Thesis Ref. No._____

ASSESSMENT OF PRE- AND POST SLAUGHTER HIDE AND SKIN DEFECTS AND THEIR ASSOCIATION WITH CARCASS CONDEMNATION IN TWO WOREDAS OF EAST ARSI ZONE, ETHIOPIA

MSc Thesis

Addis Ababa University, College of Veterinary Medicine and Agriculture,
Department of Tropical Animal Production and Health

BY

Behailu Amde

June, 2015

Bishoftu, Ethiopia

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A Thesis submitted to the College of Veterinary Medicine and Agriculture of Addis Ababa University in partial fulfillment of the requirements for the degree of Master of Science in Tropical Animal Production and Health

BY

Behailu Amde

June, 2015

Bishoftu, Ethiopia

Addis Ababa University

College of Veterinary Medicine and Agriculture

Tropical Animal production and Health

As members of the Examining Board of the final MSc open defense, we certify that we have read and evaluated the Thesis prepared by **Behailu Amde Feleke** entitled: ASSESSMENT OF PRE- AND POST SLAUGHTER HIDE AND SKIN DEFECTS AND THEIR ASSOCIATION WITH CARCASS CONDEMNATION IN TWO WOREDAS OF EAST ARSI ZONE, ETHIOPIA and recommended that it be accepted as fulfilling the thesis requirement for the Degree of Master of Science in **Tropical Animal Production and Health**

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SIGNED DECLARATION SHEET

First, I declare that this thesis is my original work and that all sources of material used for this thesis have been duly acknowledged. This thesis has been submitted in partial fulfillment of the requirements for an advanced (MSc) degree at Addis Ababa University College of Veterinary Medicine and Agriculture and is deposited at the University/College library to be made available to borrowers under rules of the Library. I solemnly declare that this thesis is not submitted to any other institution anywhere for the award of any academic degree, diploma or certificate.

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Date of Submission: _____

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LIST OF ABBREVIATIONS

CSA	Central Statistical Authority
ESGPIP	Ethiopia Sheep and Goat Productivity Improvement Program
EUC	European Union Commission
FAO	Food and Agricultural Organization
GDP	Gross Domestic Product
HS	Hide and Skin
HSL	Hide, Skin and Leather
Km	Kilo Meter
masl	meter above sea level
MoARD	Ministry of Agriculture and Rural Development
SNNP	South Nations and Nationality People
UNIDO	United Nations Industrial Development Organization
USD	United State of America Dollar

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ASSESSMENT OF PRE- AND POST SLAUGHTER HIDE AND SKIN DEFECTS AND ASSOCIATION WITH CARCASS CONDEMNATION IN TWO WOREDAS OF EAST ARSI ZONE, ETHIOPIA

ABSTRACT

Across sectional study was conducted from December 2014 to April 2015 in Dodota and Hitosa woredas and in Colba and Gelan tanneries with the objectives of assessing hide and skin defects. The study was carried out through questionnaire survey and observational study. About 49% of the respondents care for the hide and skin and 75% of them in both woreda uses muddy floor house for their animals to shelter at night. In addition 99% of the respondents from both woreda, replied that, there were no extension services on pre and post slaughter hide and skin quality management. Moreover there is no slaughtering facility in Hitosa woreda. The hide and skin observational study revealed none of hide and skins were free from the defects. The major defects observed on raw hide at collection centers were corduroying (74.1%), flay cut (73.3%), gouge mark (67.4%), dirt (43.3%) and in raw sheep skin higher prevalence of flay cut (31.4%) followed by dirt (26.5%), corduroying (17.5%) and gouge mark (16.8%). Whereas, a higher prevalence of dirt (20.8%) was observed in goat skins followed by flay cut (16.4%), corduroying (14.1%), and remained flesh on skin (10.7%). The prevalence of lice, poor pattern, flay cut, dirt and bruising were significantly higher ($P < 0.05$) in sheep than goat skins while flesh remnants and poor substance were significantly higher ($P < 0.05$) in goat than sheep skin. The major defects at the wet blue stage hide were flay cut (59.1%), gouge mark (42.2%), and putrefaction (35.2%). In sheep pickled skin there was higher prevalence of cockle /ekeke (36.9%), gouge mark (28.3%) and scratch (27.0%). Moreover, on wet blue goat skin the result revealed a high prevalence of cockle / ekeke (48.1%), veininess (44.6%) and crack (41.9%). The prevalence of cockle /ekeke, veininess, scar, corduroying, crack, gouge mark, poor pattern and brand mark were significantly higher ($P<0.05$) in goat skin at wet blue stage where as putrefaction and shoat pox were significantly higher ($P<0.05$) in sheep skin on pickled stage than goat wet blue skin. The most important defects in rejected /grade7/ wet blue for hide were flay cut and cockle in sheep and

goat. In pickled sheep skin grading grade 1-3 accounts 14% and grade 4-7 accounts 86% of the total observation. On condemned nodular goats carcasses study the result revealed higher proportion of cockle on its skin at wet blue stage. In the processed cattle hide still flaying defect and putrefaction were the dominant defect for hide rejection but in case of processed sheep and goat skins cockle, scratch and scar were the principal defects for the skin rejection. The raw hide and skin managemental problems that made at the time of slaughtering and post slaughtering were the dominant problems that indicates the producers were not emphasize in keeping the quality of the hide and skin, the absence of slaughtering facility and extension service exacerbate the problem. The nodular goat carcass condemnation in an export abattoir surveyed and its relation with external parasite allergic reaction needs further study.

Key words**:** *Animal management, Defects, Hide and skin, Nodular goat carcass, Pickled, Tannery, Wet blue*

1. INTRODUCTION

Archeological studies have shown that hide and skins have been used since antiquity as clothes, vessels, bedding, and possibly structurally in ancient dwelling places. At present leather is used in various applications. According to FAO (2010), skin of cattle, camels, horses and buffaloes is called hide and that of goat and sheep is known as skin. Hides and skins, raw materials for the tanning industry, are renewable and easily perishable resources their production is dependent on the rearing, management and disposal of the livestock population. The availability of skins through slaughtering or death of livestock is of particular importance to the leather industry. Skins could be obtained from fish, birds and reptiles as well as wild and domesticated animals (Arugna, 1995).

On a world scale, significant cattle populations are to be found in China, the US, Brazil, Argentina, India, the former USSR and the EU. Sheep and lambskins originate predominantly in China, New Zealand, Australia, the Near East and the EU. Only about 40 % of the global availability of hides and skins enters into the free international market with the consequent problems of dual pricing of raw materials, price volatility on open markets and relative scarcity of raw material. While developing countries hold over 78 % of the world bovine herds they together produce about 64 % of the world hide output on a numerical basis or 57 % of total output by weight. With respect to sheep skins, developing countries account for about 65 % of the global number of skins produced. The top 10 ranking suppliers of raw hides and skins are made up of only developed countries with the exception of Ukraine and Iran. Apart from the EU, the major leather production centers in the world in 2008 are found in Mexico, Argentina, Brazil, South Korea, China, India, and Pakistan (EU, 2009).

Globally, approximately 6.0 million tonnes of raw hides on a wet salted basis were processed to yield about 522600 tonnes of heavy leather and about 12759 million square feet of light leather, including split leather. In comparison, Europe produced about 71700 tonnes of heavy leather and about 2473 million square feet of light leather. For goat and

sheep worldwide 646800 tonnes of raw skins on a dry basis were converted into almost 4716 million square feet of sheep and goat leather (EU, 2009).

Ethiopia has 55.03 million cattle, 27.35 million sheep, and 28.16 million of goats (CSA, 2014). This places the country as one of the richest countries in livestock resources. It has a huge potential for production of hide and skins. For instance, its potential was estimated at 3.78 million cattle hides, 8.41 million sheep skins and 8.42 million goatskins in 2012/13 (CSA, 2013**).** In Ethiopia, hides and skins contribute much to the export earnings from the livestock sector. In addition, it has a large contribution to the leather industry in the country. The exportation of skin and hides is the largest foreign exchange earners in the country (CSA, 2004**)**. And the country's export of hides and skins and leather (HSL) reached 15,491 tons, with export earning amounting to 75.3 million USD in the year of 2005/06 (ETFLPMA, 2006)**.** Ethiopia's agriculture sector contributes between 45-50 % of the country's total GDP in the 2010-11 Fiscal year, live animals generated USD 147.9 million of Ethiopia's foreign exchange, leather and leather products generated USD 103.8 million, and meat and meat products generated USD 63.3 million, ranking 6th and 8th and 9th respectively. Ethiopian small ruminant skins, especially sheep skins traditionally have a very good reputation for quality in the world leather market due to their fine grain and compact structure (Abadi, 2000).

The leather industry sector is one of the forth growing economic sectors in Ethiopia (MoARD, 2009). Currently 27 tanneries in Ethiopia produce all forms of hides and skins and finished leather for the domestic and export markets. These tanneries have an average daily soaking capacity of 107,850 pieces of sheepskin, 51,550 pieces of goatskin and 9,800 hide, the annual capacity reaches an estimated 48 million (32.4 million sheep and 15.5 million goat) skins and 2.9 million hides. Current capacity to process hides and skins greatly exceeds domestic supply, particularly for raw sheep and goatskins (USAID, 2013)**.**

Though Ethiopia has very good potential to produce substantial quantities of hide and skins, the quality of the hide or skin is to a large extent related to the amount of damage to the grain (or outside) surface (ESGPIP, 2009)**.** In this regards, the leather industry sector is losing large amount of money due to decline in quality and fall in export price (CSA,

2007). It is estimated that about one quarter to one–third of all the skins processed at tanneries are unsuitable for export due to various defects (Kassa *et al*., 1998). Skin defects occur as a result of a variety of causes in the life of the animal, during slaughter and post slaughter (ESGPIP, 2009).Tannery owners in Ethiopia are reported to complain that, three decades ago, they used to get the best quality (grade1-3) sheep skins over 70% of what they produce today, but due to the cockle problem, today it has dwindled to 15% (Kassa *et al.,* 2012). The major problem affecting the leather and especially tanning industry is related to skin diseases, scratches, scabs, branding, poor pattern, flay cuts and holes, putrefactions and heat and poor substances are the main problems related to skin and hide quality that the tanners are facing (Abadi, 2000).

A considerable portion of the pre-slaughter defects that accounts for 65% are directly related to skin diseases caused by ectoparasites; or to the secondary damage that occurs when the animal scratches itself to relief the itching and the scar produced due to the lesions has increased dramatically in the past 10-15 years and is holding number one position as cause of skin down grading and rejection (Kidanu, 2001). According to Okuni *et al.* (2011), out of the total 277 rejected goat skins, 34.6% were due to putrefaction, 33.9% flay cuts and 9.7% were due to vermin damage. Branding costs the leather industry large amounts of money due to the wasted portions of the hides. The loss of value is dependent on the placement of the brand. A side or rib brand can commonly cost $10.00 in value, and other location, such as hip brands, can cost $5.00 in value (Stanton. 1995).

In this regards, there exists a paucity of research output in identifying the hide and skin down grading problems, causes of rejections, and the measures to be taken under different agro ecologies. And most of the study was on impact of sheep and goats ectoparasites on the tanning industry (Abebayehu and Kibrom 2010; Werku, *et al*., 2011; Bisrat, 2013; Hagos, *et al*., 2013; Kebede, 2013). However, to date; there are no reports on the occurrences of defects on the hides and skins in East Arsi zone especially Hitosa and Dodota Woredas which have high potential of livestock production. Besides, the level of awareness on skin defects by skin and hide collectors, traders etc was not assessed. Therefore, this survey was carried with the objectives stated below.

RESEARCH OBJECTIVES

General objective:-

- To assess the major hide and skin defects in the study area and to determine the relation between carcass condemnation and skin defects.

Specific objectives:-

- To assess the major management practices affecting hide and skin quality
- To identify the major types of hide and skin defects at collection centers and in tanneries
- To establish the association between goat carcass condemnation and skin defects at Modjo organic export abattoir.

2. LITREATURE REVIEW

2.1. Anatomy of Hide and Skin

The skin is one of the most interesting organs of the body. Its structure and organization affects not only the leather made from the skin but strongly influences the requirements to preserve the skin for leather making. Hide and skins in their raw state consist of three layers, the epidermis or thin outside layer, a second thicker layer known as the corium, and a third layer of adipose tissue or flesh. In the process of tanning, the first and third layers are removed. The epidermis is made up of cells an under layer of living epithelial cells and an outer layer of dead cells. This outer layer consists mostly of an insoluble protein, keratin, and affords surface protection to the body. The aesthetic value of leather comes from the grain layer. The corium layer gives leather its strength and resiliency. It is rich in the protein collagen. Individual collagen molecules combine together in the corium to form very small fibrils that are in turn bound together to form collagen fibers, which are visible under the microscope. The strength of the skin and of leather is due to cross weaving of these fibers (Baily, 2003).

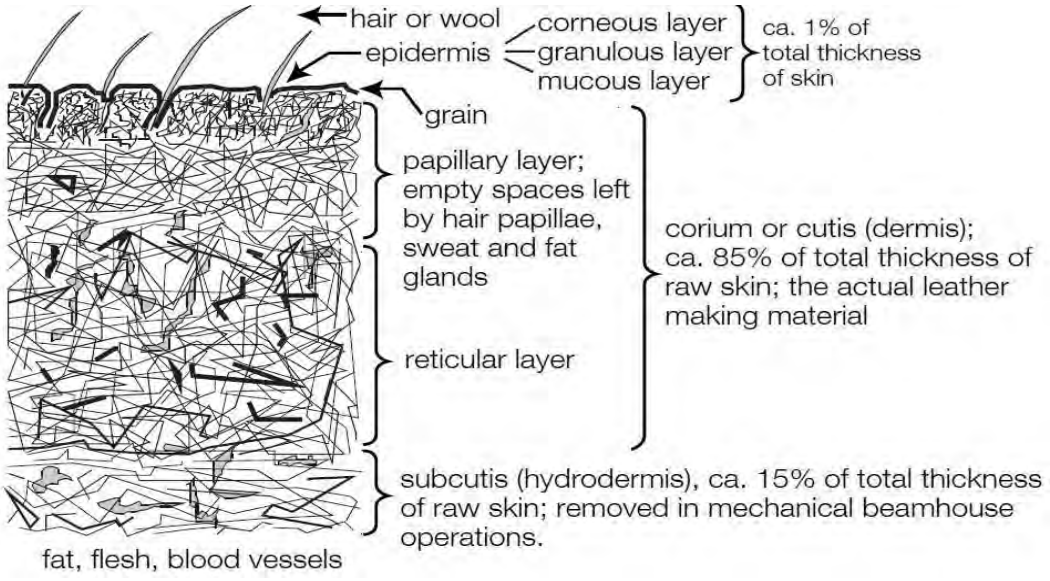

Figure 1: Cross section of the skin

2.2. Hide and Skin production and Consumption in Ethiopia

The use of leather goes back to the pre-historic times. The principal raw material is the hide or skin of animals. Hides and skin constitute valuable material removed from the animal carcass. Skin of cattle, camel, horse and buffaloes is called hide, and skin of goat and sheep is called skin. Generally the hide is 17% of the carcass weight and 7% of live weight. Hence this part adds the considerable value in the animal products (FAO, 2010).

