

**PRODUCTION OF LEATHER VESSELS FROM THE INDIGENOUS
GHANAIAAN LEATHER**

By

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DECLARATION

I hereby declare that this submission is my work towards the MPhil degree and that to the best of my knowledge, it contains no material previously published by another person or material which has been accepted for the award of any other degree of the University, except where due acknowledgment has been made in the text.

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ABSTRACT

Anecdotal evidence and further report from leather experts shows that there is close to no enlightenment of the production of leather vessels in Ghanaian leather industries. Therefore the study was conducted as a result of the need to add leather as a supplementary material to the traditional materials such as clay, metal, wood and half-gourd used for producing vessels in Ghana. The purpose of the study was to find out how Ghanaian indigenous leather could be used in the production of leather vessels. The qualitative study employed three key techniques, namely: “cuir bouilli” leather hardening methods, the sand pounding technique, and assemblage and construction technique. Based on the results, the baking and hot wax methods adversely affected the indigenous leather positively in the hardening of the leather. The results also show that using only one part of the leather (the back, belly or butt) affected the quality of the leather vessels, but incorporating the various parts of the hide helped improve the quality and durability of the leather vessels. The implications of the results and future research directions are also presented.

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CHAPTER ONE INTRODUCTION

1.1 Overview

This chapter provides the basic framework of the whole thesis. It comprises the background to the study, statement of the problem, purpose of the study, objectives of the study, research questions, the importance of the study, delimitation, definition of terms, and organization of the text.

1.2 Background to the Study

The use of leather vessels has a long history dating from the Neolithic times through to the medieval age, but was well known and used during later Tudor periods. It was discovered that, to model and shape leather it should be made wet, which becomes jack leather when left to dry, hence the leather vessels during the medieval period became popular known as jacks. Leather drinking vessels are still made today in the High Pennine region of Upper Teesdale by specialists. The use and manufacture of vessels have been practiced in many societies throughout the history of the world. Vessels are hollow utensils (jars, cups, bowls, etc.) used to hold liquid and dry substances. They are created from clay and many materials, including leather.

In Ghana, vessels are closely related to the societal history of the country even to the present. The vessels are commonly manufactured from clay (kukuo), metal (dadesen), wood (waduro), and half-gourd (calabash). There are also materials such as plastic, glass and special metals used to manufacture vessels and these vessels are imported most notable from “china”. Therefore the historical use and existence of leather vessels in Ghana is a “mirage”. Leather vessels have been useful to many countries, unfortunately not in Ghana. Leather vessel is used as containers for storing special items. Today, all kinds of containers are produced from many different materials, even

though they come with short comings, leather vessels can be used as a supplementary container.

But the use of the material leather dates back to the pre-historic times. The main raw material is the animal skin or hide; the hide gotten from large animals, while skins are from small animals. The skin or hide needs to be tanned and the tannery operation involves converting the raw skin or hide (pelts) into leather, a constant material, which can be used in the production of a wide range of articles. The whole procedure involves a structure of complex chemical and physical reactions and mechanical processes. Performing various steps of both pre-treatment and posttreatment, this creates a final product with definite properties like water and heat resistance, permeability for perspiration and air, elasticity and so on. "Chrometanned leathers tends to be more liable, softer, very stable in water, has higher thermal stability and takes less time to be manufactured than vegetable-tanned leather" (Yazicioglu and Boler, 1983). Today, "mineral tanning is predominantly popular because of its proficient and effective quality. Nevertheless, vegetable tanning is still used by many leather manufacturers for certain purposes, like the making some shoes, luggage and bags" (Leach, 1995).

According to Koloka and Moreki (2010) "the abundance and worth of raw material in the leather industry remains weak, resulting in material (hides and skins) not realizing their limit in the industry markets". These natural resources are still seen as by-products of the meat industry instead of needed main material for the leather industry; therefore much prominence is given to the meat. Currently, profits that could be realized from these useful "by-products" of the meat industry remains underutilized and unexploited resulting in the true economic value of raw material (hides and skins) unknown to an ordinary Ghanaian.

Leather is a transitional industrial product, with several uses in down-stream sectors of the consumer products industry. It is also relatively cheap, durable and available. It is widely cut and assembled into leather goods like bags, shoes, furniture and many other articles of daily use in the world. Therefore, purpose leather article determines the type of leather to use. The global market value for leather is \$72 billion and that of raw hides and skin is \$4.4 billion, growing steadily at 3% per annum (GEMS, 2012).

These industries are one of the vital agricultural sub-sectors and also have a great potential towards employment and economic growth in general (CBN, 2006). Financial records show that, the contribution of the hide, skin and leather industry towards achieving economic growth through an expansion of hides and skin production, skin precuts and the export market for both semi-processed and finished hides is huge and the only way to embrace such achievement is through value added initiatives (Adebayo, 2003). The research seeks to contribute to the container base production in the Ghana.

1.3 Statement of the Problem

In many civilizations around the world, animal leather was processed and used for various purposes since time immemorial. The pelt industry produces leather from animals slaughtered in Ghana, used as conventional artefacts which provide job opportunities for several people in the country, especially the northern part of Ghana which is noted for its vegetable tanning Industry. However, there is close to no enlightenment of the production of leather vessels in Ghanaian social history.

The history of leather vessel has received relatively little attention, scholarly or otherwise (Waterer, 1950). Leather was in many ways the plastic of former ages,

ubiquitous, and extremely diverse in its use. Perhaps for this reason it is less prominent in the Ghanaian historical consciousness than more „precious“ materials. The result is that both the complexity of the means of treating leather and the diversity of its uses are not as well understood as they might be.

Despite the availability of raw materials, there is no trace of leather vessel production in Ghanaian leather industries. However, the knowledge on the use of indigenous leather is only limited to the production of conventional products such as footwear, bags, belts, drums, bracelets and many others. Moreover, the Ghanaian indigenous leather, at present, is struggling with the influx of imported leather from Italy, leading to its decrease in utilitarian value.

