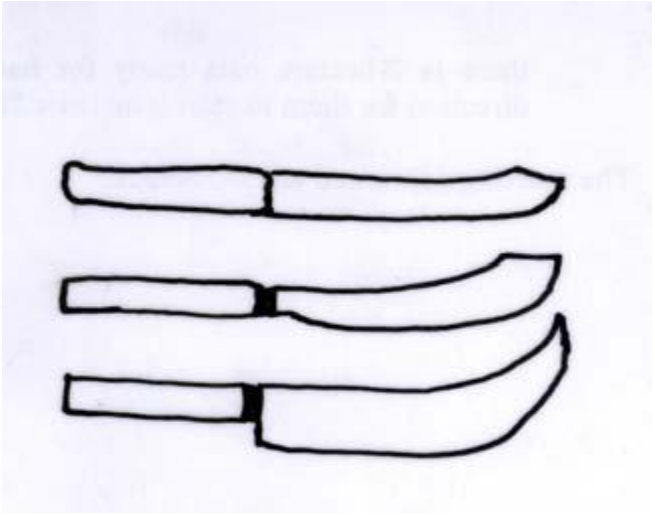
- HS w/c are uniform, square in shape and symmetrical.
- if animal killed by a transverse cut across the throat, the cut would have to be continued around back of the head,
- if the throat cut was made longitudinally there scope for retaining more of the hide or skin from the head.



Proper ripping line

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.

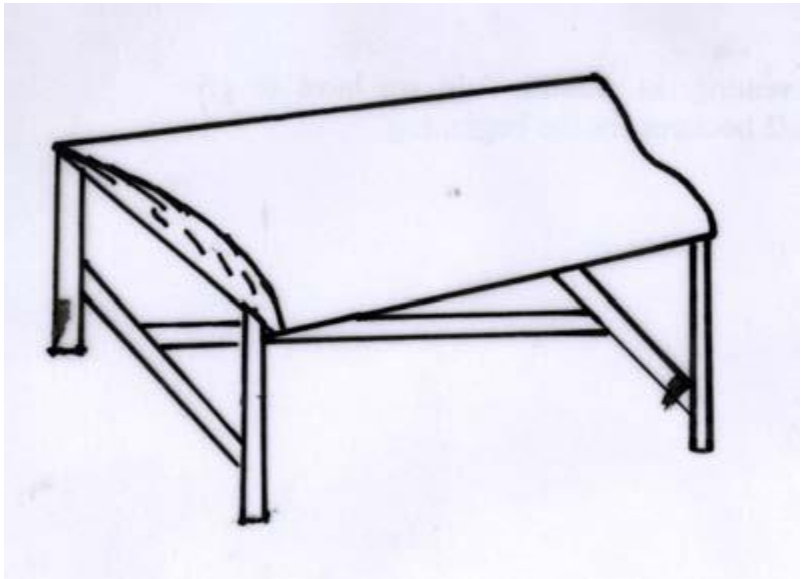


Flaying

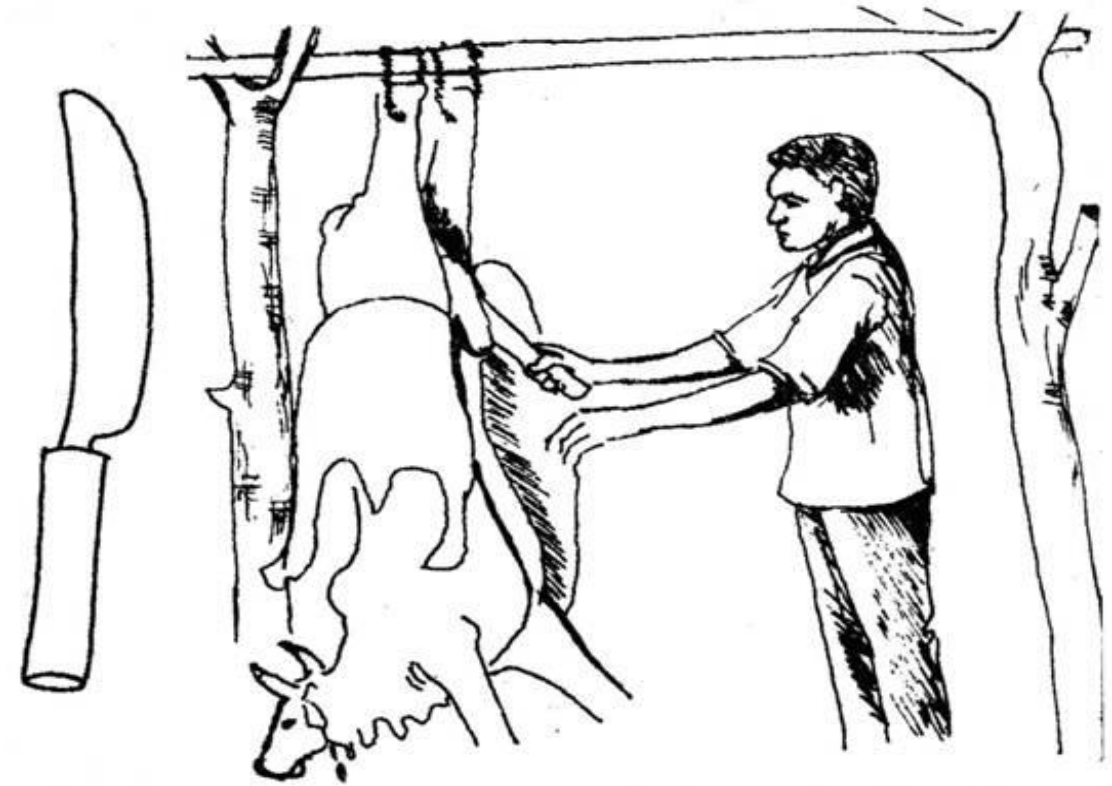
- **It is removal of the hide/skin from the carcass**. The final stage of removing HS is commonly called **flaying** & start before all the ripping lines have been completed.
- A ripping knife is not suitable for Flaying, since sharp tip would be likely to cut into the HS or carcass & damage it.
- Specially designed flaying knife which has a blunt tip to prevent stabbing damage and a curve blade which makes it easy to cut around the carcass of animal is usually needed.
- some times in shoat , **pulling** instead of cutting is used in flaying. In some countries the skin is loosened from the carcass by **blowing air** into a small hole in the leg and little use is made of knife.
- Once the HS is detached form the carcass it should be fleshed and preserved as quickly as possible

Fleshing

- Is removing the subcutaneous tissue and remaining meat from the hide after washing.
- Fleshing may be done with the same type of knife that is used for flaying.
- best done **on table** which is flat or gently curve, should be completely free of irregular holes or bumps.
- any residual fat or flesh on HS will reduce the effectiveness of the preservation procedure whether is the penetration of NaCl during salting or loss of moisture



Proper way of flaying



Washing

- Immediately after flaying, hides should be washed by pouring water. Hides spread out on cement floor or large table. Use scrubbing brush.
- Rinsing freshly flayed HS in cold water will certainly dissipate residual body heat so that bacteria damage will occur more slowly.
- if fleshing is done properly, most of the hypodermis (contaminating bacteria will be removed) , leaving a relatively clean surface.

Trimming

- Is cutting irregular flaps from the edge of the hide.
- Tail is cut off leaving 20 cm on the hide.
- All pieces of hide below the knee shall be removed. The mask (hide on the head) can be cut off to be dried separately

Perforating

- Perforating is making holes around the edge of the hide/skin to suspend it on a frame or rack.
- Normally a number 12 nail (punch) is used. Holes should be as near the edge as possible *(2.5* cm).

Lancing

- Is tying a hide/skin to a frame by ropes (thongs).
- This is most easily done in a standing frame; the hide is first suspended from the top by two ropes, then the tail is attached to the lower pole by two more ropes.
- In this way the hide is cantered in the frame, with the line of the backbone parallel to the sides of the frame.
- Ropes should not be too light (taut), for as the hide shrinks during drying, ropes may break before the drying process is complete.
- If it is done on the ground, hair side should be down on grass or hay bedding.
- 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.