Based on annual off take rates of 7% for cattle, 33% for sheep and 35% for goats, the potential production is estimated at 3.78 million cattle hides, 8.41 million sheep skins and 8.42 million goatskins in 2012/13(CSA, 2013). The 7% off-take rate for cattle falls significantly below the African average of 12.71% and the world average of 20.31%. While the off-take for sheep ranks slightly below the average for Africa, the off-take for goat skin ranks slightly higher than the Africa average, though both remain well below the world average (USAID, 2013).

Ethiopian hide and skin have good reputations in the international leather market for their unique natural substance of fitness, cleanness, compactness of texture, thickness, flexibility and strength. The cattle hides, identified as “Zebu type”, are popular for their fine grain pattern and fiber structure that are well suited for the production of quality upper leather. The highland sheep skins known as “hair sheep”/“Selale type” are considered to be the worlds finest and have a highly compacted texture. They are excellent raw material for high quality leather for dresses, gloves, sports gloves and other garments. This unique feature of the Ethiopian sheepskins enables them to fetch higher prices in the international leather market. Goatskins from the highlands are categorized as “bati-genuine” and those from the lowlands as “bati-type” in the international market. “Bati-genuine” is associated with highest quality class goatskins in the world. The particular characteristics of Ethiopian bati-genuine goatskins are their thickness high flexibility and clean inner surface and are known world-wide for being excellent raw material for producing high quality suede leather (Ahmed, 2001).

This raw material of the leather industry is mainly derived from local areas of the country where basic amenities for slaughtering and subsequent marketing are either not in existence or lacking. Additional sources of hides and skins include slaughter slabs, municipal slaughterhouses, the limited number of export abattoirs, and meat and meat product processing plants. With regard to skin production, except the export abattoirs engaged in the production of chilled mutton and goat meat for export, the contribution of other slaughtering premises in terms of skin supply is very negligible. About 90 to 95% of the skin production is derived from urban as well as rural backyard slaughters and the remaining 5 to 10% from major urban slaughterhouses and export abattoirs (Ahmed, 2001).

2.3. Market Supply of Hides and Skins

The marketing of hide and skins starts at the producer/consumer level and passes through a chain of middlemen until it reaches the tanneries. The collectors of raw hide and skin are available in almost all towns of Ethiopia. At least one businessperson is found in the smallest town. Some of them have other sideline business such as butchery, retail trade, and brokerage. They collect the hide and skins from both rural through rural agents or through farmer's carriage to market and urban areas through intermediary collectors or themselves. Many of them are indeed long age experience starting from the time of Armens, with the majority of them starting the business in the 1960s (Mekonnen and Gezahegn, 2008).

The market chain for raw hide skins consists of the primary producers/consumers, who are the initial sources (individual meat consumers, rural slaughter slabs, municipal slaughter houses, abattoirs, and meat processing plants), agents of traders, collectors, local tanners, regional medium/small traders, regional /Addis Ababa big traders and tanneries. After preservation by air-drying or wet salting, the hide and skin are passed on to big traders and then to the tanneries. The tanneries can be supplied directly from the slaughter premises, regional big traders or Addis Ababa big traders as well (Ahmed, 2001).

2.3.1. Producers (Households)

The major producers of hides and skins are individual householders residing in the different Kebeles across Ethiopia. The great majority of sheep and goats (90%) and most of the cattle (70%) are slaughtered informally in homesteads for consumption by the owner or in a small community where no formal slaughtering facilities exist. No data exist on the informal slaughtering activities, and it is largely beyond the reach of government considerations (USAID, 2013).

2.3.2. Rural slaughter slabs operators

The operators in rural slaughter slabs produce a sizable volume of hides and skins, second to the individual household. Theses operators use poorly equipped slaughter points, where the infrastructure is sometimes a slab of concrete, under a shade or using poles for hoisting carcasses. These operators are normally located in small towns adjacent to butcheries in various trading centers. More than 80 percent of such facilities are established in Oromia (54%) and Amhara Regional State (27%). Such facilities are scattered in rural towns and often without adequate supervision. The tools used in these facilities are usually rudimentary and of inferior qualities causing damage to the hides and skins during flaying/slaughter. In many cases running water is not available and hides are not watered off after slaughter. Most often, all operations are carried out on the floor (USAID, 2013).

2.3.3. Municipal slaughter houses operators (*bigger and medium abattoirs*)

Cattle hides are recovered by hand from the carcass, causing extensive damage in the form of deep cuts and holes. Cuts and holes reduce the value of a hide or skin. The difference between a machine-flayed hide, which presents no cuts or holes, and a hand-flayed hide, with cuts and holes, can reach 20-30% of the hide's value (USAID, 2013).

2.3.4. Village level collectors/ Traders agents

The hides and skin from the sources (usually the household across the country) are normally collected by the village level collectors or trader agents. The trader agents collects

the raw hides and skin by going door to door in case of urban area and by setting temporary collection point at most accessible spot in case of rural areas. The village collectors are not licensed but in some regions such as Tigray, are provided with a three month renewable work permit and identity card up on submission of proof of designation as an agent ship from the licensed trader to work under the trader (USAID, 2013).

2.3.5. Small traders

The small traders are the next level traders above to the village collectors who work under them directly. They collect raw hides and skin through the village collectors and also directly from the producers. They collect, handle/preserve, store and transport the skins to their respective wholesalers. These traders are obliged to have facilities to be used for preserving and storing raw hides and skin they received. They use salt for preservation of the skins in their stores. However they usually use dirty and insufficient amount of salt with improper grain size (USAID, 2013).

2.3.6. Intermediary traders / Collectors

The intermediary collectors or small local traders frequently act as agents for larger suppliers (wholesalers) based in larger towns and cities. These wholesalers, in turn, regularly supply hides to tanneries. Intermediary traders collect, handle, preserve, store and transport the skins they purchase on behalf of their respective wholesalers. In many cases, however, observers report that both small and intermediate traders/collectors use insufficient amounts of salt and/or an improper grain size, which inadequately preserves hides and lowers their value. The intermediaries usually collect, salt and store skins in their own facilities. They often transport hides/skins in such a way as to minimize cost by optimally matching the quantity shipped with the size of the truck used to transport them (USAID, 2013).

2.3.7. Large traders/wholesale suppliers to tanneries

These suppliers usually own storage and transport facilities with which they source the raw hides and skins that they then supply to tanneries. The relationship between large traders

and tanneries has evolved over time. In the early 2000's, tanneries used to advance to the traders who supplied them; funds of money and/or salt in exchange for hide collection (USAID, 2013).

With regard to regional contribution of hide and skins supplied to tanneries, in the 1995/96 fiscal year, data collected from regional agriculture bureaus reveal that Ormoyia accounts for 38.9%, SNNPR for 28.9%, Addis Ababa for 19.2% and Amhara for 7.3% of the total cattle hide supply. The balance is collected from the remaining regions of the country. Some 80% of Addis Ababa's hide supply is accounted for by Addis Ababa Abattoir, Kara and Akaki slaughterhouses (Addis Ababa Agricultural Bureau 1998).

Considering the development potential and economic importance of hides and skins, in the last two to three decades the government has launched different development programs aimed at increasing the supply and improving the quality of the raw material. Despite these development interventions, hides, skins and the leather industry are still constrained by the poor quality of raw materials, lack of an efficient market structure, a weak extension service, competition from local/rural tanning industries, and a lack of price incentive for production of good quality raw material (Devasy, 1990).

2.4. Leather Industry in Ethiopia

The emergence of modern tanning in Ethiopia dates back to 1918 and 1927 with the establishment of the then ASCO (currently Addis Tannery) and Darmar /Awash (currently ELICO) tanneries, respectively. Between 1954 and 1976, Dire, Modjo and Kombolcha tanneries were established (Darge, 1995). The leather industry sector is one of the forth growing economic sectors in Ethiopia (MoARD, 2009). However, because the sector is constrained by different factors like external parasites, inappropriate management of animals, faults during slaughtering and improper handling of skin before reaching to the tannery, the sector is losing large amount of money due to decline in quality and fall in export price (CSA, 2007).

Currently 27 Tanneries in Ethiopia produce all forms of hides and skins and finished leather for the domestic and export markets. These tanneries have an average daily soaking capacity of 107,850 pieces of sheep skin, 51,550 pieces of goat skin and 9,800 hide. The annual capacity reaches an estimated at 48 million (32.4 million sheep and 15.5 million goat) skins and 2.9 million hides. Current capacity to process hides and skins greatly exceeds domestic supply, particularly for raw sheep and goatskins (USAID, 2013).

Ethiopia's tanneries process an average of 16 million skins and 2.4 million hides per year, yet this represents only 64% of their installed finishing capacity for skin processing and 63% of the capacity for hides processing, while some tanneries run as low as 30% capacity. This "low supply"/"high demand" of hides and skins creates shortages that often result in a lack of competitiveness among domestic suppliers and produces hides and skins of mediocre quality. Lower quality hides and skins negatively impacts not only tanneries, but also Ethiopian footwear and other leather goods producers who sell their product domestically and abroad. To help ease the shortage of hides and skins, some tanneries have begun to import semi processed hides (USAID, 2013).

The tanneries receiving raw HS are often complaining the decline in the quality and quantity from time to time. The information from Hora, Shoa, and Ethiopia tanneries indicated that after 1983 the supply of 1-3 grade rawhides and skin has sharply declined. The discussion in Ethiopia tannery indicated that this is from 60% in the pack of skins was first grade before 1983, declined to 25%. This is consistent with the Arbaminch collectors. The percentage of highest-grade skins from grade 1-3 is very low in a randomly packed hide and skins on its arrival to the tannery. In this way, the Gojam skin is the best quality skin with more of 1 to 3 ranking, with much of its proportion of best quality, and they said they fall under fierce competition to secure the Gojam one. With regard to the tanneries, only 45% of the installed capacities for skin processing and 81% for hides processing of the tanneries are utilized due to lack of supply of raw materials (Mekonnen and Gezahegn, 2008).

According to data from Ministry of Industry (2012), the leather and leather product exports increased from 67 million USD to 104 million USD between 2004/05 and 2010/11. Due to the financial crisis and other factors, export decline in 2009/10 but picked up heavily in 2010. On average the leather and leather products industry contributed 5.9% to the total export earnings for the year 2004/05-2010/1 corresponding to a slight decline, due to other export items occupying significant positions in the country's export mix. According to FAO the global trade of light leather was16.6 billion USD in 2010. Despite its impressive resource base Ethiopia's share in this trade is about 6%. But trends of the different product categories show the crust, finished leather and shoe exports increased while wet blue and pickle decline. In fact, pickle and wet blue exports ended in 2010 due to the government policy which put heavy taxes on exports of wet blue, pickle and crust in order to encourage production and export of finished leather (UNIDO, 2012).

2.4.1. Tanning

Tanning is the process of transforming the raw hides and skin which is a biological material into a non biological material called leather. In the tanning process the collagen fiber is stabilized by the tanning agents such that the hide is no longer susceptible to putrefaction or rotting. In this process the collagen fibers are stabilized by the cross-linking action of the tanning agents. Furthermore their dimension stability, resistance to mechanical action and heat increase. Tanning involves a series of processes which are commonly divided into four distinct stages: pickling, tanning, re-tanning and finishing. The corresponding products of these stages are pickled pelt, wet-blue leather, crust leather and finished leather, respectively. A full tanning process indicated in Appendix (6).

2.5. Hide and Skin Preservation/Curing/

When an animal dies, microorganisms begin to penetrate the skin within just a few hours and once inside they begin to multiply rapidly in the nutritious environment under the skin. The skin of all animals is naturally covered with rich bacteria flora. The soil contains thousands of species of microorganisms as does manure, both of which are present in large

quantities on the bovine skin. The impact of these organisms not only affects the preservation of the skin but the safety of the meat as well (Baily, 2003).

In the production and distribution of leather, two types of biodeterioration are encountered, bacterial (which generally applies to hides and skins in the early stages of the process) and fungal (which usually applies after tannage has taken place). Fungal bio-deterioration can affect leather both in part processed condition within the tannery and after it has been made into and distributed as a fully finished article (Mark, 2007). The preservation techniques of hides and skins can be divided into long term preservation (drying methods, ground dried, sun dried, frame dried, shade dried, dry salting, wet slating and re-use of salt, salt additives, and brining) and low term preservation (Cooling and Deep freezing) (Dutta, 1999).

Raw hides and skins are 60-70% water and 25-30% protein. In this form the hide is susceptible to bacterial activity within hours after being removed from the carcass. The autolytic degradation of skins/hides is assumed to be due to a combined action of tissue enzymes and bacteria, the latter requiring moisture to be available (Rao and Henrickson, 1983).

Curing is the process that provides an environment in which bacteria cannot survive. Several curing agents have been reported in literature, e.g potassium chloride, silica gel, boric acid, and herbal-based products (Preethi *et al.,* 2006).Tanneries stock hide and skin to optimize the efficiency of their batch processes. There is a wide choice of method to prevent in transit of hide and skin that cannot processed immediately. The choice depends mainly on the period of time envisaged for preservation. Long term methods are, salting, brining, drying and salt drying. These four methods of curing are effective for up to six months without jeopardizing the quality of the leather products. Salt is a biostat and acts by inhibiting the growth of bacteria by lowering the moisture content in raw stock. Various methods of salt curing can be applied. In general hides and skins are spread out, covered with salt and then stacked, sandwiched with more salt. The hide and skin may need to be resulted if they are stored for a long time. As an alternative to throwing salt on the pelts, they can be agitated in brine solution. This generally takes place in processing vessels such as drum raceways (EU, 2003).

In salting, the quality of salt (sodium chloride) used depends largely on the storage time required. Brining is a preservation technique mainly used in the USA and involves dragging hide through a salted solution (EU, 2003). Skin and hides processed into leather salt preservation is the popular practice in India and other tropical countries. Skins and hides are preserved by application of sodium chloride at a concentration of 40-50%. The dual function of common salt is dehydrating ability and bacteriostatic effects (Sivabalan and Jayanthi, 2009).

Sun drying is the simplest and the cheapest method of curing hide and skin without the use of salt is to dry them by evaporation under the sun. It is one of eco-friendly curing process. This method is however practicable only in countries with dry warm climate. This preservation method where ever practiced is often poorly controlled resulting in either over drying leading to subsequent problem in further processing in leather or under drying leading deterioration in the skin quality. Generally, the sun dried skin produce inferior quality leather and these are difficulties in wetting back of the hides and skin while processing in to leather (Roddy and Hermoso, 1943).

2.6. Major Causes of Hide and Skin Quality Defects

Self-sufficiency in food production, increase in rural income and foreign currency earning of the country through improving the quality and quantity of export items which are among the main objectives of the current agricultural development polices of Ethiopia. Cattle, sheep and goats are important source of income for agricultural community and are also one of Ethiopia's major sources of foreign currency through exportation of live animals, meat, hide and skin (Shiferaw *et al*., 2010). Considering the development potential and economic importance of hides and skins, in the last few years, the government of Ethiopia has launched different development program aimed to increase the supply and improve the quality of the raw material (Mahmud, 2001).

Ethiopia's agriculture sector contributes between 45-50 % of the country's total GDP in the 2010-11 fiscal years, leather and leather products generated USD 103.8 million, which have 4% share and ranks 8th of the total agricultural export (UNIDO, 2012). However, the

percentage of skins having defects that downgrade quality has increased tremendously. Tanneries state that only 10 to 15% of harvested skins qualify for top grades, with the rest downgraded and rejected mainly due to deterioration of skin quality due to ectoparasitic skin diseases and various defects (ESGPIP, 2009).