Apart from Ghana's indigenous leather, decreasing in utilitarian value, social changes and population growth of the country possess the need for the additional needs of society. One of such needs are containers, but existing containers in Ghana are limited to materials like glass, metal, wood and clay, not much is known about leather as a suitable material for vessel production; hence, the need for this research.

1.4 Purpose of the Study

The goal of this study is to discover the suitability of the Ghanaian indigenous leather in leather vessels production.

1.4.1 Specific Objectives

1. To experiment on the suitability of using “cuir bouilli” techniques for hardening the Ghanaian indigenous vegetable tanned leather for the purpose of vessel production.

2. To identify and experiment the effect of vessel forming techniques on the use of back, belly and butt parts of the indigenous vegetable tanned leather in the production of leather vessel.
3. To produce samples of leather vessels using the Ghanaian indigenous vegetable tanned leather.

1.5 Research Questions

1. How would indigenous vegetable tanned leather be hardened for the production of leather vessels through the use of “cuir bouilli” technique?
2. What effect would leather forming techniques have on the use of back, belly and butt of indigenous vegetable tanned leather in the production of leather vessels?
3. How would Ghanaian indigenous vegetable tanned leather be used to produce samples of leather vessel?

1.6 Significance of the Study

1. The outcome of the study will create awareness on the possibility of using the local leather in an unconventional manner aside its conventional use.
2. The research will open employment ventures in the country, especially the northern part where leather is largely available.
3. This industry will help increase the economic benefits of the country.
4. The research will add a new enlightenment to the potentiality of the indigenous Ghanaian vegetable tanned leather.
5. This thesis will act as a body of knowledge and reference for other researches.

1.7 Limitations

Unfortunately local technologies used in processing the material and its articles leave much to be desired. Leather as a material lends itself to several uses, however, it is noted for its characteristic offensive odour it emanates and this leaves much to be desired. The resulting effect is that people who buy articles made with such poor quality leathers find it difficult to use or keep them in their rooms. They have to be left outside their rooms in a highly ventilated area for over a period of time to get the offensive odour to reduce before using them. Even such a procedure does not lead to the removal of the odour. Whenever the articles are exposed to moisture, they begin to smell again. The finished articles also grow mouldy easily and this causes stains to appear on them.

The tannins and dyes for tanning leather and fur are vegetable based; hence, the term “vegetable tanned leather” is used most often. However, since these plant-based chemicals, are seasonal their supply is always reduced whenever they are out of season. This shortage of tannins also affects the acquisition of requisite chemicals for teaching and learning and the production of leather and fur all year round.

The vegetable-based dyes used by the local tanners also easily turn pale after a while or when they are exposed to sunlight. They also turn dark after they have been handled in the arm over a period of time. This requires finding an alternative means of protecting vegetable dyed leathers which can withstand such a problem.

1.8 Delimitation

The scope of the study focuses on local vegetable tanned leather (hide) as a potential material in vessel production due to its availability and its natural characteristics and

also the study was limited to some selected traditional vessel in Ghana such as cups and bottles.

1.9 Organization of the Text

The research is presented in five chapters. The introductory chapter gives the Background to the study, Statement of the problem, Purpose of the study, Research questions, Significance of the study, Limitations, Delimitation, and finally, the Organization of the rest of the text. Chapter Two elaborates on the theoretical and empirical literature reviewed. The methodology is presented in chapter three. Chapter Four comprises the data presentation, analysis and interpretation of findings. Finally, the summary of the entire research, conclusions and recommendations made are presented in Chapter Five.



CHAPTER TWO REVIEW OF RELATED LITERATURE

2.1 Overview

The purpose of this study is to discover the suitability of the Ghanaian indigenous leather in leather vessels production. In this study, the researcher reviewed relevant related literature on leather, vessels, history of Leather vessels, Construction of leather vessels, finishes, maintenance and repairing and impact of leather vessels.

2.2 Theoretical Framework of the Study

During the 20th Century in the steel industries and mining sector of the time, historical records show the use of some leather vessels, particularly in those sectors, popular at the time known as tankards and Leather jacks. The use of these leather vessels was obligatory to carry a copious amount of drinking water in the minis. In the Barnsley mining area the leather vessels used became branded as Jingle Boys, this name because of the feature of bells to the base of the handle of the drinking vessel which were rung to draw the water boys of the mine.

Also in West Midlands, steel grinders drank from leather vessels which had a whistle fixed to the base of the handle of the drinking vessels which were blown by the miners to yet again, draw the water boys back. But leather vessel in those days was named Piggins, which had its Whistle starting the popular pub name; originating during medieval times, Water jugs used were made from leather. The Tudor period also had its feel of leather jugs known as Bombards for the reason that the shape of its body resembled the barrel of the bombard gun. The use of the Leather bombards jar were very popularly used throughout the general public from the man in the street to royalty due to its massive sizes, leather lightness in comparison to its strength and durability. The only classification difference was decorated appearance of the jack, tankard or Leather bombards, which showed once level in society. There is sufficient evidence of English royalty giving historical decorated leather jacks to continental royalties.

2.3 History of Leather Processing

The story of leather is long and colourful. Many years before recorded history, people wrapped themselves in dried animal pelts. The fact that the skins turned stiff and

putrefied was a problem, but the ways of softening and preserving the hides were discovered. This was the beginning of the processing hides into leather. At first the pelts were most likely dried in sunlight and air dried. Far ahead they may have also been soaked in water and dried over a fire. Later it was discovered that some backs, twigs, and leaves soaked with the hides in water and then after dried helped to help preserve the leather.

Through archeologists' findings, we know that the first man used the skins of hunted animals for food as well as clothing. Nomadic ethnic groups made shelters from the hides of larger animals, such as bison. As civilization advanced, preserving hides and tanning them into leather became an important industry. In the 18th century tanning was an old and respectable trade and a tedious one. Nearly a year was spent manipulating a hide before it was delivered as leather to the saddle maker, harness maker or other craftsmen.