Chapter- 4

Preservation of Hides and Skins

5.1. Identification of contaminating agents

5.2. preservation methods

5.2.1. Drying

5.2.1. Salting

- 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.

Preservation

- is the name given to a variety of procedures which can be applied to HS in order to reduce or stop spoilage.
- It maintains quality but not improve it .
- If freshly prepared HS can't be delivered directly to the tannery, they must be preserved.

Objective : to maintain/keep HS in a good condition without spoilages until they are processed in tanneries.

- The preservation procedures must be
  - Effective
  - Safe and non toxic
  - Widely applicable
  - Reversible
  - Cheap
  - With no adverse Effect on the leather

HS preservation…

- Since the spoilage in HS is caused by bacteria , these organisms are target of preservation procedures.
- controlling the bacterial growth by depriving them some basic requirement
- The fundamental requirements for of most bacteria are

1. **Suitable pH** (acidic, neutral or basic) – HS pH 7.0 (neutral) trt. with acid or alkali but need precautions
2. **Suitable temperature** - fresh HS has body temp. inc but < 65oC & decre temp 30 oC, for longer storage 2-4 oC , -18 oC for indefinite time storage
3. **Food -**
4. **Sufficient water** – drying salting to remove moisture
5. **Oxygen**

Bactericides

- depriving bacteria of what they need to survive and grow.

some of the chemicals that have been used to preserve HS

Inorganic chemicals	Organic chemicals
Boric acid	Phenols
Fluorides	Cresols
Zinc Compounds	Naphthalene & its derivatives
Sulphites	Quaternary ammonium compounds
Metabisulphites	
Chlorites	
Hypochlorites	

5.1. Identification of contaminating agents

- 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 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.

HS preservation…

Types of preservation depends

(i). Weather condition

(ii). Availability of material

(iii). Location of tanneries

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.

HS preservation methods

The following are some of the common drying preservation techniques

1. Air drying
   - Suspension /frame drying
   - Line/wire drying
   - Skin drying sheds
   - ground drying
2. Salting
   - Wet salting
   - Dry salting
   - Brining

- In theory, the drying of HS could be achieved by methods like Mechanical dryers, lyophilization (freeze drying), dehydration with alcohol. These are expensive, complicated & not appropriate in rural areas.

Air Drying

- **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 Drying …

- The moisture in H/S is evenly distributed through out the full thickness including surface layers. When the H/S is exposed to the air, surface moisture quickly evaporates.
- The evaporation of the water reduces concentration of water in the surface layers.
- Factors affecting the duration of the drying period includes: **Ambient temperature, RH, Wind Speed and nature and thickness of the H/S**.

A. Suspension frame drying: 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**.

Air Drying …

- 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.

- 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:

1. Advantages of suspension drying

- 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.

Advantages of suspension drying…

- 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.

Disadvantages 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

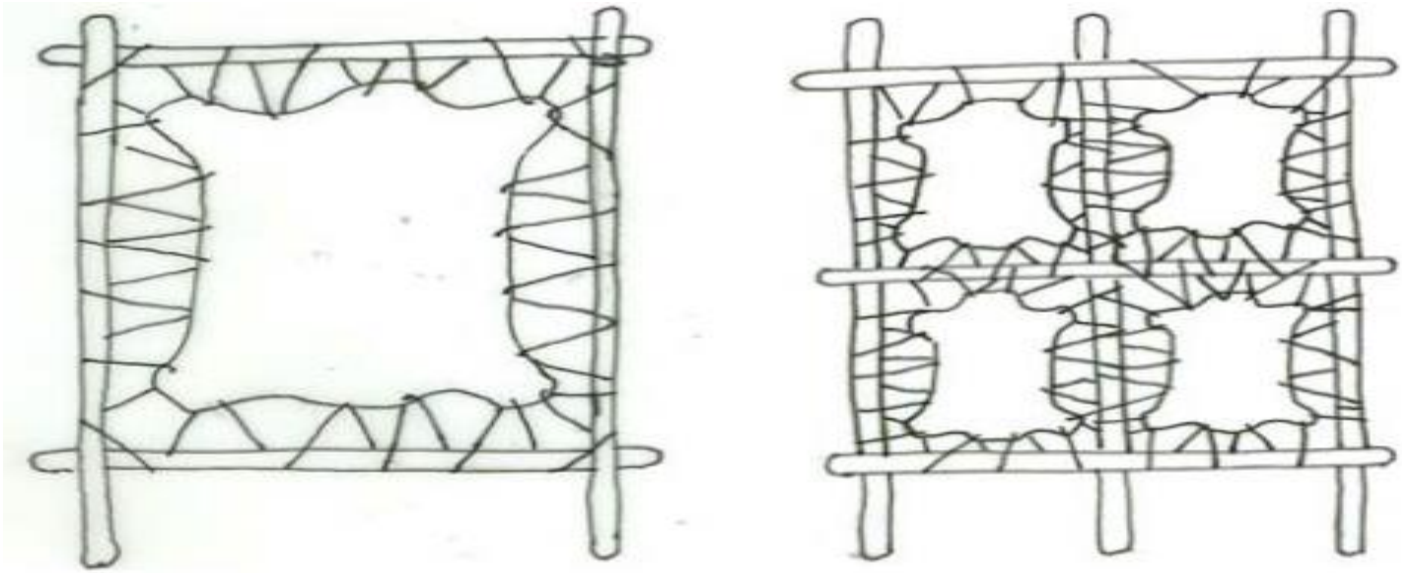


Figure 10.9. Frame drying of skins.

2. Suspension drying over cords or wire

- 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
- The drying time is the same as frame drying.
- 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.

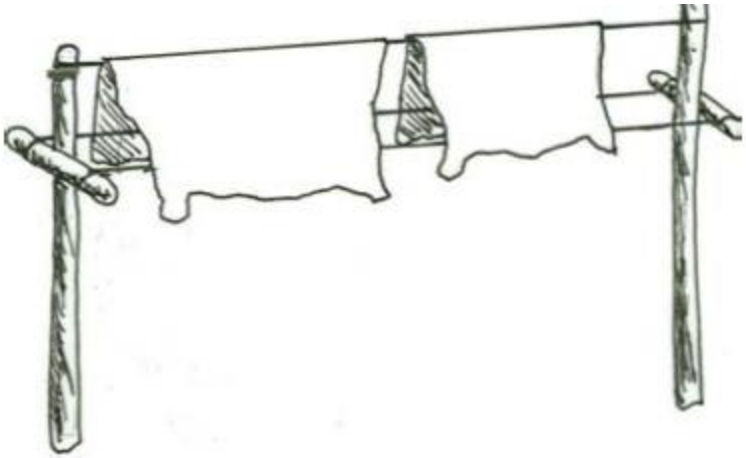


Figure10.10. Suspension drying over cords.

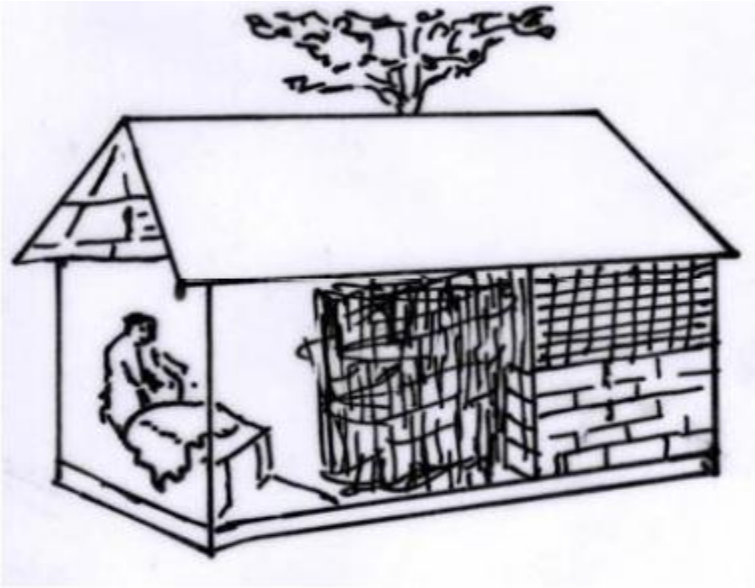


Figure 10.12. Skins drying shed.