Skin quality is primarily defined by the absence of damage to the grain layer of the skin (Hadly, 2001). Top quality leathers, known as Aniline, are produced from hides and skin having few or no visible defects. Minor scratches and irregularities are not taken seriously and even considered to the contrary as a good proof for genuine aniline leather. Aniline leathers are generally soft, full in substance and visibly display the attractive grain patterns of the natural skin and are produced by direct drum dyeing of leathers and /or skins without passing through grain correction process. The quality of finished leather is related to a number of surface and structural defects that hide and skin acquire in the life of the animal, during slaughtering, storage and transportation stages (Kidanu, 2001).

2.6.1. Pre slaughter defect causes

Environmental/natural causes: breed or types of sheep skins show more undesirable breed characteristics than goat skins. The best quality skins are plump or stout and have dense uniform structure and usually have surface areas that are small in proportion to their weight. Fine wool sheep breeds, such as Merino, produce skins that are thin, have pin hole grain and are extremely ribby. These skins produce only the cheapest type of leather. The skins of hair sheep have a high proportion of fat in the upper part of the corium and on the flesh side of the skin. In goats, the skin becomes coarser as the animal grows. Skins from goats in the highlands are poor in substance, and open grained (ESGPIP, 2009).

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

2009).The breed of animal is of course important, the best hides for leather purposes usually coming from those animals which are bred for beef production, i.e. those which develop carcasses with a high proportion of lean meat in a reasonably short time under conditions of economic feeding. These hides, available from all the beef-producing countries of the world, are very tough and firm, fairly uniform in thickness and having a "square" form, since breeding programmes are designed to produce a body conformation with minimal amounts of tissue in the neck, leg and belly regions (Calcutta *et al.,* 2008).

Sex/Age: The skins from male goats and sheep will be heavy with a coarse grain. Female skins will have better tensile strength. The skin structure of young animals tends to be fine, compact and have tight grain patterns. As animals grow older, the grain surface becomes tougher and coarser grained. Also with age animals accumulate more scars from brands, diseases, parasites, scratches and other injuries (ESGPIP, 2009).

Nutrition: Poor nutrition causes an animal to be smaller. It also causes the skin to be thinner and have poorer substance producing leather which lacks elasticity and has a dead feel (ESGPIP, 2009). On the other hand, fat animals can cause too much fat content in the hide, which prevents curing agents from penetrating the hide (Freeman, 1997). Poor nutrition predisposes the skin to low febrile condition where the weight and final quality of leather is affected irrespective of the subsequent efforts of other condition being optimized. The resulting condition is referred to as “papery leather” which is a common problem experienced in the areas where poor or unavailability of pastures and forbs is eminent. Hence animals in such areas are of dilapidated condition affecting subsequently the final quality of leather (Mwinyihija, 2006).

Climate: Animals raised in warmer climates have shorter hair and the leather originating from animals raised in these areas has superior substance and smoother and thinner grain patterns. Animals raised in colder climates or at higher altitudes have longer hair or wool and resulting leather will be of poor substance and have a coarser grain. These effects are prominent on goat and sheep skins (ESGPIP, 2009).

Defects due skin infection: A considerable portion of the pre-slaughter defects that accounts for 65% are directly related to skin diseases caused by the ectoparasites; or to the secondary damage that occurs when the animal scratches itself to relief the itching. Skin diseases are known to affect the quality of skin. As many as one-quarter to one third of all skins processed at tanneries have various defects and are unsuitable for export purposes (Kassa, 1998).

Ringworm: Ringworm is a fungal infection of the skin that is common in many animal species. It occurs in cattle, sheep and goats but not with great frequency. Lesions are most common seen on the head, ears, neck and shoulders. The lesion is often circular with hairless areas and the development of a thickened and crusty skin (ESGPIP, 2009).

Dermatophilosis: *Dermatophilus congolensis* infection is a pleomorph bacterium which belongs to dermatophilaceae of the order *Acetinomycetales,* lumpy wool of sheep (dermatitis of sheep) and strawberry foot root of sheep are also caused by *D.congolensis*. Is a common disease causing suppurative lesions which break out spontaneously or become hardened. These cause blemishes on the superficial grain tissues. The disease in sheep called lumpy wool disease (dermatitis of sheep) appearing in the inguinal region, in goats appear especially on the face and on the ears, probably because goats get infected when feeding on contaminated brushes, at the same time being hurt by the thorn. In cattle the skin lesion seen on the ventral area of the body, such as axillae, brisket, inguinal area, scrotum and udder. In sheep when the lower legs are affected the condition is generally referred to as 'strawberry foot rot. Transmission is by direct contact or through vehicle example by tick (*Amblyoma varigatum)* (Seifert, 1992).

Sheep and goat pox: Sheep pox virus Capri pox virus (*CPV*) *ovis* and the goat pox virus *CPV caprea*, both virus belongs together with the lumpy skin disease (LSD) virus to the genus *Capri pox virus* and antigenically closed related (Seifert, 1992). Sheep pox is a viral disease of sheep and goats which is highly contagious. Healing of the skin affected by pox is slow and permanent scars can be left. This causes huge economic losses in the tanning sector (ESGPIP, 2009).

Lumpy skin disease (LSD): Is a viral disease that affects the skin of cattle. Small ruminants are susceptible to artificial infection. The characteristic gross pathological findings are the skin nodules which sometimes are also found in the subcutaneous tissue. The biggest economical loss is the loss of condition and permanent lesions of skin (Seifert, 1992).

Defects due to external parasite: Defects due to parasitic damage particularly cockle lesions has increased dramatically in the past10-15 years and is currently holding number one position as cause of skin down grading and rejection (Kidanu, 2001). According to Hagos *et al.* (2013), cockle lesions caused by many ectoparasites seriously affected skin qualities. The prevalence of cockle lesion on *Bovicola ovis* and *Melophagus ovinus* infested group of sheep pelts in Wukro Sheba tannery Tigray Region was 100% and 92.5%, respectively. On the other hand, the prevalence of cockle lesion on sarcoptic mange infested goat pelts was 100%.

Demodectic mange: Demodex species enters the hair follicles and sebaceous glands producing a chronic inflammation with proliferation and thickening of the epidermis and loss of hair. It can be easily detected at the raw material stage. It can be a major cause of downgrading skin quality at the tannery (ESGPIP, 2009). In bovine demodicosis the most important effect is the formation of many pea-sized nodules, each containing caseous material and several thousand mites which cause hide damage and economic loss. Though these nodules can be seen in smooth coated animals, they are often undetected in rough coated cattle until the hide has been dressed (Urquhart *et al*., 1996). The dilated follicles vary in size from that of a pin-head to a chicken egg. Not uncommonly, the larger nodules rupture to produce suppurative sores. Skin damage resulting from these ruptured nodules can cause defects in raw leather and significant economic losses to the tanning industry in the form of diminished quality of processed cattle hides (Mullen and Durden, 2009). Demodectic mange lesions can be detected fairly easily by examining the flesh side of air dried skins, noting the round “cheesy” yellow spots and the dried lesions in the hair. During early tanning process this cheesy mass is washed out leaving empty pockets, thus, producing a pitted and scared grain surface. Other mange lesions (scabies) produce a coarse

grain and scratch scars (FAO, 1995). Demodectic mange has been reported in sheep (*Demodex ovis*) and goats (*Demodex caprae*). Studies in Ethiopia have indicated that it is one of the major skin diseases of sheep and goats (Molu, 2002).

Sarcoptic mange: *Sarcoptic scabiei varcaprae* and *Sarcoptic scabiei varovis* have a wide geographic distribution in many goat and sheep rearing in arid and semi-arid areas of Ethiopia, and it is more commonly seen in goats than sheep in Ethiopia, they are widely distributed in lowland mainly (Yacob*et al.,* 2008a; Mulugeta *et al.,* 2010; Asnake *et al.,* 2013), low and midlands (Kumsa *et al.,* 2012), as well as central midland part of the country (Yacob *et al.,* 2008b).This is chronic mange that may affect large areas of the body. It is the most common cause of mange in cattle, sheep and goats. The skin lesions are wide spread and can cover the whole body. There is itching and loss of hair. The skin becomes thickened and folded in affected areas. Scales and crust develop on the skin surface. As the skin becomes more damaged it loses its power to protect the animal against secondary bacterial infections (ESGPIP, 2009).

Psoroptic mange: Mites of the genus Psoroptes cause psoroptic mange in cattle, sheep and goats. In sheep, the condition is known as sheep scab. As with sarcoptic mange in goats, the skin lesions can be widespread and mange cases are often fatal. There is itching and loss of hair or wool. The skin becomes thickened and folded in affected areas. Scales and crusts developed on the skin surface, as it becomes more damaged it loses its power to protect the animal against secondary bacterial infections (ESGPIP, 2009).The effect of tanning is not as severe as in sarcoptes, although the grain surface of the tanned skin become rough (Green, 1967)

Chorioptic mange: This type of mange is caused by chorioptic mange mites known as *Chorioptes* spp. This condition is often referred to as leg mange or foot mange because of the distribution of the lesions, which are usually limited to the lower limbs extending up the limbs to affect the scrotum in males or udder in females. Chorioptic mange is characterized by the production of crusts and flaking especially on the backs of the feet. It causes the downgrading of skins to the tanneries (ESGPIP, 2009).

Sheep ked*:* Sheep keds are wingless flies brown in color. They are found on goats but are more commonly seen in sheep. Keds suck blood and can cause anemia as well as skin irritation. Sheep ked *Melophagus ovinus* is more prevalent in highlands than midlands and no cases yet recorded in lowlands in the country. The prevalence of "Ekek", an Amharic word for itch, lesion in *Bovicola ovis* and *Melophagus ovinus* infested groups of sheepskin were 100% and 95%, respectively. Infestation of sheep with *Bovicola ovis and Melophagus ovinus* leads to the development of "Ekek" and causes higher proportion of skins to fall into the lower grades (Tefera and Abebe, 2007a). Ermias (2000) unveiled that from the freshly examined sheep pelts 32.7% had *Melophagus ovinus* in Sebeta Tannery.

Lice: Two types of lice affect ruminants, biting (chewing) lice and sucking lice. Biting lice are brown in color and mobile. Affect cattle and small ruminants. They feed by chewing on the skin surface and surface debris. Biting lice produce itching, irritation and possible hair loss. Lice infestation in Ethiopia is the most frequently reported and the most important skin disease of small ruminants this is because lice are found to be the cause of cockle. According to Tefera and Abebe (2007), *Bovicola ovis* and *Linognathus* spp. are the two species with prevalences in sheep of 38.5 and 2.4%, respectively while in goats *Linognathus* species has prevalence of 28.3%. Nowadays, pediculosis is a serious health problem of small ruminants in Ethiopia. The highest prevalence was recently reported in sheep from Assela by Hailu (2010), who identified *Linognathus* spp (75.5%), *B. ovis* (67.1%), *Linognathus ovillus* (14.6%) and *B. ovis* (36.1%). Lice infestation in Ethiopia is the most frequently reported and the most important skin disease of small ruminants this is because lice are found to be the cause of cockle. Tefera and Abebe (2007b) in their research indicated that *Bovicola ovis* and Linognathus species in sheep has a prevalence of 38.5% and 2.4% respectively. In goats Linognathus species has prevalence of 28.3%. keds and lice are considered a major cause of cockle and are visible on the skin surface of affected animals (Kidanu, 2001). It is a defect which appears on the grain side of semi-processed and crust leather after pickling that cannot be detected when the skin is examined raw or unprocessed. It results in huge economic loss to tanneries and the country at large since the damage is recognized after a lot of cost incurred on the processing after which the damaged skins have to be rejected or downgraded (Kassa, 2006).

Ticks: Is belong to Arthropod phylum and to the class of Arachinindae sub class *Ixodidae*, for domestic animals they are the most dangerous and most wide spread of ectoparsites and disease vectors. Tick occurs in the temperate as well as in to the tropics and sub tropics regions of the world. They adversely affect animal health especially in the tropics. The losses have been estimated in the range of USD 7 billion, annually, with 80% of the world cattle population of approximately 1.24 million at risk from tick and tick borne diseases (McCosker, 1979).There are numerous types of ticks that affect cattle, sheep and goats in Ethiopia. Ticks attach to the skin of animals and feed on blood of the animal host by the use of piercing mouth parts. Ticks can affect skin quality in two ways. The penetration of the skin by the piercing mouth parts makes holes which are defects in processed skins; such skins give "ticked" leather, which is of inferior quality (Henderson, 1991). When feeding, ticks can allow bacteria to pass through the skin leading to the development of local abscesses which damage skin quality more extensively than the holes caused by feeding (ESGPIP, 2009). The economic impact of tick infestations is enormous in Ethiopia with a conservative estimate of one million Ethiopian Birr (over 55 thousand USD) loss annually was made through rejection and downgrading of hides and skins due to effect of ticks (Kassa, 2006).

Defects due to mechanical Causes: most noticeable defects on hide and skin like brand marks, scratches, scars and bruises are caused by mechanical means. Scratches are very common types of lesions caused mechanically by thorns, barbed wires and horns; whereas branding is farmers, made by owners for animal identification and traditional result healing purposes (Kassa, 2005).

Brand mark/ branding: Permanent mark applied to the hair/grain side either by a hot or freezing iron type device, location determines hide classification (USA hide, skin and leather association, 2014). Branding costs the leather industry large amounts of money due to the wasted portions of the hides. The loss of value is dependent on the placement of the brand. A side or rib brand can commonly cost $10.00 in value, and other location, such as hip brands, can cost $5.00 in value (Stanton, 1995). Hot iron brands can cause scar tissue to form through the thickness of the hide. From surveys, Schraeder and Christopher (1999),

determined that branding was used to deter the theft of cattle and was also a sense of pride to the cattle owner.

Housing and fencing: The issue of housing and fencing is a management problem and therefore requires appropriate steps to reduce damages to the hide/skin of an animal. Some of such damages include pricking, scratches, drag marks and dunging. Indeed these damages affect the grain layer (Leather surface of the corium layer) which after tanning, lowers' the quality of leather grades and utility in resultant leather goods processing. In particular dunging predisposes the hides or skin to microbial action serving as a good medium for microbiological activity eventually destroying the final quality of the leather surface (Mwinyihija, 2006).

2.6.2. Peri and post slaughter defects

Poor pattern: This is the shape of a skin formed by unaccepted pattern of ripping before flaying. A bad pattern obviously affects the utilization of the leather produced and reduces the marketability of the finished product. The pattern of a skin, on being laid out, does not conform to the standard or correct pattern adopted by the trade, more simply, it is asymmetric and parts of it are displaced from the accepted position. The fiber structure is abnormal in the part transposed by the asymmetric cutting (ESGPIP, 2009).

Putrefaction: Bacterial and enzymatic breakdown, rotting HS. Hide and skins should be preserved within short period of time, after removed from the carcass to avoid bacterial growth and decomposition of the skin that downgrade the quality of hide and skin it is a commonly seen post slaughtering problem due to improper preservation, exposure of the hide or skin to rain during transportation. Hair slip is the first sign of putrefaction, if hair slip is not checked putrefaction starts from both the grain and flash side leading to decomposition of the grain layer and the flesh side and in advanced cases complete disintegration of the corium may occur (ESGPIP, 2009).

Poor bleeding / veininess: If the carcass is not well bled-out at the time of slaughtering, blood remains in the vessel and capillaries of the hides and skins. As a result bacteria then develop more rapidly and the veins may show up clearly (in an unsightly way) on the grain

surface of the leather (Mann, 1960). The area with the congealed blood has a degrading effect to the leather quality. Veiny leather is the result of blood vessels of in the skin where the blood is not completely drained poor through proper bleeding. This is an unwanted effect which shows very clearly in suede leather. Veininess is a prominent defect in goat skins and very prominent in glazed kid leather (Desta, 2008).