2.4 Leather Manufacturing Process

The hides and skins of animals are the sources of leather. The skins of large animals such as cattle, camels and horses are referred to as hides. Those of smaller animals such as sheep, goats and pigs are called skins. Animal skin consists of the epidermis, an outer protective layer of the skin covering the dermis. The „collagen“ which is present in corium, through tanning operations converted into highly durable leather material.

In India, 80% of hide available are from animals that died naturally due to ban on cow slaughter in many parts of the country. Goat and sheep skins, however, are by products

of the meat industry. Hides are 1-3 square meter (m²) in size and weigh about 10-20 kilograms (kg). Skins are smaller in size, 0.4 – 0.5 m² and lighter in weight around 1-2 kg. Slaughtered animal hides and skins contain 60-70 % of moisture, which make them liable to bacterial attack, which in turn decomposes the hides and skins.

2.4.1 Raw Materials for the Leather Industry

The leather enterprises depend on the by-product of the meat industries for about 95 %, forming the raw materials needed in this industry. The hides and skins gotten from farm animals (cows, sheep, and goats) are the leading common raw materials in the leather industry. In another exemplification we can have lions, camels, and buffalo hides being depended on as raw material for the industry. And skin derived from smaller animals as, fishes, dogs and monkeys can also from the raw material the industry needs.

The production of cattle hides, goatskins and sheepskins in Ghana has been on the increase which indicates the availability of raw materials and the prospects of not running into short supply. Raw materials availability has been acknowledged as a basic comparative advantage towards the export of leather and leather products (Felsner and Schmel, 2002). The value chain of leather in Ghana varieties from the raw materials (hides and skin) through to the leather products made (shoes, bags, sandals, slippers and accessories) (Jennifer, 2014).

2.4.2 Animal Hides and Skins Production

For many developing countries animal hides and skins are valued exports and they play an essential role in the livelihood of many communities as a source of income and employment prospects (Eboh *et al.*, 2004). Archaeological studies have shown that

leather has been used since antiquity as clothes, vessels, bedding, and possibly structurally in ancient dwelling places.

At present, leather is used in various integrated applications in buildings, vehicle furniture's and so on. Hides and skins, raw materials for the tanning industry, are renewable and easily perishable resources (Arunga, 1995).

The obtainability of hides and skins through the slaughtering of animals is of particular importance to the leather industry (Amakom, 1995). They could also be obtained from fish, birds, and reptiles, this to say that, both the wild and domesticated animals provide skins and hide. The most chief sources are cattle, goats and sheep (Nemile, 2003).

2.4.3 Animals used for Making Leather

About 65% of all leather comes from bovine material. Climate and adequate husbandry account for the fact that the best bovine raw material generally comes from the developed countries. The shift in raw material origins has prompted the industry to use more hides with surface defects or other structural deficiencies.

2.4.3.1 Pigskin

Presently, over 10% of all leathers made in the world are from Pigskin. China has made headway in the production of pigskin leather and is now the dominant producer of pigskins. Granting that this material may become extremely essential for the industry in the future, even being deliberated as the largest reservoir of future raw material, the leather potential has reduced, due to the fat content and structure of pigskin, it is extremely challenging to process. What is more, with all leather raw materials in perspective, pigskin is the most closely linked with the meat industry. Consequently,

for cultural beliefs and economic cost reasons, the skin is often left on the carcass and also used in the production of gelatin (UNIDO, 2010).

The world knows the access of pigskin into the leather market depends on culture believe, price and machinery. Making good leather out of pigskin involves considerable technical challenges. Statistics for pigs is far less reliable from the point of view of the leather industry since it depends on whether the skins are removed or scalded on the remains.

2.4.3.2 Goatskin

Goatskin which, by long term usage in the leather skin production industry is represented by the term *Morocco leather* (Bookbinding and Conservation, 2011).

Kidskin, used for gloves, shoes and other accessories, is traditionally goatskin, although other leathers such as sheep and kangaroo can be used to make kid (Cumming, 1982; Allen, 1916).

Tanned leather from goatskin is considered extremely durable and soft hide.

Goatskins usually used to make gloves, carpet binding, boots, rugs (for example in Indonesia) and other products. Kid gloves, prevalent in Victorian times, are still made in the present day. Non-tanned goatskin is used for drumheads, parchment or sounding boards of some musical instruments, like in medieval Europe (mišnice), in India (esraj), in Ireland (bodhrán) and for instrumental drums in Indonesia (bedug).



Source: Researcher's Activity Outcome (2015)

Plate 2.1: Leather from Goat Skin

2.4.3.3 Sheep skins

Sheep skins are one of the most common and important sources of raw material for the tanning industry. They are extensively smaller than cattle hides (Leach, 1995).

According to (FAO, 2002a) , In Egypt there are 4,450,000 heads of sheep which produced 2.7 million pieces of skin weighed 1600 tones (dry weight) and creates the export value of skins average 2.8 million US\$ (FAO, 2002b).



Source: Researcher's Activity Outcome (2015)

Plate 2.2: Leather from Sheep Skin

2.4.3.4 Cowhide

Cowhides are natural by-product of the cattle food industry. It is the natural, unbleached hide and hair of a cow. Cowhide retains the original grain color of the animal this mainly based on the breed of the animal. It can also be processed into leather, which can be used to make articles like shoes, leather jackets, and belts and so on. Bovine hides persistently represent about 2/3 of leather used by the industry, making it the most used material in the world by the leather industry. Cowhide can be painted to resemble skins as zebra, tiger, fish or snake skins, but this is done usually to the lower quality cowhides. The best quality hides are usually left in their natural state (grain colours based on the breed of the bovine).