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

Ground drying

- 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.

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.

Skins drying shed…

- The sides should be open and protected by strands of barbed wire with the exception of a line of corrugated iron sheets at the top .
- 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.

2. Salting

- As means of desiccation of H/S instead of solely relying on evaporation as in air/suspension drying.
- very few Mos can grow where the **Aw <0.90**, little for biochemical rxn.

(a) Stack (Wet) salting : H/S 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.

- **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.

Wet Salting

- 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.
- 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.

Wet Salting…

- 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.

(b) **Dry salting :** is very similar to wet salting but skins are dried after the initial salting. It gives the advantage of both drying and salting

- It is especially well-suited for preparing skins/hides for export and at the same time overcoming the problem of wet salting.
- 10% less salt is required than in wet salting

Dry salting

- The initial steps are the same as in wet salting; however, salting has to be done without any delay after flaying.

C. Brining: Green fleshed and washed skins are soaked in brine (salt solution) for 24 hrs in a circular tank.

- 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 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.

Brining …

- 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.
- during brining extra equipments for controlling pH, halophilic bacteria . The brine and H/S agitated continuously by paddles which shift the h/s along the race way.
- Wet salting : by this method 80% of sheep skins; 20% of goat skin and 5% of cattle hides are preserved in Ethiopia. It is easy to process

Figure10.13. Salting skins on a cement floor.

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

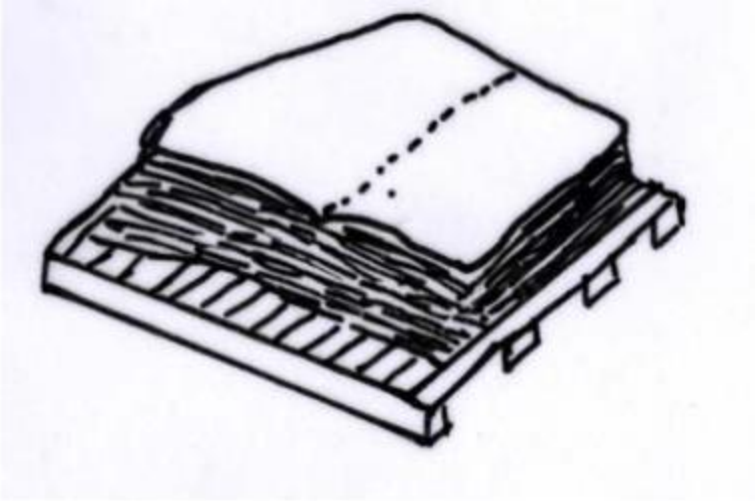


Figure 10.15.Salted of skins on a pallet.

Chapter - 5

Storage and Transportation of Hides and Skins

5.1. problems in storage

5.2. Storage of wet salted hides and Skins

5.3. Folding and baling

5.4. Transportation

- After completion of preservation procedures HS must be **stored** and subsequently **delivered** to the HS merchants(tanners) premises.
- Transportation procedures should be as rapid as possible.
- prompt storage and transportation of HS will minimize capital expense deployed in the maintenance of the large stocks of raw materials.

Storage of HS

- Improper storage destroys even perfectly dried hides. Storage time should not exceed 10 days. Use insecticides during storage to protect beetles. There are different types. To mention some:

(a). Solutions

e.g. arsenic in water

(b) Emulsions

e.g. Gammexane sprays

c) Powders

e.g. DDT, Pyrethrum, *etc*.

Aeration: insecticides do not prevent moulds; therefore we have to aerate hides in the wet season out of doors.

Storage

- **Storing of preserved hides is of great importance.**
- All HS, whatever their method of conservation must be **stored in the shade** in a cool environment with adequate ventilation.
- The HS should not touch the warehouse floor, hence they should be **kept on pallets**.
- Dried HS should be shielded against humidity in general and liquids in particular.
- Water dripping on a dried hide or skin will cause putrefaction, that will manifest itself after re-hydration for tanning as a hole.

5.1. Problems in storage

- when the raw stock has either been successfully **cured or dried,** there is a need to **store the preserved** stock under satisfactory conditions and with protection against these potential causes of damage.
- common problems in storage are **insect damage**(attack by insects), **gnawing rodents**, mould growth and bacterial attack
- Damage occurring during :

(a) Insect Damage- caused by larvae of beetles of the *dermestes* spp particularly, *D. maculatus*(or Vulpinus) and *D. lardarius*.

- Often called hide beetles are about 0.8 cm long and are dark brown or black in color.
- Protective powder 4% boric acid and 2% *sodium pentachlororphenate* together with kaolin filler - used as a means of reducing or preventing insect, mould and bacteria.

Problems in storage…

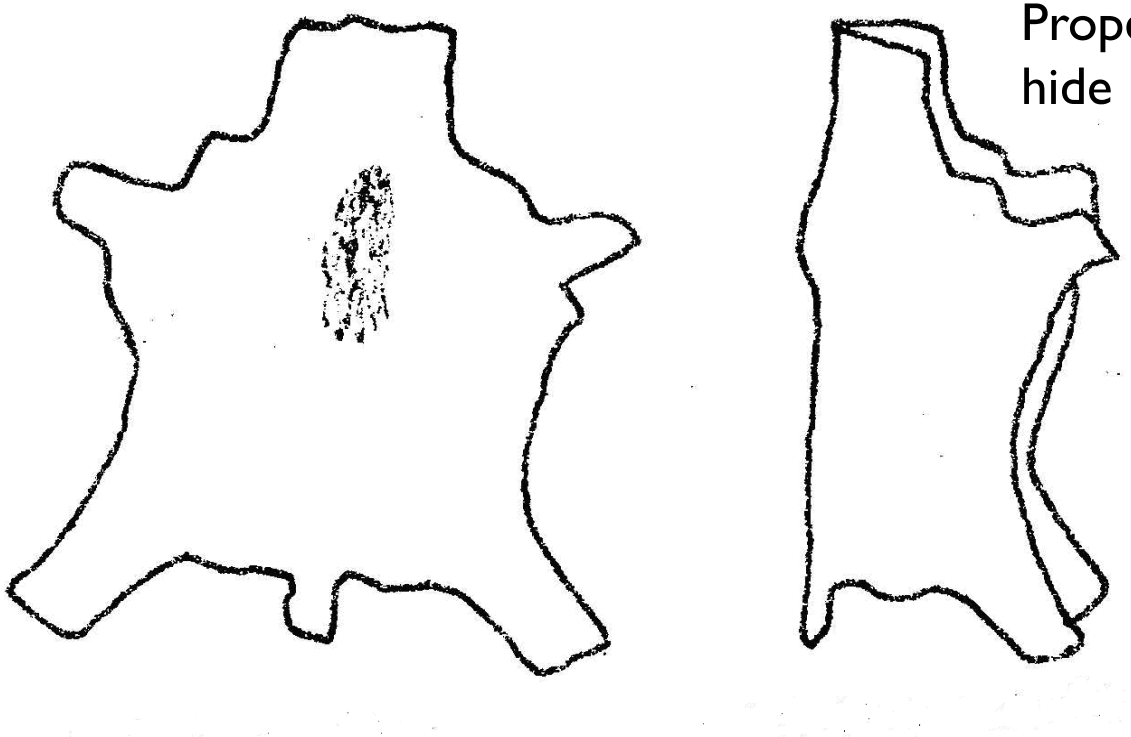
(b). **Mould growth and bacterial attack** - during the final drying stage before storage, a solution of a soluble phenolic salt e.g. Sodium pentachlorphenate (0.05-0.10%) on the dried H/S used for protection.