Flay cuts/hole: Damage caused by careless use of a knife during flaying, sometimes cutting through the skin. Complete perforation of the hide or skin accidentally made by knife. Flay cut, gouge marks and scores are caused during flaying period through use of sharp pointed knives. This subsequently reduces the quality and use of leather.

Gouges: Knife damage to the skin during flaying, taking out scooped portions of the corium. (Thinning of the hide and skin by knife of flaying appliance).

Siding or corduroying: A series of shallow and parallel streak appearing on the hide or skin as a result of poor flaying.

Crack: If dried hides are allowed to be flint dry before folding the fiber get ruptured and there will be cracks due to grain rupture. In frame drying improper lacing and too much tension will cause distorted shape and rupturing of fibers in thinner portions leading to leather with lower breaking strength and looser structure (ESGPIP, 2009).

3. METHODS AND MATERIALS

3.1. Study Area

The study was conducted from December 2014 to April 2015 in two purposively selected woredas of East Arsi Zone (Dodota and Hitosa woredas), in tanneries (Colba and Gelan at Modjo) and Organic export abattoir at Modjo town. Hitosa is one of the 180 woredas in the Oromia regional state, part of the Arsi Zone. The altitude of this woreda ranges from 1500 to 4170 meters above sea level (masl); mount Chilalois the highest point. The livestock population of the Hitosa woreda is estimated as 144,851cattle, 62,976 sheep, 44,819 goats, 3,842 horses, 27,973 donkeys 586 mules and 370,546 poultry (HWAPHO, 2015). Dodota is another woredas in Arsi Zone located in the Great Rift Valley. It's part of former Dodotana Sire woreda which was divided into Dodota and Sire woredas. The altitude of this woreda ranges from 1400 to 2500 masl. Dodotona-Sire woreda produced 4.3% of the total amount of hides and skins in Arsi Zone. The livestock population of the woreda is estimated as, 34,473 cattle, 23,161 sheep, 17,200 goats, 1906 horses, 8,103 donkeys and 30,566 poultry**.** (DWAPHO, 2015).

The organic export abattoir as well as Colba, and Gelan tanneries are found in Modjo town. Modjo town is one of the towns of the East Shoa Zone of Oromia Region,located 75 km south east of Addis Ababa situated between 8°35′N latitude and 39°10′E longitude at an altitude of 1,777 masl (CSA, 2008). Gelan tannery obtains sheep and goat skins for processing from skin collection centers in and around the East Arsi Zone, Addis Ababa and Sheno and it had a soaking capacity of 2,000 sheep and 1,000 goatskins per day. Whereas, Colba tannery get cattle hide, sheep and goat skins from its main collection centers in Arsi, Adama, Bishoftu, and Addis Ababa as well as from sheep and goats slaughtered at Modjo modern export abattoir. The tannery has a soaking capacity of 400 to 500 hides and 9,000 pieces of sheep and goat skins per day (kebede, A. Personal communication).

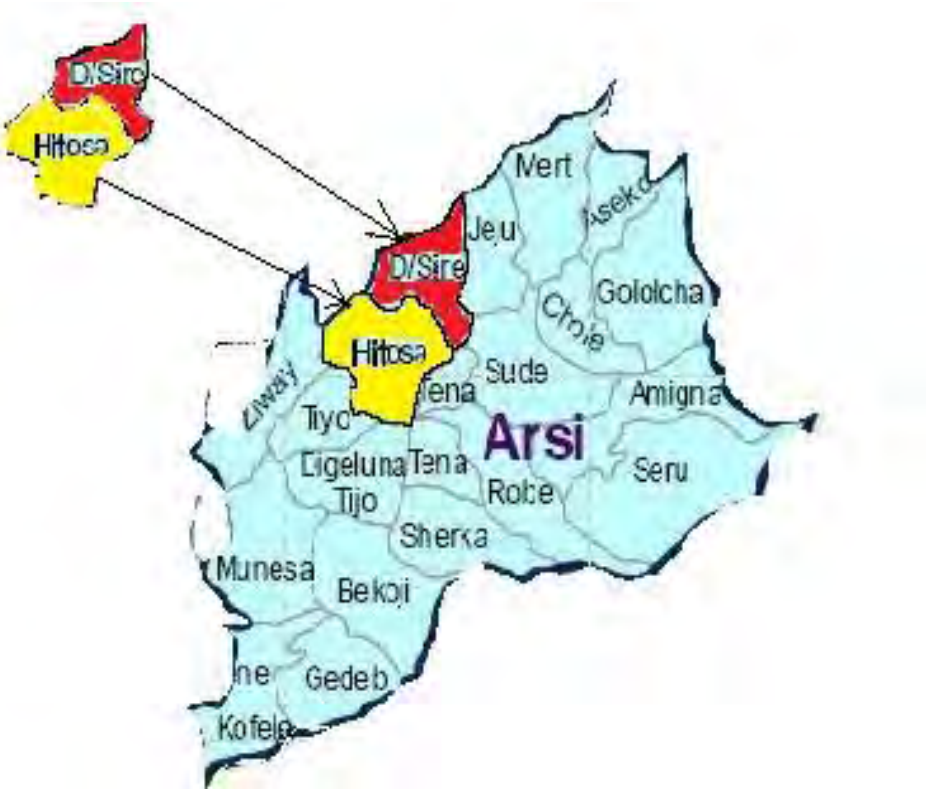

Figure 2: Map of the study area

3.2. Study population

For the questionnaire survey, the study population consisted of all farmers that keep livestock in the two woredas. Besides, for the raw hide and skin defect assessment, the study population included all hide and skins supplied to major collection centers on the main market days of the week. Similarly, those hide and skin bought from the study area after reaching to their destination, cattle hide at wet blue stage in Colba, and sheep skin at pickle and goat skin at wet blue stage in Gelan tannery were randomly sampled and type of defect and their grading value were registered on pre-prepared data collection sheet (Appendix, 2).

On the other hand, for the assessment of the relation between carcass quality and skin defects, the skins and carcass of goats slaughtered at organic export abattoir whose carcass

bear nodular lesions and skins and carcass obtained from those that were free of the lesion were taken as a study population.

3.3. Study design

A cross-sectional study design was employed to study the animal management practice in relation to hide and skin, animal slaughtering technique they used, and hide and skin management during and post slaughtering. In addition, to assess major skins diseases of animals and the status of the veterinary service in the study area a focus group discussion method was involved.

For the identification of defects on raw and processed hide and skins at collection centers and the two tanneries again a cross-sectional study was carried out. Furthermore, for the evaluation of processed skins removed from carcass of goats with nodular lesions and those free from the lesion a comparative study was conducted.

3.4. Sample Size Determination and Sampling Method

3.4.1. Questionnaire survey

A random sampling technique was used to select livestock owners for the questionnaire. The household was selected from ten purposively selected kebeles of the two woredas. The sample size was determined using the formula recommended by Ashram (2007), for formal studies.

$$n = \frac{0.25}{SE^2}$$

Where,

n = sample size

SE= standard error,

The required sample size was calculated at a standard error of 5%, 0.05 precision and 95% confidence level. Accordingly, 100 livestock owners were incorporated in the questionnaire survey.

3.4.2. Observational study

For the observational study sample size of hides and skins required for the examination of pre-and post-slaughter defects at collection centers and in the tanneries was calculated using the formula described by Thrusfield (2005).

$$n = \frac{1.96^2 P_{exp} (1-P_{exp})}{d^2}$$

Where,

n = required sample size

P_{exp} = expected prevalence

d^2 = desired absolute precision

Based on the above formula, with the assumption of 50% expected prevalence as there were no reports from study, 95% level of confidence (CL), and 5% desired level of precision the sample size was calculated as 384 for skins of each animal species. Accordingly, 1,152 (384 cattle hide, 384 sheep and 384 goat skins) were selected for the study.

3.4.3. Nodular carcass observation

Purposive sampling technique was conducted for nodular carcass and its skin association with its skin quality. 30 goats skins that have carcass nodular lesions and apparently normal carcass were purposely selected and sampled to determine the association between carcass lesions and defects on their skins after processed.

3.5. Data Collection

3.5.1. Questionnaire survey

A total of 100 households (50 from Hitosa and 50 from Dodota) were randomly selected from the two woredas and interviewed using a pre-prepared structured questionnaire (Appendix, 1). They were interrogated for husbandry practices of livestock in relation to hide and skin quality, practice of animal slaughtering and post-slaughter hide and skin management.

3.5.2. Hide and skin observation

Data from the selected hide and skin collectors and tanneries were gathered using formats. Besides, the hides and skins arrived at these study points were randomly observed, the possible defects were identified and then registered on a pre-prepared checklist according to the findings. Furthermore, investigations were made on fresh cattle hide, sheep and goat skins which were supplied by producers or small traders to the main collectors in Eteya and Dera town of Hitosa and Dodota woreda respectively. Hides and skins collected from the study areas were inspected for defects after being processed in the two selected tanneries. Accordingly, hides were examined for defects at wet blue stage in Colba tannery, while goat and sheep skins were assessed for the presence of defects at Gelan tannery at wet blue and pickled stage, respectively. The hides and skins sourced from the study areas were stored separately and processed in different batch. Identification of defects and subsequently grading was done based on their defect or usable area according to the standard set by the Ethiopian Quality Standard Authority (ESQA, 2008) and under the guidance of hide and skin selectors of the company in visible selection spot/ area and the result were registered on the pre prepared registration sheet (Appendix, 5).

Various forms of skin defects appearing beyond 2.5 cm in sheep and goat skin and cattle hide from the edges towards the center of the skin like holes, poor pattern (loose fiber), dirt, gouge-marks (thinning of the skin caused by knife), corduroying (a series of shallow and parallel streaks appearing on the skin due to poor flaying), and heating (putrefaction of skin revealed by a premature loss of the hair) scar, scratch and cockle lesions were registered

from grain and flesh surfaces of raw and processed hide and skin. The definition of the defects presented on page 14-23.

Goat skin from export abattoir was sampled after partial skinning, goat carcasses (mainly glutial, longismus muscle and hind leg/thigh muscle areas) were observed for the presence of nodular lesion with subsequent removal of skin for examination. Skin scrap sample were taken from removed skin for parsitolgical microscopic laboratory diagnosis, then the skin was tagged, preserved and submitted to Gelan tannery for possessing, where circular identification mark were given by knife cut on the neck region to differentiate from the other goat skins soaked together, after processed and at wet blue stage the assessment of skin defects and grading was made and registered on the prepared sheet. The skin scrap that was taken from 60 of them was preserved in 10% formalin then submitted to AAU veterinary parasitological laboratory for microscopic ectoparsites diagnosis.

3.6. Data Management and Analysis

Data were collected, coded, entered, managed and stored into Microsoft Excel and analyzed using Statistical Package for Social Sciences (SPSS, version 20) software. Descriptive statistics were used to analyze data. The Chi-square (X^2) test were used to observe the association between species and skin defect and the skin quality of nodular carcass and nodule free skin.

4. RESULTS

4.1. Questionnaire Survey

4.1.1. Socio-demographic characteristics

Overall, 100 livestock owners were interviewed for the assessment of their awareness on skin defects. The socio demographic characteristics of the respondents are as follows. The sex of the respondents was male (95%) and female (5%).The age ranges from 26 to 64 years old and the average age was 44 years. Majorities (97.3%) of the respondents were illiterate, however, 2.7% of them were able to write and read (Table 1).

Table 1: Socio-demographic characteristics of the respondents in the study areas

Characteristics		District		Total
		Hitosa	Dodota	
Sex	Male	46	49	95
	Female	4	1	5
Age	Young	2	7	9
	Adult	44	39	83
	Elderly	4	4	8

Majorities (91%) of the respondents from both Hitosa and Dodota woredas rear cattle for ploughing whereas only 9% of them keep cattle for both ploughing and milk production. Most of the respondents, 74% (Hitosa) and 92% (Dodota) utilize sheep and goat for both household consumption and income generation. Furthermore the respondents disclosed that

equines are mainly used as pack animals while poultry are kept for meat, sale and egg production.

4.1.2. Assessment of pre slaughter management practices

In the assessment of the awareness and practices of livestock owners, 40% of the respondents from Hitosa and 48% from Dodota stated that they care for the hide and skin irrespective of the purposes for which the animal is raised. Their reasons were to keep their animal healthy and hence the quality improvement of the hide and skin was secondary to this value. Of the respondents, 98% of them from Hitosa and 68% from Dodota described housing of their animals during the night. The nature of the house for animals was muddy floor in 96% and 62% of the respondents from Hitosa and Dodota woreda, respectively. Few respondents from Hitosa (8%) brand their cattle for the purpose of identification and disease treatment whereas those from Dodota did not practice at all. Seventy-four percent of household respondents from both woredas were aware of the negative impacts of improper management of live animals on hide and skin quality. In both woredas, almost all the respondents practice home slaughter. They slaughter their cattle on the ground without stunning. Sheep and goats are hoisted for finishing after slaughter. All respondents claim to use straight sharp tipped knife for ripping slaughtered animals. On the other hand, 76% of the respondents from both areas use both straight sharp tip and curved sharp tipped knife for flaying while 24% used only curved sharp tipped knife for flaying purpose.

4.1.3. Post-slaughter hide and skin management practice

The current study on the assessment of livestock owners' practices in relation to hide and skin management showed that 41% of the farmer respondent from both woredas practice one or more types of preservation methods whereas the vast majority sell hide and skins in fresh state. Among these, 27% of them reported to use wet-salting and 14% of them use ground drying. The survey result also indicated that the respondents keep home the hide and skin unpreserved before selling for different period of time (Table, 2)

Table 2: Period of time that producer keep home the hide and skin unpreserved before they sale

no	Period of time kept home unpreserved	woreda	
		Dodota	Hitosa
1	6 hours	-	2%
2	12 hours	16%	18%
3	24 hours	38%	46%
4	2 days	22%	22%
5	More than 2days	24%	12%
	Total	100	100

Personal observation and discussion with responsible experts as well as hide and skin traders in both woredas showed that the hide and skin marketing areas were unshaded (exposed to direct sunlight) and muddy or full of dust. Moreover, the purchased hide and skin on specific market day remained for long hours under direct sunlight on market days. Furthermore, the stores to hide and skin in both the study woredas were not constructed in standardized ways and they were not well ventilated, had not enough space, the floors were not cemented and inclined for drainage (Figure 3, 4).

Figure 3: Plastic bags used for transportation of skin sold at unshaded hide and skin collection point at Eteya market

Assessment of knowledge on the impact of improper preservation revealed that only 56% of the respondent knew the impact of improper preservation on the quality of raw hide and skin. According to the respondents, reasons for delay in selling are market inaccessibility, absence of giving priority so that waiting the next market day is a common practice and unattractive market price. Almost all the respondents reported to use plastic bags to transport skin to market places or collection centers. Observation on hide and skin collection centers witnessed that the rooms lack cleanness with reminants of flesh except one in Boru kebele of Hitosa woreda. It was also seen that immediate salting after buying was not a common practice. Hence, the hide and skins found in the hands of collectors are often seen putrefied and produced bad smell. This is exacerbated by the already poor quality raw materials supplied being packed in plastic sacks (Figure, 4) without being aerated while they are transported to the main suppliers found in Eteya town.