The main development in the production of caprine skin, ovine skin and bovine hides are most directly related to leather production, and the gaps between killing and

tannery intake fundamentally have to do with hide collection issues. The Table 2.1 shows the percentage growth per annum in each of the three types of cowhide and skins since 1986 - 2003.



Source: Researcher's Activity Outcome (2015)

Plate 2.3: Leather from Cow Hide

Table 2.1: Cowhide and skin production growth (1986-2003 average) in Unit: % per year

	Bovine	Sheep	Goat
World	0.8	0.3	3.6
Developing countries	3.2	2.5	3.6
Latin America	2.5	0.1	0.2
Africa	1.6	1.8	1.3
Near East	1.8	0.6	3.6
Far East	4.8	5.3	4.4

Source: FAO (2003)

The document of the FAO data shown in Table 2.1 left out the pigskin leather which is already estimated at 11%, slightly more than 2.5 billion sq. ft. /year as shown in Table 2.2, but rather the above shows the well documented types of the main raw

material (cow, goats and sheep) of the. It also does not cover the leather production of buffalo, deer, yak, ostrich (birds), kangaroo, fish, reptile, camel and the many others. Since the leather production of these animals is available in very small amounts or limited world leather production, they are estimated to be around 1% of total world supply. There is an expectation they will become increasingly important and achieve a figure closer to 2 % soon.

Table 2.2: Share of leather raw material by type

Animals	%
Bovine	66
Sheep	15
Pig	11
Goat	7
Other	1-2

Source: FAO (2006)

Indeed a lot of literature on the production of leather in the world has faced a lot of difficulty in the measuring of the production of pigskin and other types produce in the world creates a vital difference; there is a suggestion that buffalo, cattle, sheep and goat leather production are presently running in the world leather production at between 21 - 22 billion square feet, as opposed to the 18.7 billion given by FAO (2006). Also, there is a report from UNIDO (2002) on many studies disagreeing that the most major aspect is the cultural factors of the world, this has major influences on the production of hides and skins. One of the countries presently showing a strong leather industrial development is Ethiopia a sub-Saharan east African country. There is the hope of them being a strong domestic leather industry and pulling more hides and skins into the tanneries and possibly increasing the off-take rate.

Statistics from FAO indicates that during 2001-2003 international trade pegged its total rawhide output at 38%, which exceeded about almost over a third of the average figure for that of 1980 when the same statistic was taken. Sheepskin trades rather dropped 47% in that same period, which made Europe the main exporter. Goatskin exporting countries held on to their own domestic supply thereby causing a decrease in the same period (2001-2003).

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2.5 Leather Production

The pre-tanning processing and the production of hides and skins into leather are practiced all over the world. Nevertheless, localities for the production of natural leather and the fabrication of leather articles are much less general in the world. Two thirds of well refined completed leather comes from ten countries, making the four dominant once Italy, China, India and the Republic of Korea (Leach and Trevor, 2009).

2.5.1 Tanning

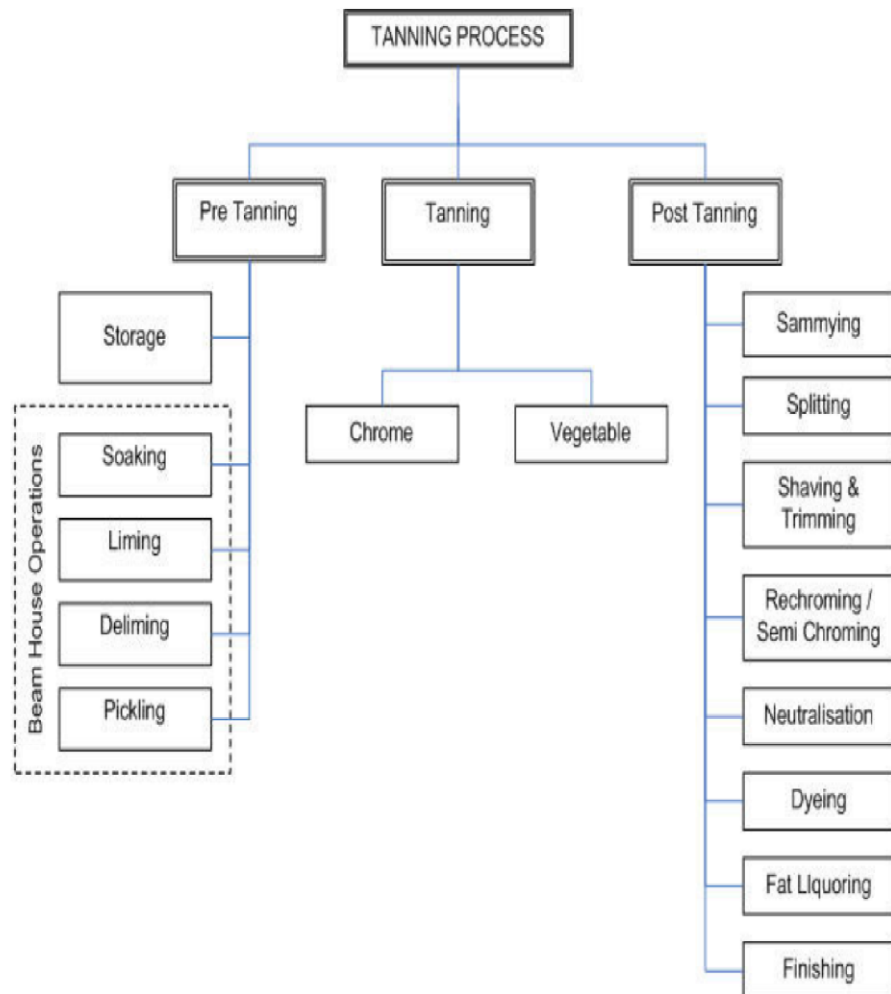
The preservation of raw hides and skins in the tannery can be divided into four main categories:

- Preservation of hides and skins storage
- Beam house operations
- Tanning operations
- Post-tanning and finishing operations

There can be a variation in the above categories depending on the raw materials available for the activities in the tannery and the final desired products.

a. Process of Tanning

The process of transforming raw hides and skins into leather is termed tanning. The processes are classified into three sections (pre-tanning, tanning and post-tanning) are depicted in Figure 2.1.