(c). **Damage occurring during transport**

- In tropical and sub tropical developing countries, various forms transportation may be employed.
- damage to grain
- damage by rain in rainy season
-

5.2. Storage of air dried hides and skins

- To facilitate storage & handling, HS should be folded hair side to hair side along the line of the backbone and tail.
- **Folding** :- is made after hides have thoroughly dried and trimmed; only one fold, preferably at early morning (when hides not overly dry), is recommended.



Properly trimmed and folded hide

5.2. Storage of dried HS…

- In this way, the delicate surface under the hair is protected against abrasion.
- bundles of about 10 hides should be firmly tied together prior to being transported. Most Shoat skin are not folded but 50-100 pieces tied together in bundles prior being transported.
- if not tied they may rub against each other and cause abrasion damage.
- Before storage H/S should be **dusted, sprayed, or fumigated with appropriate insecticide**.
- The store room should **be weather and rodent proof**. There should be good circulation of air (ventilation).
- Concrete floor provides good working conditions.

Dried HS..

- bundles of HS shouldn't be placed directly on floor b/c of risk of sweating and condensation.
- **pallets or spacers** of some sort should be used to keep HS off the floor.
- Then bundles of HS may be simply stacked on top of each other.
- B/n stacks, space may be provided to promote the circulation of fresh air.
- For transportation, stacking bundles one over the other is needed.

Storage of wet salted HS

- The storage of dry salted HS is the same as air dried HS.
- salted HS tend to be less susceptible to insects but are not free of risk.
- should be checked during storage, especially those treated with **mixture of salt and naphthalene**.
- wet salted HS can be stored in the same place they were preserved provided that a solid floor (concrete floor) and proper drainage are maintained.
- avoid high ambient temperature & ventilation in order to reduce incidental drying of salted stack.
- It can be folded, rolled into bundle and tied with some inert material.

5.3. Folding and baling

- Dried HS and salted stock can be folded in the f/f sequence

(i) Wet salted stock should be shaken free of excess salt before folding begins . Dry salted stock don't need this

(ii) The HS freed of excess salt, is spread out flat on clean area of floor or on a large table with the flesh side down

(iii) wooden rectangle or sheet of water proof plywood measuring 1.8m x 1.2m, the 1st fold made by placing the pattern symmetrically on the hair side of the hide, lower edge roughly concedes with tail end, long sides are parallel with & equidistant from backbone.

(iv) First fold – belly area folded to the right. The left outside edge of the fold conceding with left, longer side of the pattern.

(v) Second fold - 1.2 m x 1.2m

Cont'd

(Vi). Third fold- shoulder and neck area of the HS folded down over the upper.

(Vii). Fourth Fold- partly folded area of HS to left of backbone is folded over to the right to lie over the longer.

- folded flesh side out Vs hair side out
- the plastic tape (1cm) is used to for **baling**. Wire is also used for baling.

5.3. Folding and Baling

- For exporting by land, air, or sea; or for transportation baling and folding after grading is important for good marketing
- the same pattern is applied to air dried /salted HS and avoid cracking.
- Wet salted HS can be folded only to about 45 cm x 60 cm.
- Air dried HS need extra care.

5.4. Transportation of HS

- Transportation of HS from point of collection and storage (after drying or curing) have been carried out either to the larger market or for export. It involves using :
- Animal drawn transport
- motor transport – larger vehicles
- Boats

- care must be taken that the goods are tied in bundles and are not loose
- no danger caused by scrapping or other fractional movement.
- woven matting should be there to protect the grain & folded corners.
- suitable and effective wrapping of bales to avoid /reduce potential risk of serious damage by rain during transport in uncovered vehicles or by animal transport.

Chapter – 6

Defects of Hides and Skins

6.1. Defects due to natural characteristics
6.2. Ante and Post- mortem defects
6.3. Damage by Parasites, fungal and viral diseases
6.4. Defects due to curing, storage and transport

- Defects in *leather* implicate higher cost in production and greatly reduced selling value for the leather.
- In Ethiopia, the economic loss due to hide and skin defects is very high.
- The national exports as well as the tanning and leather industry experienced an important economic loss due to hide and skin defects most of which are avoidable.

6.1. Defects due to natural characteristics

- Natural defects is anything that is not caused by men.
- It can be mechanical damage ***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.
- It includes breed, climate, diet, age and sex.

6.2. Ante mortem defects

- arise from variety of causes during life time of the animal concerned with genetic, errors in husbandry practices, mechanical / bacterial or insect attack.

(a). Breeding factors, Zebu VS Exotic

(b). Barbed wire damage – enclosures of pasture /fencing

c. Yoke marks – draught animals in developing countries

(d). Goad or Prod marks – use of sharp- pointed goads when the animals are being driven. Use blunt ended or rounded sticks to avoid it

(e). Shearing cuts- coetaneous injection punctures

(f). Horne rake - damage due to fighting when the animals are closely herded

Ante mortem defects…

(g). Dung Damage –prolonged contact with dung

(h). Branding – permanent damage to HS due to badly placed hot branding for the purpose of ID, trt. to dss and social ritual.

- use solid CO2, Liquid N2, freeze branding and coolant to improve the problem.

B. Ante-mortem defects arising from Disease or other natural causes

1. Contagious acne of horse
2. Erysipelas in swine
3. Mycotic Dermatitis

C. Damage resulting from Fungal Attack

- Dermatomycosis (Ring worms)

Damage resulting from Viral attack

1. Lumpy skin disease
2. Pox

Damage resulting from Fungal attack

Defects due Ectoparasites ("Ekek")

- Mange – follicular or demodectic mange
- Scabies – mites multiply under the skin
- Ticks -
- Lice -
- Sheep Ked -
- Warble flies -
- Cockle-
- Ring worms-
-

Cont'd

D. Damage Resulting from Protozoan Attack

1. Globidiosis
2. Trypanosomiasis

E. Damage from Helminth attack

1. Habronemiasis
2. Elaeophoriasis summer bleeding, filarial dermatitis

F. Damage resulting from arthropod parasite attack

1. Hypoderma spp.
2. Chrysomia Spp.
3. Calliphorus Spp. ..Fleece fly strike

G. Tick Damage - Ixodes and Argas Spp.

H. Follicular manges and mites

Ante- mortem defects …

- Sarcopytes Scabiei

C. Damage Arising from Miscellaneous Causes

1. **Zinc deficiency** – affects epidermis causes cracking of the skin. Common in pigs.
2. Damage by bush thorns, sharp burrs, to shoats skin

Post- Mortem Defects

- Can be more serious than ante- mortem defects
- occur before preservation and during preservation, storing and transportation

(a). Improper Bleeding
(b). Rubbed or dragged grain
(c). Flay Cuts
(d). Bad pattern –due to ripping
(e). Inadequate cooling and cleaning

Post –mortem Defects

f. Inefficient fleshing and trimming

g. overstretching and distortion of dried Hides

h. Folding Damage -

i. Curing Faults -

j. Damage associated with transport of HS:- rubbing

Defects, reviewed below, occur at the moment of slaughtering and during or following flaying:

- Bruises
- Rubbed or dragged grain
- Improper bleeding
- poor pattern or irregular shape
- Flay cuts, gauge , scores, corduroy
- Fouling with blood, stomach contents and dung (filth stains)
- improper after- cleaning and trimming defects

Pre slaughter operations which affect HS quality are

- husbandry practices
  - Diet,
  - breeding purposes,
  - disease control .