Figure 4: Improper storage and transportation from Dera town and from pocket villages to Eteya main hide and skin collection store

4.1.4. Constraints on hide and skin management

An assessment on major constraints on hides and skin management indicated that 98% and 100% of the respondents from Dodota and Hitosa, respectively replied that, there were no extension services regarding pre-and post-slaughter management of hide and skins. Feed shortage and inadequate veterinary services were also mentioned as major constraints that could ultimately contribute to lower hide and skin quality. On focused groups discussion (FGD) and an inquiry presented to veterinarians in Dodota and Hitosa districts, major skin diseases and ectoparaites of cattle in order of their importance were lumpy skin disease (LSD), lice, ticks, abscess and mange. Similarly, diseases or pests of sheep and goats in order of priority were shoat pox, lice, mange, ticks and abscess which were supposed to affect the quality of the skin.

Author's personal observation show that there were no slaughtering facility in Hitosa woreda and slaughtering was done in an open space reserved for this purpose. On the other hand there was a small slaughter slab in Dodota woreda that had cattle hide preservation and storage facility. The hide and skin collected in Eteya by main collection centers stay for three to four months before being supplied to tanneries. The major reason was delay in back payments from tanneries.

4.2. Observational Study on Hide and Skin Defects

4.2.1. Defects of raw/unprocessed hides and skins

Hides

The present study showed that, one or more defects were observed in all (n=386) examined raw hides. The type of defects and their prevalence were corduroying, followed by flay cut, gouge mark, dirt, flesh remnants, horn gouge and bruising (Table, 3).

Table 3: Number of defects (%) observed in raw hide in the study area

Type of defects/parasites/ observed	Number of hides with defects (N=386)	Percent
Corduroying or siding	286	74.1
Flay cut or hole	283	73.3
Gouge mark	260	67.4
Dirt	167	43.3
Skin parasite and diseases(lice, tick, mange and LSD)	25	6.5
Poor pattern	23	6.0
Scar/wound	15	3.9

Sheep and goat skins

The study revealed that, all raw skins sampled from 388 sheep and 384 goats were found with at least one defect. In sheep skins, there was a higher prevalence of flay cut/hole (31.4%) followed by dirt (26.5%) whereas, a higher prevalence of dirt (20.8%) was observed in goat skins which was followed by flay cut/hole (16.4%) and corduroying and other defects (Table 4, Figure, 5).The prevalence of lice, poor pattern, flay cut, dirt and bruising were significantly higher ($P<0.05$) in sheep than goat skins while remained flesh on skin and poor substance were significantly higher ($P<0.05$) in goat than sheep skin.

Table 4: Number (%) defects detected in comparison between raw sheep and goat skins observed

Types of defects and parasites observed	Number of defects (%)		*P*-Value
	Sheep raw skin N=388	Goat raw skin N=384	
Lice	17(4.4)*[a]	6 (1.6)	0.022*
Mange (alopecia)	12(3.1)	11(2.9)	0.857
Pox lesions	3(0.8)	0 (0.0)	0.08*
Bruising	38(9.8)	6 (1.6)	0.000*
Flay cut/hole	122(31.4)	63(16.4)	0.000*
Corduroying /siding	65(16.8)	54(13.8)	0.261
Gouge mark	44(11.3)	39(9.9)	0.523
Remained flesh on skin	68(17.5)	41(10.7)	0.007*
Dirt	103(26.5)	80(20.6)	0.053*
poor pattern	27(7.0)	10(2.6)	0.005*
scar/wound	6(1.5)	4(1.0)	0.538
Putrefaction	28(7.2)	18(4.7)	0.140
Small size	34(8.8)	35(9.1)	0.855
Poor substance	0(0.0)	5(1.3)	0.024*

* Statistically significant *[a]. Figures in parentheses are percentages

Figure 5: Necrotic pox like lesion on raw sheep skin (Eteya collection center East Arsi zone)

4.2.2. Defects on processed skins and skins

Processed hide and skin grades

Proportion of grades on processed cattle, goat wet blue and sheep pickled stage were presented in table 5. Three hundred eighty nine cattle hide and 399 goat skins at wet blue stage and 385 pickled sheep skin were graded according to standard criteria at tannery. Accordingly, only few cattle hide went into first grade. There were very few or none sheep and goat skin in the second and third grades whereas majority of both hide and sheep/goat skin were in the grades from 4-7 (Table, 5). Significant number of hides and skins are classified as reject (grade 7).

Table 5: The proportion % of grades on cattle, goat wet blue and sheep pickled stage

Type of skin	**Grade**						
	1	**2**	**3**	**4**	**5**	6	**7**
Sheep skin	0 (0.0)	7 (1.8)	47 (12.2)	85 (22.1)	77 (20.0)	80 (20.8)	89 (23.1)
Goat skin	0 (0.0)	0 (0.0)	1 (0.3)	69 (17.3)	135 (33.8)	107 (26.8)	87 (21.8)
Cattle hide	8 (2.1)	8 (2.1)	18 (4.6)	56 (14.4)	73 (18.8)	115 (29.6)	111 (28.5)

*figures in parentheses are percentages

Defects on cattle hide at wet blue stage

A total of 389 cattle hide were examined for the occurrence of defects after being processed in Colba tannery and all revealed one or more defects. The study showed higher prevalence of flay cut followed by gouge mark, putrefaction, corduroying, scratch, scar and cockle / ekeke (Table, 6, Figure 6).The prevalence of flay cut, gouge mark, putrefaction, brand mark and machine defect were significantly higher ($P < 0.05$) in processed cattle hide than processed sheep and goat skin while cockle/ekeke, veininess , crack and poor substance were significantly higher ($P < 0.05$) in sheep pickled, goat wet blue skin than cattle wet blue hide.

Table 6: Number and percents of defects detected on hide wet blue stage

Type of defects observed	**Wet blue Cattle hide N=389**	
	Number of defects	**Percent**
Flay cut	230	59.1
Gouge mark	164	42.2
Corduroying	137	35.2
Purification	137	35.2
Scratch	110	28.3
Scar	78	20.1
Cockle/ekeke	49	12.6
Brand mark	25	6.4
Machine defect	22	5.7
Wound	21	5.4

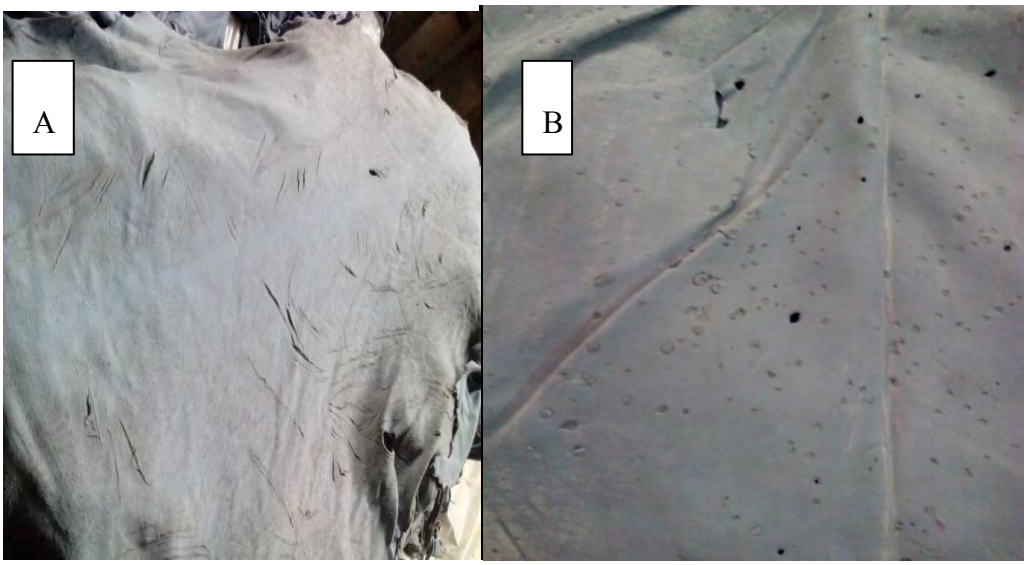

Figure 6: A) Flay cut and corduroying on cattle wet blue hide at Colba tannery

B) Pox like defects on cattle wet blue rejected hide at Colba tannery at Modjo

4.2.4. Distribution of defects to hide and skin quality grades

The distribution of skin defects in different quality grades on cattle hide processed at wet blue stage is presented in table 7. Flay cut was most important in quality grade 2-7 especially in quality grads 5-7 in a higher proportion comparing with the higher quality grades 1-3 and gouge mark, corduroying, putrefaction and machine defects which were distributed along all grades (in quality grades1-7). The other defects scratch, scar, pox, crack, brand mark and poor pattern were distributed in higher proportion in lower grades 4-7.

Table 7**:** Distributions of defects on cattle wet blue stage in different grades

Type of defects	**Grade**							**Total**
	1	**2**	**3**	**4**	**5**	**6**	**7/reject**	
Cockle/ekeke	0(0.0)*	0(0.0)*	0(0.0)	1(0.9)	2(1.2)	14(4.6)	32(8.0)	49
scratch	0(0.0)	0(0.0)	4(16.7)	12(11.9)	16(9.8)	30(9.8)	48(12.0)	110
Flay cut	0(0.0)	4(28.6)	5(20.8)	25(24.8)	50(30.9)	68(22.1)	78(19.6)	230
Scar	0(0.0)	0(0.0)	4(16.7)	3(3.0)	7(4.3)	29(9.4)	35(8.8)	78
Crack	0(0.0)	0(0.0)	0(0.0)	4(3.9)	1(0.6)	2(0.7)	3(0.8)	10
Corduroying	3(27.3)	3(21.4)	4(16.7)	13(12.9)	30(18.5)	44(14.4)	40(10.0)	137
Gouge mark	5(45.5)	2(14.3)	3(12.5)	27(26.7)	27(16.6)	53(17.3)	47 (11.8)	164
Veniness	0(0.0)	0(0.0)	0(0.0)	1(0.9)	0(0.0)	2(0.7)	0(0.0)	3
Purification	2(18.2)	3(21.4)	3(12.5)	5(5.0)	13(8.0)	45(14.7)	66(16.6)	137
Poor pattern	0(0.0)	0(0.0)	0(0.0)	2(1.9)	3(1.9)	2(0.6)	4(1.0)	11
Pox	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	2(0.5)	2
Machine defect	11(9.0)	1(7.1)	1(4.2)	3(2.9)	2(1.2)	5(1.6)	9(2.3)	22
Brand mark	0(0.0)	0(0.0)	0(0.0)	1(0.9)	3(1.8)	5(1.6)	16(4.0)	25
Poor pattern	0(0.0)	0(0.0)	0(0.0)	2(1.9)	3(1.9)	2(0.7)	4(1.0)	11
wound	0(0.0)	1(7.1)	0(0.0)	2(1.9)	4(2.5)	4(1.3)	10(2.5)	21
Tick hole	0(0.0)	0(0.0)	0(0.0)	0(0.0)	1(0.6)	2(0.7)	3(0.8)	6
Total defects	11	14	24	101	162	307	397	1016

*Figures in parentheses are percentages

Defects on pickled sheep skin and wet blue goat skin

The prevalence of different defects on pickled sheep skin and wet blue goat skin examined in Gelan tannery is presented in table 8. On the assessment of sheep pickled skin, the study showed higher prevalence of cockle / ekeke, followed by gouge mark, scratch, flay cut, putrefaction, scar and crack. The prevalence of defects on goat wet blue skin is presented in table 8, and their prevalence according to their importance were cockle/ekeke, veininess, crack, scratch, gouge mark, flay cut, scar and corduroying. The prevalence of cockle / ekeke, veininess, scar, corduroying, crack, gouge mark, poor pattern and brand mark were significantly higher ($P<0.05$) in goat skins at wet blue stage where as putrefaction and shoat pox were significantly higher ($P<0.05$) in sheep skin at pickled stage than goat wet blue skin. On defects like scratch, flay cut, poor pattern and machine defect in sheep and goat skin there was no statistically significance ($P>0.05$) difference .

Table 8: Comparison of defect prevalence and proportion between sheep and goat skins after processed

Types of defects	Pickled Sheep N= 385	Wet blue Goat skin N= 399	*P*-value
	Number of defects (%)	Number of defects (%)	
Cockle/ekeke	142(36.9)*[a]	192 (48.1)	0.001*
Scratch	104(27.0)	127 (31.8)	0.139
Flay cut	58(15.1)	75 (18.8)	0.164
Scar	46(11.9)	167(41.9)	0.000*
Crack	22(5.7)	150(37.6)	0.000*
Corduroying	44(11.4)	166(41.6)	0.000*
Gouge mark	37(9.6)	79 (19.8)	0.000*
Veniness	38(9.9)	178(44.6)	0.000*
Putrefaction	58(15.1)	14 (3.5)	0.000*
Poor pattern	29(7.5)	19 (4.8)	0.106
Pox	12(3.1)	4(1.0)	0.036*
Brand mark	0(0.0)	14 (3.5)	0.000*
Machine defect	7(1.8)	3 (0.8)	0.183
Poor substance	6(1.6)	0(0.0)	0.012*
Ring worm	2(0.5)	0(0.0)	0.149
Tick hole	0(0.0)	1 (0.3)	0.326
wound	0(0.0)	1 (0.3)	0.326

* Statistically significant; *[a] Figures in parentheses are percentages

4.2.6. Distribution of defects on different grades of sheep skin at pickled stage

The distribution of skin defects in different quality grades on sheep pickled stage is presented in table 9. Ekek/cockle, scratch, scar, flay cut and venines were distributed from grade 2-7. Whereas corduroying, gouge mark, putrefaction, crack and poor pattern were distributed from grade 3-7. Moreover, Cockle, flay cut and scratch were highly distributed in grade 7/reject.

Table 9**:** Distribution of defects on sheep pickled stage in different quality grades

Type of defects	**Grade**							**Total**
	1	**2**	**3**	**4**	**5**	**6**	**7/reject**	
Cockle/ekeke	0(0.0)	1(14.3)	14(26.9)	28(24.3)	30(21.7)	27(19.4)	42(27.3)	142
Scratch	0(0.0)	1(14.3)	12(23.0)	18(15.7)	31(24.5)	26(18.7)	16(10.4)	104
Flay cut	0(0.0)	2(28.6)	3(5.8)	10(8.7)	13(9.4)	11(7.9)	19(12.3)	58
Scar	0(0.0)	1(14.3)	3(5.8)	3(2.6)	12(8.7)	12(8.6)	15(9.7)	46
Crack	0(0.0)	0(0.0)	5(9.6)	4(3.5)	4(2.9)	7(5.0)	2(1.3)	22
Corduroying	0(0.0)	0(0.0)	3(5.8)	11(9.7)	12(8.7)	13(9.4)	5(3.3)	44
Gouge mark	0(0.0)	0(0.0)	2(3.8)	2(1.74)	13(9.4)	13(9.4)	7(4.6)	37
Veniness	0(0.0)	2(28.5)	4(7.7)	19(16.5)	8(6.0)	2(1.4)	3(2.0)	38
Purification	0(0.0)	0(0.0)	5(9.6)	11(9.7)	11(8.0)	19(13.7)	12(7.8)	58
Poor pattern	0(0.0)	0(0.0)	1(1.9)	8(7.0)	3(2.2)	4(2.9)	13(8.4)	29
Pox	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	3(2.2)	9(5.8)	12
Machine defect	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	7(4.6)	7
Ring worm	0(0.0)	0(0.0)	0(0.0)	1(0.9)	0(0.0)	1(0.6)	0(0.0)	2
Poor substance	0(0.0)	0(0.0)	0(0.0)	0(0.0)	1(0.7)	1(0.6)	4(2.6)	6
Total defects in grade	0	7	52	115	138	139	154	605

* Figures in parentheses are percentages

4.2.7. Distribution of defects on different grades of goat skin at wet blue stage

The distribution of skin defects in different quality grades on goat wet blue stage is presented in table 10.veininesw as distributed from grade 3-7. Whereas cockle, scratch, flay cut, scar, crack, corduroying and putrefaction were distributed in the lower grades 4-7. Moreover cockle (ekek), scar, crack, scratch corduroying and gouge mark were highly distributed in grade 7/reject.