Source: (Leach and Trevor, 2009)

Figure 2.1: Process of tanning skin/hide into leather

b. Pre-tanning Operations

i) Raw hides/skins

Raw hides/skins usually consist of 65 % water and proteins and fat 30-35 %. In view of the high measure of dampness in the hide/skin, there will be bacterial degradation.

To keep this bacterial movement, the dampness substance should be brought down to under 30%. This is applied so as to dry it out, typically done normal salt (i.e., Sodium Chloride) to the hide/skins to the tune of 30-45% by weight.

ii) Sorting

Hides and skins are sorted into a few evaluations by size, weight, or quality.

iii) Trimming

Trimming is for the most part completed amid the sorting procedure. An edges' percentage (legs, tails and heads, and so on.) of the raw hide and skins can be cut off. Generally, this is done in the abattoir, yet it can likewise be done in tanneries.

iv) Curing and Storing

Curing is a procedure that keeps the disintegration of hides and skins from the time they are flayed in the abattoir until the procedures in the beam house start. At whatever point raw materials can't be prepared instantly ("green"), it must be cured. Prominent routines for long haul conservation are salting and drying. Techniques for fleeting safeguarding (2-5 days) are cooling, utilizing smashed ice or refrigerated storage, and biocides. Curing is done in the abattoir, at the hide market, or at the tannery. In specific cases it may be important to repeat the processes in the tannery, e.g., chilled hide away can be salted for more stockpiling or if salting was not sufficiently effective. Hides and skins are by and large put away on beds in ventilated or aerated and cooled and/or cooled territories, contingent upon the strategy for curing picked. From storage the hides and skins are taken to the beam house.

v) Soaking

The fundamental reason for this procedure is to evacuate the salt utilized amid curing, re-hydrating the material and to dispose of undesirable materials, for example, dung, blood, soil and so on. The length of time of soaking may run for a few hours to a couple of days. Contingent upon the kind of raw materials utilized, in soaking added substances, for example, surfactants, enzyme preparations and bactericides can be utilized to help protect the pelt in many ways. The process of soaking can be classified into three stages

1. Dirt soaking – In dirt soaking, 300-400 % of water is utilized to evacuate the undesirable materials
2. Main Soaking – The motivation behind Main Soaking is to re-hydrate the material. In this operation, water, non-anionic wetting agent (0.2 % concentrated soda ash (0.2% concentrated) and additives (0.0 5% focus) are utilized.
3. Last soaking – Just water is utilized for the washing reason as a part of this operation major part of salt connected with the safeguarding of skin/hide up is evacuated amid the soaking operation.

vi) Liming

The reason for this operation is to encourage the removal of hair, tissue, fat (somewhat), inter-fibrillary protein and to open-up the fibrous structure for osmotic swelling. The procedure of liming can be comprehensively grouped into two sections i.e., dehairing and re-liming

1. Dehairing – Lime (8-10 %) along with Sodium Sulphide (3 %) is applied to the skin to remove hair.
2. Re-liming – To open up fibrous structure, lime, soda ash, caustic soda, *etc.*, are applied. The pH of the skin being processed will rise to 12- 12.5.

vii) Fleshing

The excess fleshing is removed physically or by using fleshing machines. The amount of wet fleshing is in the scope of 10-15% of the heaviness of pelt (hide/skins).

viii) De-liming

This is a procedure to change the pH in the middle of 8-8.5 keeping in mind the end goal to improve the enzymatic action, which changes over a proteins' percentage into solvent structures. pH redress i.e., from 12-12.5 to 8-8.5 are finished by utilizing ammonium chloride as a part of instance of soft leather and ammonium sulphate if there should arise an occurrence of hard leather.

ix) Pickling

Pickling is a procedure of adjusting the pH suitable to the tanning operation and to anticipate swelling of the leather i.e. dehydration (drying out) of the leather. In this procedure, water (80 %), salts (8-10 %), formic acid (0.28-0.3 %), sulphuric acid (0.75 – 2 % in light of thickness) are applied.

PH correction: for vegetable tanning, a pH in the middle of 4 and 4.5 is looked after a while; pH in the middle of 2.5 and 7.3 is kept up if there should be an occurrence of chrome tanning.

Prevention of swelling: The salts to the tune of 8-10% is utilized as a part of this procedure, to keep the swelling. In this way the lack of hydration (dehydration) happens.

2.5.1.3 Tanning Operations

The tanning procedure is of two sorts i.e., mineral tanning and vegetable tanning. Of the total leather generation in India, more than 80 %, depending on chrome tanning and the lay depends on vegetable tanning.

a) Chrome Tanning

Basic chromium sulphate [$\text{Cr}_2(\text{SO}_4)_3$] (7-10 %) containing 25% Cr_2O_3 and sodium sulphate (25-30 %) is utilized as a part of chrome tanning. A pickle's piece shower is utilized for chrome tanning operation. The pH expands to 3.8-4.0 toward the end of the chrome tanning procedure which is called pacification. The semicompleted leather after chrome tanning is called wet blue.

b) Vegetable Tanning

Plant extracts are utilized with the end goal of tanning in this procedure. The pH tumbles down from 4-4.5 to 3-3.5. In spite of the fact that this procedure is free of any substantial metal utilize, the leather created from this procedure has similarly weaker limit of heat resistance and colour holding.

2.5.2 Vegetable Tanned Leather

The tanning procedure changes the raw protein shroud or skins into a stable material which won't rot (putrefy) and is suitable for a wide mixture of purposes. There are

numerous tanning systems and materials and the decision depends chiefly on the properties needed in the completed leather, the elective's expense material, the plant accessible and the sort of raw material.