  - Diseases and infections are one particular aspects of animal husbandry which can have a major impact on the HS. Table: Diseases and parasitic infections of hides and skins

Name	Cause
Dermatomycoses	Fungus(Trychophyton verucosom)
Contagious Pustular dermititis (Acne)	Bacteria (Corynebacterium psuedotuberclosis)
Lumpy skin disease	Herpes Virus
Hyperkeratosis	Allergic response
Streptothricosis	Bacteria(dermatophilus congolensis)
Demodicosis(demodectic mange)	Parasitic mite(demodex bovis)
Warble flies	Parastic fly(hypodermis bovis,H.lineatum,& others)
Ticks	Boophilus micropilius and others
Lice	Sucking (lingognathus) and biting(dalmalinia) species

Pre-slaughter operations …

- any procedures which are good for the general health and wellbeing of the animal, including the production of meat and milk, are equally beneficial to Hides and skin production.
- The incidence of the above disease and infections varies.

- The final part of pre-slaughter operations is supply and transportation of the animal to the market. Special attention is required at this stage since the damage to the animal will not have time to heal before the animal is slaughtered.

- Simplest method of transportation is " on –the-hoof" where animals are moved in droves.

- Appropriate design of vehicles when using modern roads

Mechanical injuries affecting HS

Type	Cause
Brands	Effects of several heat or cold (hot –iron and freeze branding)
Scratches	Thorn bushes, rough fencing and others
Horn rakes	Fighting
Fighting scars	Fighting (biting)
Abscesses	Injections
Cauterization marks Yoke and harness scars	Heat sealing of other injuries Improper designs or fitting
Goad Damage	Excessive use of sharp or heavy sticks
Decorations Dung irritations	Deep cuts in the surface General dirt and filth
Vegetation Damage Shearing scars	Penetration of some weed seeds in to surface Improper technique &/ excessive haste

Chapter -8

Grading of Hides and Skins

8.1. Grading of Hides

8.2. Grading of Skins

- **Sorting and grading**
- **often used indiscriminately and applied to various selection procedures**

- **Types, shapes, sizes and thickness**
- **sorting tends to be used to describe the classification of materials based on characteristics like size and weight;**
- **Grading is often associated with quality designations.**

Sorting

- **Type** : Cattle hides (Cow), Sheep Skins (woolled), etc.
- **Weight**: Heavy(greater than 30Kg), etc.
- **Preservation** : Suspension dried (shaded),etc.

Problems of Grading

- It is not done at same time
- Variation in grading time : fresh HS after fleshing/during storage/ after preservation.

Factors considered during grading are:

- Quality of grain
- Number and degree of flay cuts , scores or gouges (horn rakes and pattern)
- Weight (heavy , medium, light, small)
-

Grading HS

- Refers to assessment of the quality of HS.
- unlike classification, it is difficult to do accurately since it requires skill acquired through experiences.
- Grading can be performed by **weight** or **appearances**.
- Grading based on **appearances** is a matter of determining the relative abundance of defects (ante-mortem and Postmortem) and follow the following steps.

1. Examining the defects on the HS parts
2. Assessing of each defects according to their importance and location
3. Assigning numerical value (**Defect) units** according to standard set
4. Grading the H/S based on the **sum of defects units** on each H/S section following standard set.

Pre- slaughter defects	
Intrinsic Characteristics	Breed, Type, Sex, Age & nutrition
Disease	Ringworm, Streptothricosis, hyperkeratosis, Dermatitis and warts
Parasites	Warble fly, ticks, mites, worms and lice
Mechanical action	Brands and scratches
Peri- Slaughter defects	
Mechanical Action	Abrasions and Bruises
Improper Bleeding	Veininess and putrefaction
Improper ripping	Small size and incorrect shape
Improper flaying	Cuts and holes
Post- Slaughter Defects	
Autolysis	Deterioration
Physio - chemical degradation	Deterioration
Microbiological Effects	Putrefaction

Grading HS

- A H/S with no defects would be designated grade I (perfect), with many serious defects would be designated Grade IV (imperfect) or simply discard. Anything of intermediate quality would be classified as Grade II or III.
- In the Ethiopian condition the raw skin grading by defects, masses and site is practiced depending on Ethiopia standards (EQSA, 39:2001).
- Standardization of skins have many advantages such as fitness for purpose of products, services, processes, better utilization of resources, better communication, interchangeability and safety and health.
- Due to the increased demand of leather and leather products, the needs for standardization become the real concern both nationally and internationally.

Grading by appearance

- Common method of grading in Ethiopia.
- The skins shall be graded by their appearance by the following method which is published by the Ethiopian standard, like 39:2001 or ES1201:2005
- The defect that a skin possesses shall be detected first,
- Each defect shall then be assessed according to its importance,

- Such an assessment shall be made on the basis of the number of defect units published by EQSA shown in table below.

- Each sheep or goat skin shall then be graded by its appearance according to the characteristics showed by EQSA in table below.

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.

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.

Classification by size

- Each pickled skin is graded individually into its size category as indicated in Table in the next slide.

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.

Grading Hides

- British specification BS.3935 refers clear (free of warble, warbled hides , 2nd clear , second warbled ,third grades and reject hides
- Examples of the classification by quality are

First clear – slaughtered hide

- Pattern - good
- Grain – sound
- Flay - well flayed , score marks moderate , none beyond belly area
- Warble – free from warble holes
- other faults – free from other faults

Reject – is classified as a hide of which less than 70% of its area is not suitable for the manufacture of leather.

Second (Causality Hide)

1. Pattern –fair
2. flay- not as well flayed as a first
3. Grain- has grain damage
4. Hair slip- affecting ≤ 30% of its total area
5. Warble – has more than 8 warble holes

Source: Elliot (1985). Please refers to this book for the detail grading and sorting of HS.

Grading Green Hides

- **First Grade -** No knife defects(very slight scores or gouges can be ignored), Pattern (shape) regular and symmetrical
- **Second grade-** reasonably free from knife defects < 1/6th of the area, < 1/8th of these defects are dispersed
- **Third grade** – up to half the area showing knife defects (cuts, scores and gouges), Pattern not regular and symmetrical.
- **Reject Grade-** knife defects even worse than 3rd grade particularly showing bad damage in the back or butt. Pattern is very irregular

Generally,

- There is a general basis of a global selection standard.
- It is based on natural defects, manmade defects, size, shape and weight.
- The application of this general standard with the quantification of the defects per grade depends on each individual country.
- Climatically and environmental conditions play an important role. The better these conditions are the lower is the number of defects per grade.
- Each country or production area has its own selections standard and reputed exporters or traders refine that standard with personal details in order to differentiate themselves from the competition.

Pricing

- Regional presence or absence of certain qualifying or disqualifying factors determine the suitability of raw materials for the finished product.
- Regular buyers from specific areas know what shipper has what standard quality and award him with a price that reflects his selection standard.
- Price is related to overall quality and grading. The better the selection, the better the price that can be demanded on the international market.
- 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.

Quality of Shoat Skin

- The highland sheep skins, known as **"Hair Sheep/Selale Sheep**," are considered to be the world's finest and have a highly compacted texture.
- 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.