Figure 7: Observation of defects and grading wet blue goat skins in properly prepared and lighted point at Gelan tannery in Modjo

Table 10: Distribution of defects on goat wet blue stage in different quality grades

Type of defects	Grade							Total
	1	2	3	4	5	6	7/reject	
Cockle	0(0.00)	0(0.0)	0(0.0)	18(12.8)	65(17.5)	58(16.2)	51(16.0)	192
Scratch	0(0.00)	0(0.0)	0(0.0)	10(7.0)	43(11.6)	33(9.2)	41(12.9)	127
Flay cut	0(0.00)	0(0.0)	0(0.0)	5(3.5)	19(5.1)	30(8.4)	21(6.6)	75
Scar	0(0.00)	0(0.0)	0(0.0)	11(7.8)	52(14.0)	56(15.6)	48(15.0)	167
Crack	0(0.00)	0(0.0)	0(0.0)	12(8.5)	43(11.6)	50(13.0)	45(14.1)	150
Corduroying	0(0.00)	0(0.0)	0(0.0)	28(19.9)	63(16.9)	43(12.0)	32(10.0)	166
Gouge mark	0(0.00)	0(0.0)	0(0.0)	4(2.8)	18(4.8)	25(7.0)	32(10.0)	79
Veniness	0(0.00)	0(0.0)	1(10.0)	48(34.0)	54(14.6)	48(13.4)	27(8.5)	178
Putrefaction	0(0.00)	0(0.0)	0(0.0)	2(1.4)	4(1.0)	5(1.4)	3(0.9)	14
Poor pattern	0(0.00)	0(0.0)	0(0.0)	2(1.4)	6(1.6)	6(1.7)	5(1.6)	19
Pox	0(0.00)	0(0.0)	0(0.0)	0(0.0)	1(0.3)	0(0.0)	3(0.9)	4
Brand mark	0(0.00)	0(0.0)	0(0.0)	0(0.0)	1(0.3)	5(1.4)	8(2.5)	14
Machine de.	0(0.00)	0(0.0)	0(0.0)	1(0.7)	0(0.0)	0(0.0)	2(0.6)	3
Wound	0(0.00)	0(0.0)	0(0.0)	0(0.0)	1(0.3)	0(0.0)	0(0.0)	1
Tick hole	0(0.00)	0(0.0)	0(0.0)	0(0.0)	1(0.3)	0(0.0)	0(0.0)	1
Total grade				141	371	359	318	1190

* Figures in parentheses are percentages

4.3. Wet Blue Goat Skin Defects in Relation to Carcass Quality

A comparative study was conducted in order to know the association between nodular lesions in goats' carcass with that of their skin. For this study 30 goats whose carcass was characterized with nodular lesions and the same number of carcass without nodular lesions were considered. Corresponding skins of both groups were processed in Gelan tannery at wet blue stage and the result revealed that goat skin removed from carcass with nodular lesions have got higher proportion of cockle/ekeke (96.7%). On the other hand skin sample taken from carcass free of nodular lesions revealed that 30.0% of them had cockle /ekeke (Table 11).The characteristics of the lesion was fine nodular eruptions on the surface of the carcass which commonly found on glutial muscles and fore leg in extensive case distributed over the whole carcass and inter deep in to the muscle. It is only detected when the surface of the carcass is palpated especially during meat inspection. Hence was difficult to demonstrate the lesion in figure. Cockle was significantly higher ($P<0.05$) on skins removed from nodular carcass than those from control group. Out of 10 skin scrap samples from each group, 60% of sample from nodular carcass was found to harbor sarcoptic mange whereas control group had no detectable ectoparasite.

Table 11: Prevalence of pre-slaughter defects on goat skin removed from goat carcass having surface nodular lesion and control

Type of defects	Skin from nodular goat carcass N=30	Control /-Ve for nodular lesion N=30	
	Skin with defect & %	Skin with defect &%	*P-value*
Cockle	29(96.7)	9(30.0)	0.00*
Scratch	9(30.0)	7(23.3)	0.559
Scar	7(23.3)	3(10.0)	0.166

*Figures in parentheses are percentages

Distributions of different grades for goat skins removed from carcass that had nodular lesions and free from the lesions were presented in table 12. The distributions of grades for nodular carcass skin were from grade 4-7, whereas skin sample from free carcass skin grade distribution were from grade 3-7. Which were the main cause of' carcass condemnation, in organic export abattoir.

Table 12: Proportion (%) of grades on skins removed from goat meat with surface nodular lesions and goat skins free from the lesion/control/ slaughtered in organic export abattoir

Type of skins	Grade						
	1	2	3	4	5	6	7
Skin removed from nodular carcasses	0 (0.0)	0 (0.0)	0 (0.0)	3 (10.0)	10 (33.3)	10 (33.3)	7 (23.3)
Control skins	0 (0.00%)	0 (0.00%)	1 (3.3%)	8 (26.7)	12 (40.0)	8 (26.7)	1 (3.3)

5. DISCUSSION

5.1. Questioner Survey

The present survey revealed that livestock keepers in the study areas manage their livestock in a traditional way, animal feed shortage is a serious problem from April to June and feeding totally depends on communal grazing with supplementation of crop residues (wheat, barley and teff bran) in both woredas. The existence of animal feed shortage in the study areas is very significant because poor nutrition predisposes the skin to low febrile condition where the weight and final quality of leather is affected irrespective of the subsequent efforts of other condition being optimized. The resulting condition is referred to as "papery leather" which is a common problem experienced in the areas where poor or unavailability of pastures and forbs is eminent. Hence animals in such areas are of dilapidated condition affecting subsequently the final quality of leather (Mwinyihija, 2006).

The enquiry geared to know the experiences of housing in both study areas revealed that livestock owners constructed house for their animals. However, they are not appropriate for good handling of animals and quality of hide and skins. Mwinyihija (2006), reported that the issue of housing and fencing are managemental problems that predispose the hide and skins to damages such as pricking, scratches, drag marks and dunging. Indeed, these damages affect the grain layer (leather surface of the corium layer) which after tanning, lowers' the quality of leather grades and utility in resultant leather goods processing.

Majority of respondent farmers were aware of the impact of good animal management on the quality of the skin and hide. However, significant number of them are also lacking this perception suggesting that continued awareness creation programs though livestock extension services is essential. In this regards, the questionnaire survey respondent's ascertained absence of extension services on hide and skin management.

Most farmers interviewed ascertained selling hide and skins in fresh/unpreserved state whereas one third of them practice wet-salting method when the material is not sold in time. Moreover, vast majority of those who responded to sell fresh send the products to the

market after protracted delay of 24hours to a number of days. This finding is in agreement with USAID (2013), who reported that in most cases the hides and skins remain unpreserved until it reached the trader. Such malpractice of delay in selling and the obligation to preserve the raw materials might be due to lack of easy market access and discouraging price offers already mentioned by respondents. In spite of this fact, the practice of wet salting at times of difficulty should be encouraged when it is done properly. Salt is a biostat and acts by inhibiting the growth of bacteria by lowering the moisture content in raw stock (EUC, 2003). This survey result is in line with the high prevalence of putrefaction we reported in pickled sheep skin and wet blue hide at Gelan tannery. In many cases, however, observers report that both small and intermediate traders/collectors use insufficient amounts of salt and/or an improper grain size, which inadequately preserves hides and lowers their value (USAID, 2013).

Backyard slaughtering practiced by all of our respondents has its own limitations. The rough slaughtering ground exposes the skin to bruising and scratches, some of them use inappropriate knives for ripping and flaying altogether contributing to hide and skin damage and poor quality. This observation is in line with the finding of defects at Colba tannery possibily associated to such management practices. According to USAID (2013), nearly 76% of sheep and 82% of goats are slaughtered in the backyard, and there are a number of factors that discourage slaughtering in slaughter houses in favor of backyard slaughter. Firstly, there is a general lack of enforcement of policies that do prohibit backyard slaughtering. Secondly, there are very few slaughtering facilities available in the country compared to the size of population.

The questionnaire designed to collect livestock diseases was in line with the report of USAID (2013), which stated livestock diseases were beyond contributing to high death rates and low off-take. Furthermore, a poor animal husbandry practices can reduce the quality of hides and skins that are presented to market, primarily through fomenting and failing to treat disease. A considerable portion of the pre-slaughter defects that accounts for 65% are directly related to skin diseases caused by the ectoparasites, or to the secondary damage that occurs when the animal scratches itself to relief the itching (Kebede, 2013).

Defects due to parasitic damage particularly cockle lesions has increased dramatically in the past10-15 years and is currently holding number one position as cause of skin down grading and rejection (Kidanu, 2001).

According to information gathered from focused group discussion in Hitosa woreda, veterinary experts indicated that in the year 2012; 50,000 sheep and goats treated/sprayed/ in the control program of external parasite conducted by Oromia Regional state Animal production and health Bureau. However, it is difficult to evaluate the efficiency of the control program, but the current result of the processed sheep and goat skin, had high prevalence of cockle lesion which accounted 36.9% and 48%, respectively and were the leading defect in rejected skin in Gelan tannery.

5.2. Observation of Raw Hide and Skin Defects

The findings of this study clearly showed that no skin or hide was detected free of defects. The most important defects of the raw hide in the study areas were high prevalence of corduroying, flay cut, gouge mark, dirt, remained flesh, horn gouge and bruising. This study concords with that of CSA (2004), which reported that knife cut (79.62%), gouge mark (54.66%) and disagree with the result on corduroying (37.18%), dirt (26.5%) were lower and poor pattern (21.39%) was higher than these findings. The prevalence of corduroying, flay cut hole, gouge mark and dirt (43.3%) in the present study were higher than the result of Melkamu (2014), who reported in East Gojjam zone of Amhara regional state as corduroying (7.9%), flay cut (12.2%), gouge mark (17.7%), dirt (17.9%), poor pattern (13.5%) and scar (6.7%).The highest prevalence of corduroying, flay cut hole gouge mark, dirt, and horn gouge in this result is directly related to the absence of slaughtering facilities in the study areas especially in Hitosa woreda all cattle were slaughtered at home backyard without any attention taken to the hide quality and type of knife to be used, and most of the slaughtering were taken place at night or early in the morning before especially at $5{:}00_{PM}$ without insufficient illumination. In addition, those hide that came from animals slaughtered for festivity purposes were with higher defects due to faulty slaughtering techniques and handling of the hide. This finding is comparable with that of USAID

(2013), who stated that many of municipal operations still remove hides and skins from animal carcasses by hand. Manual removal of hides and skins can cause extensive damage to the hide /skin via cuts and holes which substantially reduces their value. The other risk factor was no extension service by woreda agricultural development agents found in each rural and urban kebeles of the two woredas.

5.2.2. Observation of sheep and goat raw skin at collection center

The current study on sheep raw skin revealed that, the most highly prevalent and important defects were flay cut hole, dirt, corduroying, gouge mark, and putrefaction. This result is in line with Zembaba, *et al.* (2013), who described defects like corduroying (17 %), and remained flesh (5.6%) but disagreed with the other defects of his findings and expressed as, flay cut hole (6.27%), and gouge mark (16.8%) were lower and dirt (40%) which was higher than the current findings. The present study result indicated high prevalence of flay cut hole, gouge mark, corduroying, and bruise, than the report by Melkamu (2014), who reported in East Gojjam zone of Amhara regional state as flay cut hole (6.0%), gouge mark (5.6%), corduroying (0.4%), and bruise (3.9%); however, it is in line with his result of dirt (22%) in the same study. This study was not supported by the report of CSA (2004), knife cut (20.0%), corduroying (7.7%), gouge mark (3.74%) and putrefaction/heat (3.1%) had lower prevalence. In addition, other defect results like poor pattern (34.79%) and dirt (30.78%) had higher prevalence than the current findings. The high prevalence of mechanical damages on sheep pelt was related with unfair price to high quality from the collectors but there was a slight difference of price between defected and free of defected pelts and the other risk factor was lack of emphasis by the producers due to limited knowledge about the importance of quality skin.

The present study on goat pelts pointed out that highly prevalent and most important defects were dirt, flay cut, corduroying, remained flesh and gouge mark, which disagreed with the findings of Zembaba *et al.*(2013), who reported flay cut hole as (5.72%), gouge mark (6.74%), corduroying (14.11%), and with that of Melkamu (2014), who reported flay cut (15.6%), gouge mark (6.7%) which were lower prevalence than the current study, whereas dirt (32.65%) and bruise (28.05%) that are higher in the report of Zembaba *et*

al.(2013). However, the current result on the prevalence of dirt is in agreement with the report of Melkamu (2014), whose result was (28.3%). The findings in the current study is also comparable with a report of CSA (2004), that stated dirt (28.3%), flay cut hole (24.09%), heating (11.39%) however disagreed on result of corduroying (7.27%) and gouge mark (4.62%), which were lower than the present findings. The prevalence of lice, poor pattern, flay cut hole, dirt and bruising were significantly higher ($P<0.05$) in sheep than goat while remained flesh on skin and poor substance were significantly higher ($P<0.05$) in goat than sheep. This difference may be the natural / genetic variation which the skin of sheep were highly vulnerable to mechanical damages and easily affected by dirt. In general, raw skins are downgraded and rejected as a result of various ante-mortem and post-mortem defects contributed by poor animal husbandry and nutrition, skin diseases and parasites, improper slaughter and flaying operations and improper practices of curing, collection, transportation and storage (Ahmed 2000, Abebayehu and Kibrom 2010).

5.3. Wet Blue Hide and Goat Skin and Pickled Sheep Skin Observation in Tanneries

5.3.1. Wet blue hide defect assessment in Colba tannery

In the present study 389 cattle wet blue hide, 385 sheep pickled skin and 399 goat wet blue skins were examined in Colba and Gelan tanneries. In study of wet blue cattle hide, various forms of defects were detected. The most prevalent according to their order of importance were flay cut, gouge mark, putrefaction, corduroying, scratch, scar and cockle. The present study on cattle wet blue stage in Colba tannery was disagreed with the report by Bisrat (2013), who studied the case of tanneries in Addis Ababa and Modjo which came up with flay cut (21.3%), putrefaction (15.8%), scratch (13.5%), branding (2.5%) and scar (0.3%), which were lower prevalence than the present study. However, Bisrat (2013), reported in the same study as cockle (42.5%) which was higher prevalence than the current study.

The high proportion of wet blue hide grade lied in lower grades 4-7 which accounts 91.2% and the higher grades 1-3 accounts only (8.8%) of the total observations. The present study was disagreed with the report by Bisrat (2013), in the case of tanneries in Addis Ababa and Modjo which had higher proportion in grade 4-7(99.6%) and very lower proportion in

higher grade 1-3 (0.5%). The current finding of low proportion of higher grade 1-3 is supported with report of Mekonnen and Gezahegn (2008), who indicated that, the tanneries receiving raw HS are often complaining the decline in the quality and quantity from time to time. The information from Hora, Shoa, and Ethiopia tanneries indicated that after 1983 the supply of 1-3 grade raw hides and skin has sharply declined.