Leather tanning can mainly be grouped into five major methods: vegetable tanning, alum tanning, chrome tanning, combination tanning and oil tanning. Much attention will be given to the review of literature on vegetable tanned leather due to its importance in this research. Most sculpture forms involving the use of leather are best carried out using vegetable tanned leather.

Vegetable tans which are water extracted from plant leaves, backs, consist of large polyphenol molecules with some acidic groups and high secondary valency potential. The acidic groups may combine with the basic groups of the protein, displacing the hydrated water; and the numerous secondary valencies, dipole or hydrogen bonds, to the peptide groups, displacing their hydrated water.

Vegetable tannage could be considered as dehydration of the wet protein, replacing the water molecules by a sheath of vegetable tan molecules. Consequently, the indigenous northern Ghanaian tanners use tannins gotten from the pods from *Acacia nautical* known locally as “BAGARUWA”. The plant is pounded and leached with water to extract tannin for the tanning liquor. Tannage is conducted by putting the pelts in a weaker tanning solutions mostly already used solutions; then they are put in stronger ones and finally in a more stronger solutions.

The solution is stirred among the pelt so as its distribution become uniform until the centre layer of the pelt is thoroughly tanned as the outside layer. The type of pelt being tanned influences the number of times the pelt is put in the pit. The difference in the tanning is the heavy leather requires stronger tanning, hence the hides are turned regularly into the pit of vat and it takes a long period of time in the tanning solution while less thicker pelt do not keep as long in the pit of vat.

Finally, vegetable tanned leather comes with many advantages such as its firm nature, and more water – resistant than chrome tanned leather; it may be stuffed with fats and oil been worked into it (Stuffing makes the leather water repellent). Historical and present time empirical records, espouse vegetable tanned leather as Potential material in leather vessel production throughout the times, the existence and history of this leather are appreciated in almost all leather vessel production. Buck (1992) states to confirm that, vegetable with the natural tannic acid gotten from wood bark is a much older and slower method of tanning leather; also the chemical used renders the leather potency to be subject to pressure.

The vegetable tanning method, on the other hand is used to prepare leather for artefacts which require embossing, moulding, carving and other forms of tooling as emphasized by (Sharphouse, 1995; Boahin, 2005; 2008; Asubonteng, 2010). Sewell and Roberts (2011) confirmed that, vegetable tanned hide is a brilliant material for hand cutting whilst its normal shading additionally turns out to be the most open leather vessel creation. It changes from 3mm to 5mm in thickness relying upon the vessel, it is utilized for; introductory outline is cut freehand into the surface and the wet hide is formed with different devices on either side of the slice to in the long run make a 3D

impact; recolouring the main bodies with a water based vegetable stains and regularly utilize acrylic paints for improving the patterns.

2.6 Hardening of Leather

Many techniques have been employed in hardening leather. The most common term used is referred to as “cuir bouilli”. The term “cuir bouilli” has for quite a while been connected with the solidifying leather. All the more ideally, “cuir bouilli” seems to allude all the more particularly to the system of water-hardening leather.

2.6.1 Types of Techniques Employed in Leather Hardening

There are a several techniques used to make “cuir bouilli”. Basically, it appears to require the correct kind of hide, painstakingly connected warmth and potentially some type of fluid. The final item will rely on upon the method that you believe is more suitable, in light of your final objectives.

a. Simple Soaking

The primary and the least demanding, is to absorb the hide frosty water (the length of one needs to, recommendations range from 15 min to 12 h or more) then shape it and let it dry. Socking hides to make it harder is truly more suitable for vegetable tanned leather. On the off chance that the soaked leather is then set in a pot of water which has been pre-warmed to 180 OC, it will start to change fit as a fiddle (shape) and composition (texture) (Turner, 2009). After give or take 60 sec, the hide obscures, goes limp and starts to twist up. In the event that removed at that stage, it will have contracted somewhat, thickened marginally, and still have the capacity to be extended or stretched, for example, a sheet of elastic(rubber).

b. Hot Water Soaking

This is the place the leather is submerged in a pre-boiled. The more sweltering the water one absorbs it, the harder it will be the point at which it dries. Likewise, the more drawn out the time frame that the hide is left in boiling point water, the more it therapists or shrinks, the darker it gets, the thicker it gets to be, and the harder the completed item is. Be that as it may, every bit of leather has its own particular time when the water is excessively hot and will be cooked by it. On the off chance that this happens, one's most solid option is to keep it hot and stretch it out on a structure and let it dry. It turns out to be very hard and fragile yet that is the punishment for over desire that. Adequate time in high temp water will render cowhide into something which takes after wood, then again, as with most common things, the procedure has an exchange off, in that the harder the leather, the more fragile (brittle) it gets to be.

Give or take 30 sec of immersion is normally adequate to solidify leather to a suitable state - where the hide is solidified yet at the same time adaptable - and results in a shrinkage of give or take 1/eighth the first size (i.e. the completed article will be 7/8th the first's extent) and an increment in thickness of pretty nearly 25%.

c. Boiling Water Soaking

The "cuir bouilli" procedure can be significantly abbreviated by the utilization of boiling water. Turner (2009) reported that 30 sec of submersion in boiling water will bring about shrinkage to 7/8th of the first size and 40 sec inundation in boiling water results in shrinkage to 2/3rd of the first size and more or less pairs the original thickness of the leather.

2.6.1.4 Baking

According to Waterer (1950), “cuir bouilli” is made by soaking vegetable tanned hide in water until it is completely water logged and afterward shaping it to form and drying it in a consistent temperature of 50 OC (or 122 F). Heating the wet leather can make it considerably harder, say in an oven, yet there is the danger of steam singeing it and making it shrink. Play with scrap pieces until one get the temperature about what one feel is simply right and after that heat one’s piece, attached to the form with string, sewed, or nailed set up.