Chapter - 8
Pre-tanning , Tanning and Finishing Operations

8.1. Pre tanning Operations

8.2. Tanning Operations

8.3. Finishing Operations

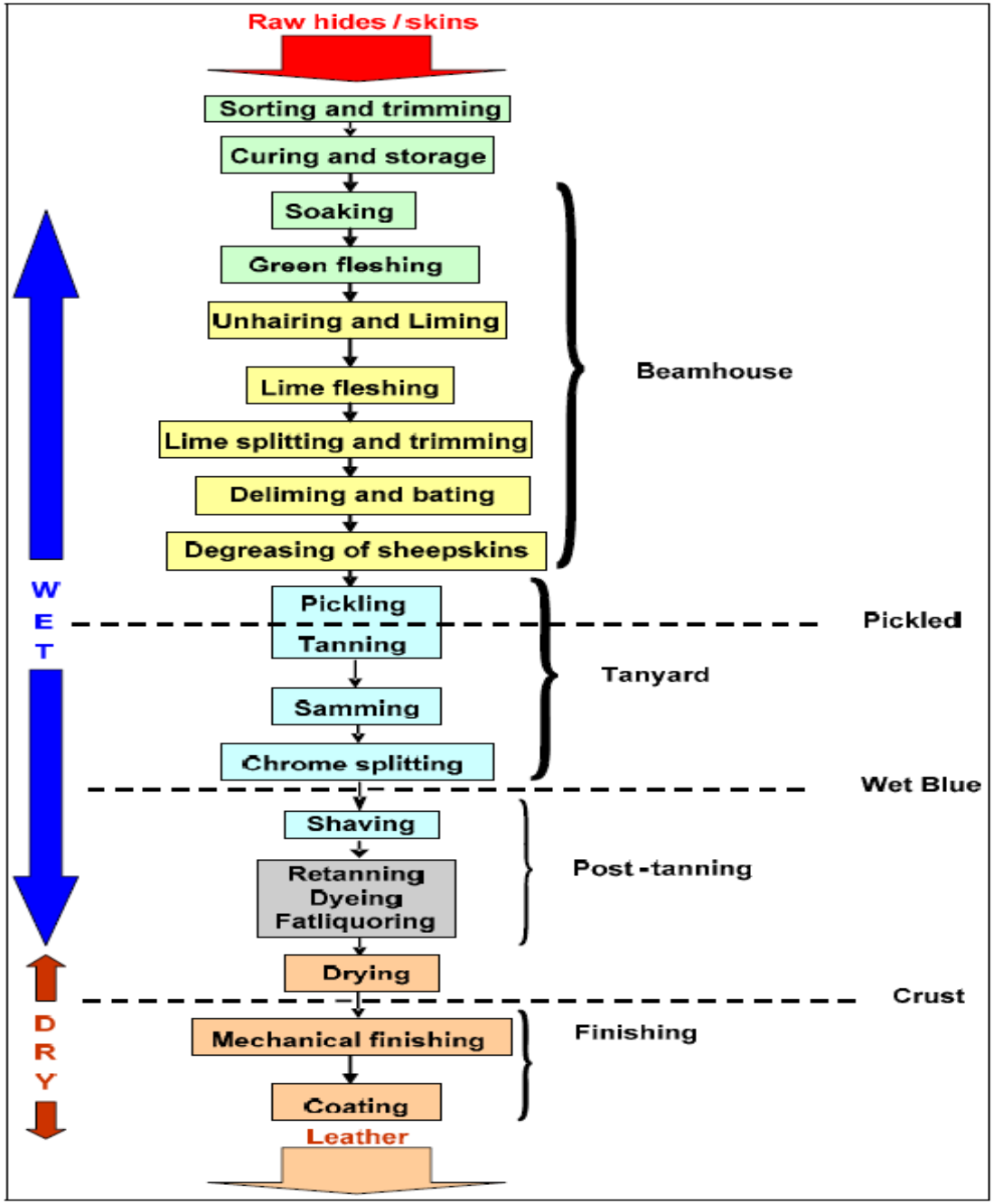
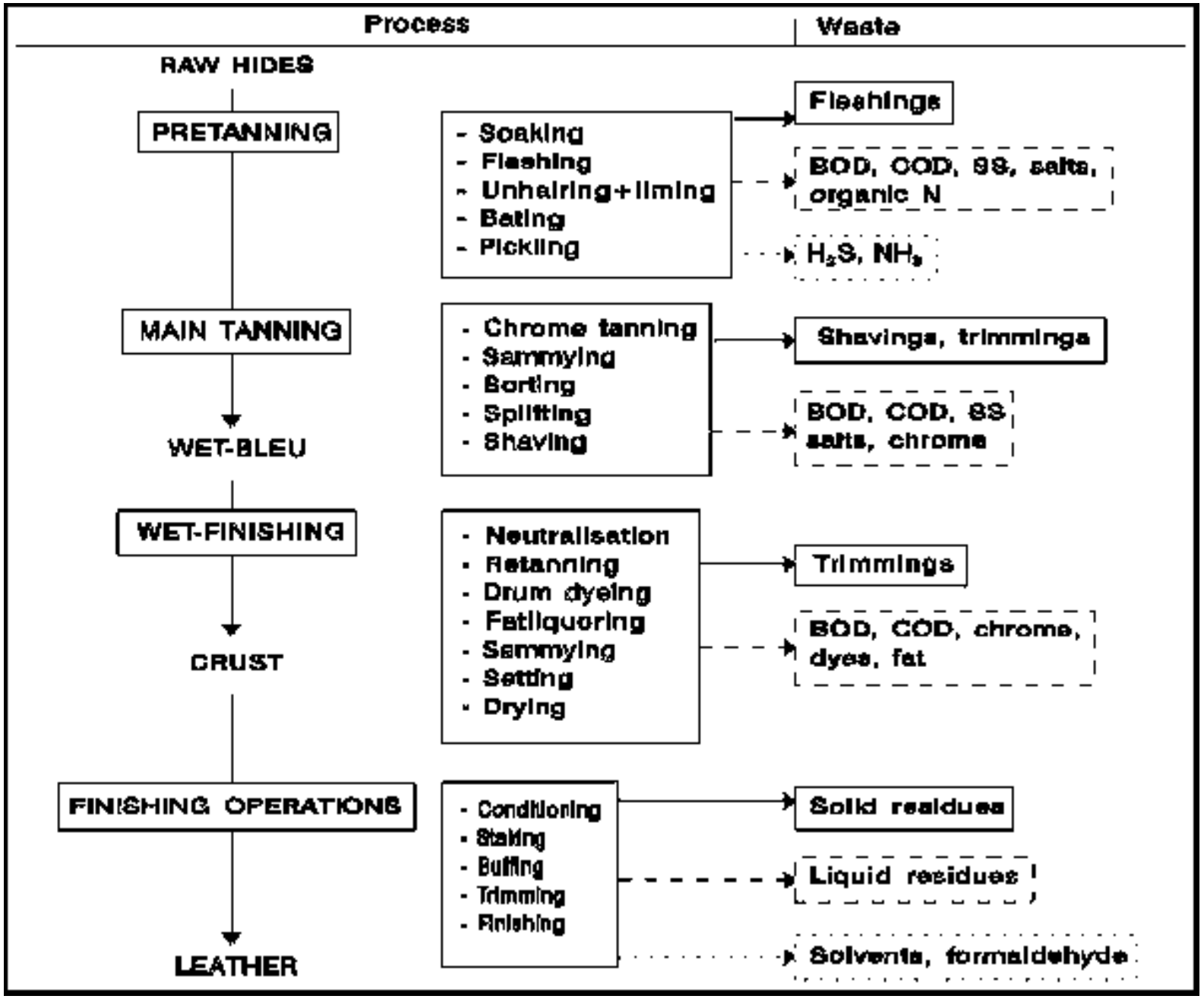


Figure 2.1: Process steps in leather making (chromium tanning)


Process
Waste
RAW HIDES
PRETANNING
- Soaking
- Fleshing
- Unhairing+liming
- Bating
- Pickling
Fleshings
BOD, COD, SS, salts, organic N
H_2S, NH_3
MAIN TANNING
- Chrome tanning
- Sammying
- Sorting
- Splitting
- Shaving
Shavings, trimmings
BOD, COD, SS salts, chrome
WET-BLEU
WET-FINISHING
- Neutralisation
- Retanning
- Drum dyeing
- Fatliquoring
- Sammying
- Setting
- Drying
Trimmings
BOD, COD, chrome, dyes, fat
CRUST
FINISHING OPERATIONS
- Conditioning
- Staking
- Buffing
- Trimming
- Finishing
Solid residues
Liquid residues
Solvents, formaldehyde
LEATHER

8.1. Pre-tanning operations

- is the process of changing the puterifiable hides and skin substance into non-puterfiable substance.
- The **hair, non-structural proteins and fats** will be removed and **collagen matrix is remained.**

- Because Tanning is **a batch operation**, hides are graded and sorted into **"packs"** of uniform **size, weight, and type** of hide so that the tanning operation can be adjusted according to the hides involved.

Pre tanning operations ..