The most important defects which have a great deal of distribution in grade 7/reject of wet blue hide were flay cut, putrefaction, scratch, gouge mark and corduroying. Due to this high proportion of downgraded hide, the company lost considerable money from direct rejection of wet blue hide and cost added for correcting defective hide.

The prevalence of flay cut, gouge mark, putrefaction, brand mark and machine defect were significantly higher ($P<0.05$) in processed cattle hide than sheep and goat skin. Almost all defects were responsible for downgrading of cattle hide. The results of this study showed high prevalence of pre, peri and post slaughter defects which were the indications of poor animal management, absence of slaughtering facility, and faulty slaughtering techniques, poor post slaughter hide management (preservation, storage and transportation), and insufficient veterinary services to control livestock diseases in the area.

5.3.3. Pickled sheep and wet blue goat skin defect assessment

The present study on pickled sheep skin and goat wet blue skin assessment result disclosed a higher prevalence of cockle in goat than sheep which is in line with the findings of Worku *et al.*(2011), who reported 54.6% prevalence in goat and 45.4% in sheep from Modjo export tannery. On the contrary the current finding disagreed with the result of Zenaw and Mekonnen (2012), who reported that high prevalence of cockle (76%) in pickled sheep than (22.4%) in goat wet blue skin from Bahir Dar tannery. Furthermore, the current finding is not also supported with a report by Assefa *et al*. (2012), who pointed out that slightly higher prevalence of cockle in sheep pickled (57.5%) than (42.5%) in goat wet blue skin in Bahir Dar tannery. The findings of this study were not comparable with the findings of Hagos *et al*. (2013), who reported higher prevalence of cockle in sheep pickled skin (35%) than goat wet blue (21.5%) in Sheba tannery. Similarly the current finding is in

disagreement with the report from Sheba tannery by Tadesse and Mebrahitu (2010), that showed higher prevalence of cockle (40.71%) in sheep skin than goat skin (6.02%).

The impact of cockle on the tanning industry is a serious concern. This is mainly due to the fact that cockle lesion cannot be detected at the raw skin and selection cannot be made prior to processing. The defect appears only after processing the skin into pickled stage. Therefore, the losses to the tanning industry is three times with regard to each cockle affected skins: first through the purchase of raw skins of undetectable inferior quality, secondly by the cost of processing of these skins and thirdly by the fact that such skins are downgraded after processing and therefore they are not suitable for sale in export markets (FAO, 1998; Kassa, 2006).

The current study revealed high prevalence of scratch (31.8%) in goat wet blue stage than in sheep pickled (27.0%) skin which were most important for downgrading of sheep and goat skin in Gelan tannery which is supported by Assefa *et al*. (2012), who reported high prevalence of scratch (73.3%) in goat than sheep pickled (26.7%) at Bahir Dar tannery and with that of Hagos *et al*. (2013), who reported higher prevalence of scratch (53%) in goat wet blue than in sheep (43.4%) pickled stage from Sheba tannery. In addition, the present result is similar with that of Bisrat (2013), who reported a prevalence of 37.3% in goat wet blue than in sheep pickled (35.2%) in the case of tanneries in Addis Ababa and Modjo. Moreover, a result from Sheba tannery which was higher in prevalence of scratch in goat (44.84%) and (43.86) in sheep that is in line with the current finding report by Tadesse and Mebrahitu (2010). On the other hand, the present finding was in disagreement with the findings by Worku *et al.* (2011), who reported higher prevalence of scratch (57.3%) in sheep pickled than goat wet blue (42.7%) from Modjo export tannery.

Flay cut was the other major problem in processed sheep and goat skin with a prevalence of 18.8% in goat wet blue stage and 15.1% in sheep pickled stage; however, there were no statistical significance difference ($P>0.05$) in the two species. The current finding was in line with the result of Bisrat (2013), who reported 11.6% flay cut prevalence in goat and 7% in sheep pickled stage in a study on the case of tanneries in Addis Ababa and Modjo. Furthermore, the study conducted by Hagos *et al*.(2013), came up with a prevalence of

6.2% in goat wet blue which was higher than 3.4% pickled sheep skin from Sheba tannery and Assefa *et al*. (2012), who reported high prevalence of flay cut (54.5%) in goat than sheep pickled (45.5%) at Bahir Dar tannery that supported the current finding. On the other hand, the finding of this study was disagreed with that of Werku *et al.* (2011), who reported higher prevalence in sheep pickled (88.9%) than (11.1%) in goat wet blue skin, as well as with that of Zenaw and Mekonnen (2012), reported from Bahir Dar tannery a higher prevalence of flay cut in sheep pickled skin (31.8%) than (23.8%) in goat wet blue skin. The high prevalence flay cut in goat than in sheep skin might be the carelessness of the producers due to its lower price and demand by the collectors in comparing with sheep skin in the current study areas. In addition, the other reason was most of sheep skin are highly affected with flay cut which were rejected in Gelan tannery before processing at the time of raw skin selection.

In this study scar was one of the most important defects in downgrading sheep and goat skin and has higher prevalence in goat wet blue skin than sheep pickled skin and data analysis showed a statistical significant difference ($P<0.05$). The present study concords with the finding of Zenaw and Mekonnen (2012), who reported higher prevalence in goat wet blue skin (15.2%) than in sheep pickled skin (9.9%). In addition, the present result is comparable with that of Bisrat (2013), who reported higher prevalence in goat (15.3%) than sheep (1.8%) in tanneries of Addis Ababa and Modjo. By the same talken, the study finding from Bahir Dar tannery by Assefa *et al*. (2012), revealed higher prevalence in goat wet blue skin (77.8%) than sheep skin (22.2%). Moreover, the current finding is comparable with the result of Tefera and Abebe (2007), who reported higher prevalence of scar in goat (24%) than in sheep (22%) from Dessie tannery. Similarly higher prevalence of scar in goat (8.18%) than in sheep (3.29%) was reported from Sheba tannery by Tadesse and Mebrahitu (2010), which is in agreement with the finding of this study; however, the prevalence of scar in both species is lower than the current finding. Contrary to this fact the current finding is in disagreement with that of Hagos *et al*. (2013), who reported higher prevalence of scar in sheep skin (7%) than in goat skin (6.8%). Moreover, Werku *et al.* (2011), reported 61.7% prevalence in sheep skin at pickled stage and 38.3% in goat wet blue skin which are not in support of the present finding. The high prevalence of scar in goat in this

study could be associated with the high prevalence of cockle and scratch in goat because they leave chronic scar on the skin that are observed after processing in tanneries.

The significant association found between 'ekek' and scratch, both on pickled sheep and wet blue goat skins could be attributed to the effect of ectoparasites on animals causing intense itching and rubbing against bushes, thorns, posts and barbed wires leading to the formation of scratches on their skin (Asp and Tauni, 1988; Urquhart *et al*., 1996; Wall and Shearer, 1997). The development of secondary bacterial complication at sites where ectoparasites feed can also cause lesions which upon healing leave scars (Noble and Noble, 1982; Asp and Tauni, 1988).

Veinness / poor bleeding / corduroying, gouge mark and brand mark which have higher prevalence in goat wet blue skin than sheep pickled skins were the other important defects encountered during observational studies in tanneries ($P<0.05$).Whereas, skin putrefaction in sheep pickled skin has higher prevalence than in goat ($P<0.05$). Poor pattern of skin in sheep and goats as well as pox detected in sheep and goats were observed after processing ($P>0.05$).

The higher prevalence of veniness or poor bleeding in goat was the most important defect in downgrading the wet blue skin of goats which was confirmed in this study. According to Desta (2008) the area with the congealed blood has a degrading effect to the leather quality. Veiny leather is the result of blood vessels in the skin where the blood is not completely drained (poorly drained). This is an unwanted effect which shows very clearly in suede leather. Veininess is a prominent defect in goat skins and very prominent in glazed kid leather.

The higher occurrence of the above listed defects indicated the faulty slaughtering, preservation and transportation of the raw material as well as lack of agricultural extension services that are addressing the hide and skin quality management in its package in the study areas. These findings are directly related with the result of the current questionnaire survey which were planned to assess the skills, attitudes and practices of livestock owners. In the survey, the participants expressed that they lack modern skills and practices of

livestock management in general and hide and skin in particular which is contrary the common day to day realities of traditional livestock management, poor animal slaughtering and post slaughtering cares for the skin. The present finding supported by the report of Hagos *et al*. (2013), who reported defects such as knife cut, poor bleeding, machine defects, putrefaction, beetles damage, crack and heat were technical defects due to faulty flaying, preservation, handling and processing of skin. Though cockle was the second dominant defect next to scratch in both pickled sheep and wet blue goat skins, there was a statistically significant difference (P=0.000, c2 =44.957) in proportion of cockle between pickled sheep skins and wet blue goat skins.

The high proportions of sheep pickled skin grade in this study, in order of importance, were grade 7 grade 4, grade 6, grade 5, grade 3 and grade 2. Grade 1-3 accounts 14% and grade 4-7 accounts 86% of the total observation. This finding is not supported by the result of Bisrat (2013), who reported a proportion of 1-3 the higher grade only (5.3%) and a proportion of lower grade 4-7(94.7%) in the case of tanneries in Addis Ababa and Modjo. In contrary the present finding is in line with the report of Assefa *et al*. (2012), who reported a proportion of higher grade / 1-3 the (20%) and a proportion of lower grade/ 4-7(80%). The experimental study by Tefera and Abebe (2007), on control group sheep skins in Combolcha tannery revealed higher proportion of 30-35% grade 1-3 which is not in lined with the current findings but in lined with the same study findings the majority of skins from ectoparasite-infected groups were of poor quality (grade 4–6) or rejects (grade 7). According to Mekonnen and Gezahegn (2008), the percentage of the highest-grade skins from grade 1-3 is very low in a randomly packed HS on its arrival to the tannery. The present study results have confirmed that all defects have a high number of distributions in different lower quality grades. Of them grade 7/reject is the most important and the distribution of defects to grade 7 sheep pickled skins in order of importance were cockle /ekek, flay cut, scratch, scar, poor pattern, putrefaction and pox. The current finding is also supported by Kassa *et al*. (1998), who stated that, as one quarter to one-third of all the skins processed at tanneries are unsuitable for export due to various defects.

The high proportions of goat wet blue skin grade in this study, in order of importance, were grade 5 grade 6, grade 7, grade 4, grade 3, grade 2 and none of the goat skins were in grade one and two confirming once more that almost all lied in the lower grades 4-7 and a very few proportion lied in grade 1-3. The present result is supported by the report of Bisrat (2013), who reported a proportion of 1-3 the higher grade only (0.6%) and a proportion of lower grade 4-7(99.4%) in the case of tanneries in Addis Ababa and Modjo. Moreover the present finding is not concords with the report of Assefa *et al*. (2012), who reported a proportion of higher grade / 1-3 (5.6%) and a proportion of lower grade/ 4-7(84.4%) from Bahir Dar tannery.

The most important defects which have higher distributed in grade 7/reject of wet blue goat skin were cockle/ekek, scar, crack, and scratch. The present finding of processed skin rejection in both sheep and goat species indicated that the dominant defects were cockle which was higher in sheep than goats. Whereas scratch, scar and crack were highly distributed in grade 7/reject wet blue goat skin than sheep pickled skin in the current study. The present finding is concord with the result of Negussie *et al*. (2011), who reported that out of the rejected skins from goats and sheep, 98.8% of them had ekek and scratch, whereas 85.6% of them contained sheep and goat pox and 52.2% of them were having knife cuts. Similarly, the result of this study is comparable with the report of Assefa *et al*. (2012), which stated the most important defects in rejected skins were ekek (54.2%), scratch (25%) and pox (18.8%).

5.4. Study on Nodular Goat Carcass Condemnations and Association to its Skin Quality

In the comparative study of 30 skin of goats removed from goat meat that harbor nodular lesion and 30 skin of goats removed from free of the lesion to study the association of nodular carcass lesions with its skin defects, the result revealed higher proportion of cockle lesion in wet blue skin after processed and the skin scrap sample laboratory result revealed 60% of the samples were detected the skin parasite sarcoptic mange. In contrary the cockle prevalence in the control group was low and none of the skin scrap sample was positive for

the external parasite. The observation made in the Organic export abattoir revealed that there is repeated rejection of goat meat even though there was no scientific evidence to associate goats' carcass with nodular lesions with that of cockle. This finding speculated the allergic lesion (cockle) which might cross deep to the skin and detected on the surface of the goat carcass at the attachment to the skin. The lesion was common in older goats that originated from the low land of Bale, Borena and Jinka areas. The lesions were not observed on sheep mutton and the result is supported by Asnake *et al*. (2013), who reported 43.8 % of the goats in lowlands were infested with sarcoptic mange. An odds ratio of 5.0 explained that goats were five times more at risk than sheep species of the lowland (black head Ogaden) and also males were two times more at risk than females (OR=2.0) of having this parasitic infestation.

The economic importance of the lesion on meat can be analyzed by converting the rejected meat of 30 goats into monetary values. Hence, the average kilogram of the rejected goat meat from export was 11.3kg and1kg of goat meat costs 5-7USD in export market. Based on these data one can calculate the total loss for 30 pieces of rejected goat carcasses as11.3kg dressed goat meat rejected **x** 30 pieces **x** current export price of 5-7 USD = 1696 – 2373 USD total loss. Moreover, this incidence can create considerable apprehension by seriously affecting the meat export market. In addition, this cost did not include all expenses from goats rearing up to slaughtering. The magnitude of the loss can be appreciated by surveying all export abattoirs and the total goat carcasses rejected per year in Ethiopia.

To sum up, the real cause for rejection of goat carcass warrants further in depth research. However, the current finding can give a clue that external parasite allergic reaction/cockle/ is not only a problem of hide and skin quality but also it is a threat for goat meat quality in export markets.

6. CONCLUSION AND RECOMMENDATIONS

The present study was conduct with the objectives of assessing the major hide and skin defects in two woredas of East Arsi zone at skin collection center, after processing in tanneries and to assess the relation between carcass condemnation and skin defects. Across-sectional study design was employed for both questionnaire survey and observational defect assessment in skin and hide collection centers as well as in tanneries. The result of the questionnaires survey indicates that all the respondents keep livestock for a different purposes and the livestock owners have poor/limited awareness in relation to live animal management with hide and skins quality, the very common back yard slaughtering without caution of the hide and skin quality, delay to sale or stay long unpreserved the recovered hide and skins.

The major defect observed during examination of raw hide and skin in this study includes corduroying; flay cut, dirt, gouge mark and remained flesh. In the processed cattle hide flay cut, gouge mark, corduroying and putrefaction are the major defects according to their prevalence. In sheep cockle, scratch, flay cut and scar while in goat skin cockle, corduroying, crack and scratch are the major defects observed in the processed skins in an order of their importance respectively.