2.6.1.5 Wax-Hardened Leather

In spite of the fact that the data identifying with the technique of wax-hardening hide has been lumped together with “cuir bouilli” for quite a while, the idea is in genuine truth a cutting edge one. In spite of the fact that the wax's quality solidified cowhide is not to the same standard as water-hardening leather, the technique has its place as far as climate sealing hides, serving to hold its structure, and rendering it helpful for conveying objects and fluids and utilization as re-order defensive layer. Because of the way that it is significantly all the more effortlessly pierced by a sharp instrument, its utilization on the old battlefield zone seems to have been restricted.

The wax ought to be held just barely above softening point. At the point when the wax is excessively hot, it will blaze or cook the hide which will then shrink up and turn out to be extremely fragile. At the point when leather is dropped into the wax of the right temperature, minor air pockets (bubbles) will develop very quickly and start to stream up to the surface. Alternatively, the leather can be left in the wax until the air pockets quit forming, or removed after a brief time. In the event that the leather article is left

in the wax, watch that the leather touching the skillet's base not get smoldered or burned. Overwhelming vegetable tanned leather can take 20 to 45 min to assimilate the wax appropriately.

2.7 Leather Products

The nature of completed leather dependably relies on upon the way the animals were raised, flayed, and the sort of tanning procedure used (Amakom, 1995). The nature of handled leather in the nation is regularly of poor quality in light of the fact that quite a bit of it is delivered by customary tanners, who use unscientific, delayed soaking methods and old fashioned surface treatment solution.

Generally, around 65 % of leather went into footwear, yet this extent has been diminishing of late toward 55 %. In 2008, interestingly, under 50 % percent of footwear was made of leather. Then again, there has been development in leather upholstery and other leather items and leather has gained new and creative employments. The vehicles upholstery part has been uncommonly solid since around 1990.

There are currently no areas in which leather can't be supplanted by different materials, and the industry needs to secure the picture of leather items as synonymous with quality – both tasteful and utilitarian. As specialized materials grow further and "engineered leather" enhance, the difficulties to leather will turn out to be all the more threatening.

2.7.1 Leather Goods and other Leather Products

History books, let us know about leather vessels called coracles (still been used in Tibet), about skin containers and hide protective layer (armour). End employments of leather have been changing significantly throughout the hundreds of years, and the industry has needed to surrender and utilizes many times in the course of the most recent 1,000 years or more, despite the fact that interest in leather has expanded. All systems that drive the business sector for skins and leather items identify with populace development and per capita discretionary cash flow. Footwear is a more essentially patronized product, while the majority of alternate things need to with developing riches associated with employment and income security.

2.7.2 Leather Goods

In the expert language of the leather commercial ventures, the expression "leather goods" covers an extensive variety of things, for example, a wide range of bags, attaché cases, baggage and other travel merchandise, level or little things (e.g., wallets, purses), belts, and so on., yet prohibits other leather items, for example, upholstery and clothing.

In many dialects, this term essentially signifies "things made of leather", e.g., in German, "Lederwaren," in Arabic, "mawed min jeld," and in Indonesian, "barang kulit." The French expression "maroquinerie" is an exemption, yet just in appearance, since it originates from Morocco "Maroc", where individuals used to deliver a specific nature of goatskin leather called "le maroquin." The leather merchandise industry has a history with exceptionally unmistakable movements in end uses and materials, from the time of horse and foot transport to the vehicles period, from the utilization of

leather items for particular practical purposes to the present business sector of extravagance products.

A lot of leather products have been are still made in little craft/art shops. Accordingly, statistics are rare, not always dependable, or in view of casual communications. Because of the wide mixture of items, with distinctive functions, construction, sizes, and material structures, accessible productions and exchange insights are communicated in worth as opposed to in characteristic (natural volume) terms.

2.7.3 Recent Developments in Leather Goods

During the last 25 to 30 years, the leather merchandise industry has experienced real changes because of special elements, for example:

- The ascent of expectations for everyday comforts and work costs in many nations that create leather products;
- The rise of showcasing and brand procedures at national and global level, mostly because of new publicizing instruments (e.g., TV and radio advertising);
- The separating of activities through generation outsourcing and exchange of ability of developing nations;
- The improvement of air travel and tourism;
- Significant advancement in procedure innovation;
- Development in efficiency;
- The advancement of the vehicle industry.

2.7.4 Leather Product Groups

The historical backdrop of leather products clarifies the underlining differing qualities that portray this activity. That is the reason it is maybe better to utilize the expression “leather goods industries,” since items and related assembling methods are extremely differing and manufacturing volumes have expanded enormously. Industrial hides and skins are currently created in such little volumes that they fit with materials in a small scale corner and are hard to classify. All the same, they ought not to be disregarded.

a. Handbags

Ladies' bags represent to a colossal leather products market. Handbags are not just a helpful adornment; they are additionally an indication of social status. The utilization of handbags is all that much impacted by society and fashion, which themselves differ starting with one nation then onto the next. There are numerous value or price in the business sector and a wide assortment of designs and styles. Hence, the market sector for bags retailing as US\$1, 000 or more has been becoming quickly in the previous five years.

b. Small leather goods

These are less subject to form and fashion. Pocket leather products, which are chiefly made of genuine leather, take after societal patterns trends and uses, for example, the size of credit card or banknotes. The most recent ten years have seen the improvement in the significance of holsters for cell telephones, MP3 players, and iPods. The super-extravagance leather product identified with electronic hardware is a fragment that is required and expected to develop.

c. Travel goods

Constitute an extensive business market sector that has created in venture with voyaging and tourism. The accentuation is essentially on ergonomics and handiness. The real patterns in the course of the most recent years have been the acquaintance of wheels with a wide range of gear and the quest for lightness. This has conflicted with leather. There have been impressive changes in the most recent decade with the entry of spending budget plan airlines carriers and ceaselessly changing security rules. Short-pull travellers not wishing to process in luggage have made a business opportunity for most extreme size hand/lodge luggage of high calibre or quality.