Soaking

- **is carried out to restore the HS to its natural moisture content and degree of swelling**.
- Soaking cleans of dirt, dung, blood ,soluble proteins and curing agents (mainly salt).
- **C**hemicals used to aid re-hydration, such as **bio-degradable surfactants** are often included and slight alkalinity helps to achieve a limited swelling.
- The soaking methods used depend on the state of the hides.

- The process is mostly carried out in two steps: a **dirt soak** to remove the salt and dirt, and **a main soak**.
- The duration of soaking can range from **several hours to a few days.**

Soaking ...

- **Bactericide** is needed to **avoid any putrefaction** damage. All chemicals penetrate faster from the flesh side of a hide or skin, compared with the grain side.
- Ideal temperature is 26°C and pH 9-10.

Unharing (Liming)

- The aim of unhairing and liming is **to remove the hair**, **epidermis**, and to some degree, the **interfibrillary proteins**, and to prepare the hide or skin for the removal of adhering flesh and fat by the fleshing process.
- This is normally done by lime based, sulphide containing, liquors, in drums or paddles.
- The drums are slow moving at 2-4 rpm, with intermittent running and the hair structure is completely destroyed.

Unhairing & liming

- The keratinous material (hair, hair roots, epidermis) and fat are traditionally eliminated from the pelts mainly with sulphides (**NaHS or Na_2S**) and **lime**.
- Alternatives to inorganic sulphides include organic sulphur compounds such as **thioles or sodium thioglycolate** in combination with strong alkali.
- Enzymatic preparations are sometimes added to improve the performance of the process. E.g. **Alkaline keratinase**
- The chemicals attack the hair roots, allowing the hair to be physically removed and obtaining a particularly smooth grain.

- Due to the high alkalinity (**about pH 12-13**). Temperature of **26°C** is ideal, but is not to be above **30°C**.

Fleshing

- Fleshing is a **mechanical scraping off of the excessive organic material from the hide** (connective tissue, fat, etc.). The pelts are carried through rollers and across rotating spiral blades by the fleshing machine.
- Fleshing can be carried out prior to soaking, after soaking, after liming or after pickling.
- The process of fleshing is called **green fleshing** if the removal is done prior to liming and unhairing.
- If fleshing is performed after liming and unhairing, it is **called lime fleshing**.

Trimming

- cutting action of the fleshing machine blades on hides can cause strings of material which need to be trimmed to give a clear shape.

Splitting

- The aim of the splitting operation is **to produce hides or skins of a set thickness.**

- They are split horizontally into a grain layer and, if the hide is thick enough, a flesh layer.
- Splitting is carried out on **splitting machines,** fitted with a band knife. Splitting can be done in the limed condition or in the tanned condition.
- is to obtain a more even thickness for processing and a more uniform final leather.
- Hides are much thicker than skins and need to be split either now, or later, in the tanned state.

Deliming and Bating

- The deliming process involves a **gradual lowering of the pH** (by means of washing in fresh water or by weak acidic solutions or by salts such as ammonium chloride or sulphate or boric acid), an increase in temperature and the removal of residual chemicals and degraded skin components.
- Bates are **enzymes** and the objective of **bating is to produce a smooth clean grain and remove non-structured collagen and other proteins**.
- It is done at specific conditions of temperature and pH and continues the deliming.
- The enzyme action improves the ***softness, grain elasticity and colour levelness of the leather***.
- The work is normally done in a drum at a temperature of 28-30°C and pH to come below 8.5. The drum speed is faster at 10-12 rpm. Maximum temperature is **35°C** for deliming.

Degreasing (Sheep skin)

- The objective is to remove excess grease from the skins to allow proper processing.
- The percentage content of natural fat depends on the type and origin of the raw hide or skin.
- Based on dry material, ***hides have 2-10%, goats 5-10%, hair sheep 8-15%, wool sheep 20-30% and pigs 30-40%.***
- Processing does remove some of the lower levels and leathers need to have some fat for softness, which is also added later.
- **Surfactants to emulsify the fat have been used in combination with fat solvents,** which produce satisfactory leathers but are environmentally damaging.
- **Kerosene** has been used with solvent recovery, but is also not acceptable in modern practice.
- **Enzymes are being increasingly used for degreasing together with bio-degradable surfactants. Temperature is 35-38°C.**

Pickling…

- Pickling is carried out to reduce the pH of the pelt prior to mineral tanning and some organic tannages (e.g. chrome tanning, glutaraldehyde tanning,
- (vegetable tanning), thereby sterilising the skin, ending the bating action, and improving the penetration of the subsequent tanning material.
- The pickle is varied according to the type of tannage to be made, with less acid conditions being used for vegetable tannage.

- However, salt concentrations are increased and essential to avoid any acid swelling.

Pickling ...

- 6% salt on the total volume of water is a safety level for the most acid conditions. Temperature must not exceed 28°C.

- Vegetable tannage should start **at pH 4**, chrome at **pH 3** and the export pickle needs to have a stronger pickle in terms of acid content (absorbed by the pelt) and a preservative to prevent mould. This pH is below 2.
- Storage is good if the pickled pelts are kept cool, below 32°C air temperature

8.2. Tanning Operations

- **Tannage is the irreversible conversion of the natural fibre network of pelt into the material leather.**
- The collagen structure is permanently cross-linked. This makes it resistant to bacteria, putrefaction and higher temperatures. When dry, it does not feel hard and can normally be rewetted.
- The objective is to convert the pelt into leather by creating a more stable structure, which will not putrefy and maintain an attractive appearance.
- **The options are:**

Chrome tannage : - is the most widely used and most important tannage, in more than 80% of leathers. This is used in the production of shoe upper, furniture upholstery, clothing, leather goods and gloving leathers.

Tanning ..

- Basic chromium sulphate is the main chemical, penetrating at pH 3 in controlled stages and being fixed at pH 3.8-4.0.
- Process starts at about 24°C to finish at 39°C for better chrome exhaustion.
- The higher end temperature is achieved by increasing the drum speed from 5 to10 rpm.
- The leather will have **a shrinkage temperature** of 95-100°C. The cross-linkage is identified as being made with the carboxyl groups of the collagen.
- The process is done in a drum and takes about 10 hours for hides; skins are tanned faster because they are thinner.
- The colour is **blue** and **it is often exported semi-finished** as '**wet blue**' with the use of preservative.

Chrome tanning..

- Environmental protection is limiting the amount of trivalent chrome salts in an effluent for discharge into a public waterway, because the heavy metal affects the treatments in the waterworks.

Vegetable tannage: uses material obtained from parts of certain plants.

- These may be the bark, wood, fruit, root or leaf of the plant.
- The chemical compositions are **complex** and are mixtures of **natural polyphenolic compounds**.
- The characteristic colour varies from **pale yellow-brown to an intensive red-brown** depending on the type of vegetable tanning material or mixture of tanning materials used and the application conditions

Vegetable tanning

- The shrinkage temperature is **70-85°C**.
- Vegetable is the original tanning method and used for heavier, more compact leathers from hides – **sole, strap, belt, bag, harness, upholstery** – but it can make soft light leathers such as linings and leather goods - particularly from skins.
- The process is slow, with limited mechanical action from pits or slower running drums.
- The time is about 4 days for lighter weight leathers and 12 days for sole leathers.
- The temperature normally starts at about **20°C** for penetration, increasing later to 35°C.
- It has been largely replaced by chrome tannage, because it is quicker and more economical.

Alternative methods of tanning

- Alternative tannages now receive more attention because of environmental concerns.
- There have been **synthetic tannages** in use for many years, known as **syntans.**
- These cover a wide range of organic chemicals, such as ***phenols, naphthalene, glutaraldehyde and various polymers***.
- The majority of alternative tanning agents fall into one of the following groups:
  - Syntans
  - aldehydes
  - oil tannage.