Accordingly the volume of the wet blue hide in the higher grade 1-3 was 8.8%. In pickled sheep skin grades the higher grade accounts 14% and while in goat skin only 0.3% found in 1-3 grades. An additional finding of the present study on those goat carcass harboring nodular lesions and the control groups, the result showed those skins removed from carcasses having the lesion got higher proportion of cockle lesions comparing with the control groups at wet blue stage in Gelan tannery. This indicates the cockle allergic dermatitis reaction might be the causes of the nodular pathological lesions on the surface of the goat carcass which was the major cause of goat carcasses condemnation in the export abattoir. The lack of extension service, absence of slaughtering facility/ municipal abattoir, high prevalence of ecto-parasites, poor awareness about the quality management of hide

and skin, faulty practices in slaughtering, faulty preservation and holdup to sale the raw material were the cause that downgrades the hide and skin quality in the study area.

Within the limit of the above concluding remarks the following recommendations are forwarded:

- ✓ There is a strong need to prepare comprehensive training manuals and extension packages on live animal management, such as feeding, housing, slaughtering and post slaughtering hide and skins managements that can be incorporated with other extension services performed by the kebele development agents at all levels which can enhance the awareness of the producers and the collectors regarding the hide and skin quality managements.

- ✓ The higher prevalence of cockle on processed sheep and goats skins demands attention to be given to mange, lice and sheep keds control or prevention programs by the responsible stakeholders.

- ✓ Municipal abattoir should be constructed at Eteya town which avoids or limits the backyard animal slaughtering which was the major cause of the detected faulty slaughtering defects on the observed hide and skins, especially very high on cattle hide.

- ✓ The HS stores of the collectors in the study areas should be constructed according to the standard set by MoA and should be supervised regularly by the responsible experts assigned in the woreda. Additionally raw HS grading should be practiced at collection centers and its purchasing price should be set based on its quality.

- ✓ Nodular goat carcass lesions association with its skin defect needs further specific study.

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8. APPENDEX

Appendix I: Questioner Survey Format

Data collection format on assessment pre and post slaughter hide and skins management and livestock handling practice at house hold (live stock owners) in the study area**.**

I. General information

1.Respondent(ID)……Date……..Zone……Woreda…..……Kebele…

……Sex…….Age……

1.1. Educational status a) Illiterate b) Basic education c) Primary School d)Religious Educations

2. Livelihood of the owner (farming system)

a) Livestock production b) crop production c) Mixed d) other specify ……

3. Major crops in the area…….

4. Livestock group reared a) Cattle b) sheep c) goat d) poultry e) equine f) all

5. For what purpose you rear animals in order of importance

5.1. Cattle a) for milk production b) meat production c) for plough

5.2. Sheep and goat a) for household consumption b) for income generation c) both A and B d) others…….

6. Do you care for skin and hides while managing your animals? A) yes b) no……

7. if your answer is yes to Q6, what is your reason;?a) To improve the look b) To improve the hide/skin quality c) other, specify_____

8. What measure you take to keep the quality of hide and skin in live animal_____

II. Husbandry practices

9. Source of feeds…….

10. Is there any feed shortage in the last two year for your livestock in this area a) yes b) No.

11.If your answer is yes in which of the month of the year the shortage was happened commonly and for how many months it lasts……

12. Do you house animals? a) Yes b) no

If yes; Floor nature a) corrugated b) muddy c) with bedding material d) concrete

13. Have you ever apply branding on your animal a) yes b) No, If yes

13.1. For what purpose do you use

a) Identification b) treatment of diseases c) other specify……

13.2. in which animal a) sheep b) goat c) cattle d) all

13.3. In which part a) hind leg b) fore leg c) on the neck d) at the back e) flank region f) other specify……..

13.4. Do you know that management practices can affect quality of hide and skin? How?.....

.....

14. Do you know/ observed/ starved animal hide or skin have a poor quality? A) yes b) no, If yes what changes you observed a) loss of hair b) wrinkle c) hardening and scaling d) emaciation d) b and d e) a and b

15. Did you slaughter animals in your home a) yes b) no, if yes which animal spps?

a) Cattle b) Sheep c) Goat d) all

16. Which slaughtering technique used during slaughtering? ……..

16.1. Cattle: a) on the ground without stunning b) hanging on the pole

Sheep and goat: a) on the ground b) by hanging on the tree/ pole

16.2. What type of ripping and flaying knives you used to remove the hide and skin from the carcass?

16.2.1 ripping knife a) straight blunt tip ripping knife b) straight sharp tip ripping knife c) curved tip flaying knife c) other _____

16.2.2. Flaying knife: a) straight sharp tip flaying knife b)straight sharp tip ripping knife c)curved tip flaying knife

17. Did you preserve the hide and skin? A) Yes b) no, if yes which preservation technique used? a) Frame dry b) Ground dry c) Wet salted d) Dry salted e) Others_____

18. Do you know the impact of storing hide and skin without preservation more than 3hrs? a) Yes b) no

19. For how long you store in your home before selling the hide and skin? Without preservation. a) for 6hrs b) for 12hrs c) for one day d) for two days e) 2.5days-3days.

20. What is the reason for dalliance to sale hide and skin in time? A) Lack of market accessibility b) Waiting the coming market day c) lack of emphasis due to unfair price

21. For whom you sold? a) Village level collectors b) collection center/ market c) others_____

22. How did you transport the hide and skin to market center? a) Fresh by plastic bag b) Air dried by carrying with sick. c) Other list_____

23. Where you store the hid/skin until delivered to market? _____

24. Is there any extension service available in your locality about hide and skin management A) Yes B) No if yes by which body a) kebele developing agent b) veterinarians c) woreda experts

25.1. Did you receive any training on how to slaughter and flay your animals in backyard?

a) Yes b) No

III. Major causes of hide and skin defects

26. Please prioritize the common diseases that affects skins according to their regularity and severity that occurs in your animals.

Spps	List of the disease	Rank based on severity (abundance)	Peak seasonal occurrence			
			short	long rainy seasons	dry	Remarks
Cattle						
Sheep and goat						

27. Do you get veterinary extension services? a) Yes b) no

28. If yes, for which health problems?

29. Do you get enough services……If no a) what another option do you have to treat animals……...

Appendix II: Checklist to Assess Hide and Skin Defects After Processed in Tanneries

Name of the tannery_____ Date of collection_____

No of skin observed	Type of defects observed and their frequency on _____ skin at _____ stage																
	Ek ek	Scra tch	Fl ay cu t	W ou nd	Sc ar	Put ref acti on	Mach ine defec t	Po x	Po or. su bst .	Cra ck	Bran d mark	Tic k hol e	Go ug e m.	C or du .	Po rpa t	V e ni n	Gr ade
1																	
2																	
3																	
4																	
5																	
6																	
7																	
8																	
9																	
10																	
11																	
12																	
13																	

Appendix III: Check List to Asses Defects on Raw Hide and Skins.

Check list to identify/isolate/ HS defects at wholesalers store at the time of purchasing and storage of the raw material.

Name of the wholesaler/store/ owner----------date----------week of the month----------species observed----------

Major causes of rejection/ defects/

No. HS examined	State of the HS	List of defects																			
		Fly cut/hole	Small size	Pox lesions	Brandmark	Dirt	Demodex lesions	Putrefaction	Salt spot	Gouge mrk	Corduroying	Horne gouge .	Poor bled	Remained fle.	Poor sub.	Lice	Tick	Manage/alopacia/	.		grade
1																					
2																					
3																					
4																					
5																					
6																					

Appendix IV: Data Collection Format from Export Abattoirs

1. General information

1.1. Name of the abattoir……. ……location……

1.2. Daily slaughtering capacity of the abattoir…….

1.3. Species slaughtered in this abattoir a) Cattle b)Sheep c)Goat

1.4. Sex …….

1.5. Age: Cattle…… Sheep……. Goat……

1.6. Number or kg. of sheep and goat slaughtered in the year of 2006 EC……..

1.7. Average kg slaughtered in the year of 2006 EC Sheep…….. Goat……

2. Had you encountered rough nodular allergic lesion like on carcasses that slaughtered in your abattoir in the last two years a) yes b) no. If yes in which Spps a) Sheep b) goat

3. In what age of animal the case is observed a) young goat b) older/aged goat c) young sheep d) aged sheep

4. In which part of the body is observed commonly……

5. what measures taken on the carcass when the lesion observed a) fit for export b) partially condemned c)totally condemned d)other specify……

e) In which month of the year the lesion is peak/ very common……

6. Do you expect this lesion is economically significant and affects the export market……..

7. Slaughtering date……..

8. Number of animals ready for slaughter a) Sheep…….b) Goat……

9. Major source of origin a) Sheep……

b) Goat…….

10. Breed a) Sheep……

b) Goat…….

C). Sex ……..

11. Average live weight of a) Sheep……

b) Goat…… in the day of slaughtering

Appendix 4. Continued

12. Average carcass weight of a) Sheep…….. b) Goat…….

13. Data of nodular goat carcass lesion diagnosed on the day of observation

s/n	Spps	Lesion	Part of the body the lesion observed	Degree of the lesion		kg	Measures taken
				mild	extensive		

Appendix V: Classification and Grading of Cattle Hides and Skins in Relation to Defects and "Usable Areas

Grade	Characteristics of skin
Grade 1	No or one minor visible defect which appearing with in 2.5cm from the edge are likely to depreciate the skin
Grade 2	One defect assessed to a total of 1-2 defect units appearing with in 5cm from the edges
Grade 3	Defect assessed to a total of 3-7 defect units
Grade 4	Defect assessed at more than 7 defect units appearing in not more than 20% of the total area of the skin
Grade 5	Defect assessed at more than 7defects units appearing in not more than 50% of the total area of the skin
Grade 6	Culls of which more than50% of the total area is usable
Reject	Culls of which more than 50% of the total area unusable

Source: Ethiopia Standard Authority (ESA) 2008

Appendix VI: Tanning Processes

Soaking

Soaking is carried out to allow hides and skins to re-absorb any water which may have been lost after flaying and curing. This is done to clean the hides and skins (removal of dung, blood, dirt, etc), and to remove interfibrillary material. The soaking methods 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 process is carried out in processing vessels, such as mixers, drums, paddles, pits, or raceways. Raceways and pits are more commonly used for the processing of sheepskins. The duration of soaking may range from several hours to a few days. Depending on the type of raw materials used, soaking additives can be used such as surfactants, enzyme preparations and bactericides.

Unhairing and liming of bovine hides

The function of liming and unhairing is to remove hair, inter fibrillary components and epidermis and to open up the fibre structure. Hair removal is performed by chemical and mechanical means. The keratinous material (hair, hair roots, epidermis) and fat are traditionally eliminated from the pelts mainly with sulphides (NaHS or Na2S) and lime. Alternatives to inorganic sulphides include organic sulphur compounds such as mercaptans or sodium thioglycolate in combination with strong alkali. Enzymatic preparations are sometimes added to improve the performance of the process.

Painting and liming of sheepskins

The aim of painting is to bring about the breakdown of the wool root within the skin so that as much undamaged wool fibre as possible can be pulled easily from the pelt. Paint, generally consisting of a mixture of sodium sulphide and lime, is applied to the flesh side of the skin and left for several hours. Application of the paint can be through a spraying machine or manually. After several hours, the wool can be ‘pulled’ from the skin, either manually or mechanically. After pulling, the skins are limed in process vessels, with the same purpose as the liming of bovine hides.

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. Sheepskins may be fleshed in the pickled state

Splitting

By mechanical splitting, the thickness of hides and skins is regulated and 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.

Deliming

The aim of deliming is to remove residual lime from the pelts and to take the pelts to the optimum condition for bating. This involves a gradual lowering of the pH (by means of washing and the addition of deliming chemicals), an increase in temperature and the removal of residual chemicals and degraded skin components. Generally, deliming is performed in a processing vessel such as a drum, mixer or paddle.

Bating

Bating is a partial degradation of non-collagenic protein achieved by enzymes to improve the grain of hide and the subsequent run and stretch of leather. In this process the rest of the unwanted hair roots and scud can be removed

Degreasing

Excess grease must be eliminated from fatty skins (sheep, pig) to prevent the formation of insoluble chrome-soaps or to prevent the formation of fat spues at a later stage. Degreasing

is most relevant in processing sheepskins, where the natural fat content is about 10 % – 20 % on dry weight. The nature of this fat makes it difficult to remove because of the presence of glycerides and a high melting temperature.

The three different methods commonly used for degreasing are:

1. degreasing in an aqueous medium with an organic solvent and a non-ionic surfactant
2. degreasing in an aqueous medium with a non-ionic surfactant
3. degreasing in a solvent medium.

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, and vegetable tanning). The choice of the exact pickling parameters depends on the subsequent tanning step. Very often tanning is carried out in the pickle liquor; however, pickled pelts, e.g. sheepskins, can be traded. Pickled pelt sheepskins must contain fungicides to protect them from mould growth during storage.

Tanning

In the tanning process the collagen fibre is stabilised by the tanning agents such that the hide is no longer susceptible to putrefaction or rotting. In this process the collagen fibres are stabilized by the cross-linking action of the tanning agents. Furthermore their dimension stability, resistance to mechanical action and heat increase.

The various agents can be categorised in three main groups:

• Mineral tannages
• Vegetable tannins
• Alternative tanning agents, which can be subdivided into Syntans, aldehydes, oil tannage.

The most commonly used tanning agent is a basic chromium sulphate and around 80 – 85 % of all leather worldwide is tanned by chromium.

Draining, samming and setting

After tanning, the leathers are drained, rinsed and either horsed (piled onto a "horse") up to age, or unloaded in boxes and subsequently sammed to reduce the moisture content prior to further mechanical action, such as splitting and shaving. The setting out operation can be carried out to stretch out the leather. Machines exist which combine the samming and setting action. After samming and setting, hides and skins can be sorted into different grades after which they are processed further or sold on the market.

Splitting

The function of the splitting operation is to cut through skins or hides at a set thickness. If the hide or skin is thick enough, splitting can yield a grain split and a flesh split which can both be processed into finished leather. Splitting can be performed before tanning, after tanning or after drying.

Shaving

The shaving process is carried out to reduce and/or even out the thickness throughout the hide or skin. The hides and skins are made suitable for their intended end use, by 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 shaved off are called shavings.

Post-tanning operations

Post-tanning involves neutralisation and washing, followed by retanning, dyeing and fatliquoring, mostly done in a single processing vessel. At this stage of the process, specialist operations may also be carried out to add certain properties to the leather such as water repellence or resistance, oleophobing, gas permeability, flame retarding, abrasion, antielectrostatics.

Neutralisation

Neutralisation is the process by which the tanned hides are brought to a pH suitable for theprocess 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

• To fill the looser and softer parts of the leather in order to produce leathers of more uniform physical properties and with more economical cutting value to the customer

• To assist in the production of corrected grain leathers

• To improve the resistance to alkali and perspiration

• To improve the wetting back property of the hides which will help the dyeing process. 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.

Dyeing

The dyeing process is carried out to produce consistent colouring over the whole surface of each hide and skin and exact matching between hides in a commercial pack. Typical dyestuffs are water-based acid dyes. Basic and reactive dyes are less commonly used by the leather industry.

Fatliquoring

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 might be synthetics based on mineral oils. Stuffing is an old technique used mainly for heavier vegetable-tanned leather. The sammed leather is treated in a drum with a mixture of molten fat

Drying

The objective of drying is to dry the leather whilst optimising the quality and area yield. There is a wide range of drying techniques and some may be used in combination. Each technique has a specific influence on the characteristics of the leather. 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.

Finishing

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: colour, gloss, handle flex, adhesion, rub fastness, as well as other properties including extensibility, break, light- and perspiration fastness, water vapour permeability and water resistance as required for the end use.

Generally, finishing operations can be divided into mechanical finishing processes and applying a surface coat.

Source:(EU,2009)