Samming

- The objective is **to remove the unbound water so that the hide can be packed, split or shaved,** with consistent uniform moisture content and an exact thickness.
- The natural differences in the structure of the hide mean that the tanning material absorption and the liquid absorption also vary.
- It is first sammed to reduce the water content from about 70% to about 60%.

setting-out operation : can be carried out to stretch out the leather.

- Machines exist which combine the samming and setting action.
- After **samming and the setting out**, HS can be **sorted** into different grades after which they are processed further or sold on the market.

Sorting - Option to export

- The objective **is to grade the hides, and skins, according to their potential quality**.
- Wet blue (or wet white) is normally exported without splitting, so that the full hide thickness is available to the buyer.
- Quality is sorted on an agreed basis. This will assess the degree of damage in the hide, or skin, and how it affects the cutting value.
- **Each quality has a different value. Exports may specify particular grades.**
- The wet leathers for export need to be carefully folded, and packed in plastic sheeting so that the packing is completely waterproof.
- This is to prevent permanent creasing of the leathers and any drying out in transit.

Splitting Option - split for further processing and tanned waste

- The objective is to obtain a more even thickness for processing and more uniform final leather, if it were not done in the limed condition.
- At this stage, the leather has a more stable structure. The tanned hide is less swollen and so it is easier to handle. The actual leveling is more accurate.
- The thickness is determined by the final product to be made. It will allow for some final adjustment by shaving.
- The machine and operators are critical to a successful operation, from quality and profitability aspects.

Trimming

- The objective is to produce an economic shape for sale or processing further.
- The grain layer (top split) needs to have any ragged edge cut away to facilitate other machine work, whilst the lower flesh split has to be trimmed to such a regular shape that can have a uniform thickness.
- Trimming should be to retain, or improve, value. The quantity of trim should be controlled to see that it is not excessive, because it loses profit.

Shaving

- The objective **is to make the final thickness adjustment and have an even cutting through leather with consistent moisture**.
- The shaved thickness is determined by the customer requirements, allowing for the loss in processing between the semi-moist condition and the final despatch.

- The hides and skins are put through a machine with a rapidly revolving cylinder cutting fine, thin fragments from the flesh side.
- Shaving can be carried out on tanned or crusted leather.

- The small pieces of leather which are shaved off are called **shavings.**

Post tanning Operations

Neutralization: is the process by which the tanned hides are brought to a pH level suitable for the process steps of retanning, dyeing and fatliquoring.

Bleaching:

- Vegetable tanned skins and leathers with wool or hair may need to be bleached in order to remove stains, or to reduce the colouring in the hair, wool, or leather prior to retanning and dyeing.

Retanning

The retanning process can be carried out with the following objectives:

- to improve the feel and handle of the leathers;

Retannage

- The **neutralization, retannage, dyeing and fat-liquoring** wet operations are almost always carried out in that order in one operation, with a total time of 3-7 hours.
- They are done in a drum, or sectioned dyeing vessel, at a range of temperatures between 35-60° C.
- Drum speed is about 12 rpm.
- A wide variety of chemicals can be used for the retannage of leather.
- They can generally be divided into the following categories: **vegetable tanning extracts, syntans, aldehydes, mineral tanning agents and resins.**

Retanning…

- The properties which can be influenced by the re-tannage include
  - fullness, - embossingphysical analytical results
  - grain tightness, - buffing and chemical and physical properties
  - softness, , - water repellence
  - fat distribution,
  - leather colour,
  - levelness of the dyeing,
  - light-fastness,
  - grain fineness,
  - smoothness,
  - buffing,

Dyeing

- The objective is to colour the leather as required by the customer, or sales forecasts.
- The dyeing process is carried out to produce consistent colouring over the whole surface of each hide and skin, and for exact matching between hides in a commercial pack.

- It is usually done in drums, or sectioned dyeing vessels, with different levels of float and temperatures.

- Typical dyestuffs are water-based acid dyes. **Basic and reactive dyes** are less commonly used by the leather Industry.

Fatliquoring

- The objective is ***to soften the leather, as required in the product***, by ***lubricating the wet fibres so that they do not stick together on drying***.
- Leathers must be ***lubricated to achieve product-specific characteristics and to re-establish the fat content*** lost in the previous procedures.
- The oils used may be of **animal or vegetable origin**, or may be synthetics based on mineral oils.
- Without fat-liquors, the leather would dry hard and any mechanical action would damage the fibre and limit the quality potential.
- It controls the feel of the dry leather. It is normally the last operation in retannage and can be combined into that float.

- After the final wet operations (retannage etc.), the leather is generally ***horsed up or stacked on platforms overnight. The water content is about 70-75%, on the leather weight***.

SAMM AND SET OUT

- The object is to reduce the water content and to spread the leather out by stretching it in all directions. The helical blades spread the hide, or skin, into a flat shape and squeeze out the surplus water. Animal skin is three dimensional to cover the animal shape, so this operation now starts to change that into two dimensions.
- The shapes need to be positioned on the rollers to avoid any creases forming in the surface; this can be difficult for the shanks. After setting out, the leather should be easier to handle for subsequent drying.

Drying

- The objective of drying is to dry the leather whilst optimising the quality and area yield.
- The objective is to take the moisture level finally down to about **8-14 % for mechanical softening**.
- Drying techniques include **samming, setting, hang drying, vacuum drying, toggle drying and paste drying**.
- Generally, samming and setting are used to reduce the moisture content mechanically before another drying technique is used to dry the leather further.
- After drying, the leather may be referred to as **crust**.
- **Crust** is a tradable intermediate product. The dried leathers have a series of mechanical operations for ***softness and general presentation so that they can be sorted for final top finishing, or for export.***

Drying …

There are 4 main methods:

a) **Suspension, or hang, drying** where the leather is simply hung up in the drying room or tunnel, which has controlled conditions of heating, humidity and air circulation.

b) **Paste drying** has the set out leathers pasted onto glass, or non-corrosive metal, plates with an aqueous adhesive solution and then dried in the through-feed tunnel dryer for 5-8 hours.

c) **Vacuum drying** is the best method for most full grain leathers, whilst it is also perfectly satisfactory for corrected types.

- The set out leathers are laid flat, grain down, onto a stainless steel table, where they are also be stretched out further by hand slickers as their shape dictates.

These driers have been developed into multi-table machines and the most sophisticated systems have a conveyor delivery from the setting out through vacuum driers, to staking and toggling operations.

d) **Toggle drying:** stretches the leather manually onto perforated metal sheets, with the shape being retained by the toggling clips, which have pincer grips to hold the edge of the leather and a small foot underneath to fit into the perforations.

- The drying conditions and control are as for hang drying.
- The frames are sometimes assembled as a type of bookcase or, much better, as a form of conveyor which has greatly improved this whole operation and reduced the handling.

8.3. Finishing Operations

Dry finishing operations

- The overall objective of finishing is to enhance the appearance of the leather and to provide the performance characteristics expected of the finished leather with respect to:

➢ **Glos, handle, Flex, adhesion, rub fastness**

❖ as well as other properties as required for the end use, including: extensibility, break, light and perspiration fastness, water vapor permeability, and water resistance.

➢ Generally, finishing operations can be divided into mechanical finishing processes and coating.

Mechanical finishing processes

- carried out to improve the appearance and the feel of the leather.
- The following list of operations includes commonly used mechanical finishing processes:-

- Conditioning (optimising the moisture content in leather for subsequent operations); **staking** (softening and stretching of leather);
- Buffing/dedusting (abrading of the leather surface and removing the resulting dust from the leather surface);
- Dry milling (mechanical softening);
- Polishing;
- Plating (flattening);
- Embossing a pattern into the leather surface.

Applying a surface coat

The purpose of applying a surface coat is:

- to provide protection from contaminants (water, oil, soiling);
- to provide color;
- to provide modifications to handle and gloss performance;
- to provide attractive fashion or fancy effects;
- to meet other customer requirements.

The following types of application methods can be distinguished:

- **padding or brushing the finishing mix onto the leather surface**;
- **spray coating; roller coating, transfer coating, an adhesive**.

The End!!

Thank You All!