d. Briefcases and portfolios:

This commercial sector is connected to travel and business. Portable PCs (laptops) have made an incredible requirement for cases with a particular design – they are basically produced using superior textiles and engineered materials. Correspondingly, ladies' and men's portfolios made of real leather and synthetic textiles hold a vital spot in the market sector. Changes in travel are influencing this sector in the same path as they travel products.

e. School articles

This class compares to that of the old "leather satchel bags." Trends and Patterns changed in 1980 with the presence of new and popular fashionable lines of school bags packs in Germany and France. Today, the Trends and Patterns is the rucksack made of canvas and design printed with different logos and brand names. Various the better-known brands today were at first military packs and developed into school sack bags made of materials, for example, corduroy.

f. Saddlery

This is a particular business sector with a certain client. Saddles and harness products fit in with the extravagance segment because of their tedious assembling and manufacturing methods. They are not really influenced or affected by fashion trends, so they can undoubtedly be made in nations with low working costs (labour). There is still a premium business sector for predominant quality saddles, particularly the "English" saddle; most makers of top notch and quality saddles are in the UK, France and Germany. Pakistan, Argentina and Morocco are currently imperative suppliers of saddles, India is additionally trying efforts to get an offer of this concentrate market.

g. Cat and dog articles

A quickly developing market sector in industrialized nations (Europe, USA and the UK), where individuals are progressively attached to pets. A large number of these items (e.g., collars, chains, gags) are made dominantly in developing nations. The pet-sustenance sector, which utilizes raw leather, is a different, however critical market division.

h. Hunting and fishing articles

This is a particular market that is not by any means affected by fashion design trends. These articles are by and large acquired by well-to individuals with a wide mixture of background.

i. Stationery articles and special cases these stationery articles, for example, work area cushions (desk pads) and scratch pad spreads are today in decay because of the utilization of computers. Be that as it may, different articles, for example, mobile telephone holsters, are blasting and booming in demand. The fountain pen has made a

comeback and, with it, the interest in protective carrying cases has re-raised. Some development at the extravagance and luxury end of this market sector can be expected and normal, as the balance between the computer and paper keeps on evolving.

j. Military equipment

In history, leather and the military have been of awesome significance to one another as far as seats, harness, belting, holsters, footwear, and at one time armour covering. Today, this is a certain specific marketing sector, which has been developed extensively in the last ten years. The main items produced are footwear and gloves (as individual defensive hardware), which are presently typically made of very specialized hides.

k. Belts

This is an unfaltering and moderately vast market, particularly in the conventional men's belts section. Belts are very little affected by fashionable style, since changes happen for the most part in buckle designs. The assembling procedure of such articles has turned out to be much mechanical.

l. Watch straps

These leather articles likewise constitute a moderately vast marketing sector that has just been somewhat debilitated by metal or synthetic straps since it settled a few years back. The assembling methods, as on account of belts, is profoundly mechanized, with the exception of top extravagance items (hand-sewed straps made of exotic skins). Skins for watch straps must be hostile to anti-allergic and to have great levels of water resistance. By and large, the leather product industry is portrayed by the assorted

qualities of its articles. These products are continually developed as indicated by buyer needs and, for specific items, to form a fashion pattern.

2.8 Leather Manufacturing Industry

The leather merchandise industry has customarily been an activity, including a lot of manual work significantly more than that of footwear. This is still genuine, and it will most likely remain so later on, especially in the extravagance and luxury portion. Numerous activities, particularly cutting and assembling, require evaluation or specific articles. Since the start of industrialization, and for most items, fundamental assembling and manufacturing methods have not experienced critical changes. It ought to be noticed that some style changes that have occurred subsequent to 1980 –for example, the preference for shoulder-strap bags and the progressive surrender of formed purses – have almost brought about the loss of certain set up assembling and production methods.

While fabricating operations have not experienced significant changes, profitability has impressively expanded because of advances made in different fields. Changes in hardware (more particular and with better execution), the advancement of new sorts of adhesives, CAD and CAM systems, new cutting methods (water jet, laser), and computerization (when conceivable) have prompted critical enhancements and improvements in quality, operation speed/execution, and the administrator's comfort. The extravagance leather products division has stimulated the improvement of new devices and little machines focused on operations that were performed by hand before (e.g. edge warming, glue spraying and smoothing). High profitability increases are likewise accomplished on account of development in work association and plant

administration. Work enhancement is encouraged today by computers and video feature procedures, and these profitability variables don't have any significant bearing just too substantial volume producing.

Another interesting, but less obvious in the manufacturing industry is the use of hides in the production of drinking vessels and extra luxury leather goods. Not at all like gems, have extravagance leather articles dependably involved a utilitarian perspective (e.g., wallets hold banknotes and Visa cards, briefcases convey reports). Alongside their essential capacities, these items, with their outline qualities, modern workmanship and valuable materials used, likewise infer economic wellbeing for the possessor/client.

This angle mostly clarifies the extravagance's accomplishment area of leather articles. Another reason is that extravagance leather products are frequently gift articles by brilliance. All through the month of December, leather products retailers achieve around 25% of their yearly profit because of Christmas sales deals (in Islamic nations, sales are exceptionally generous toward the end of Ramadan and amid Help El-Fitr). A material that has one evident legitimacy, that of being basically unbreakable, is leather, and drinking cups were regularly made of it.

2.8.1 Drinking Vessels

The utilization of the extraordinary vessels for drinking purposes might reasonably be expected to have had a natural starting point an origin and improvement. From a useful perspective, it would soon be discovered alluring to give vessels to liquids notwithstanding those serving to hold food. As in numerous other ordinary subtle

elements of cutting edge life, we must swing a turn to the primitive races to see how our current conditions were coming to.

Natural objects such as coconut and the gourd or calabash, the eggs of bigger birds such as the ostrich, shells like the nautilus are equally convenient to be used as drinking vessels. Such conventional objects are utilized by the remote or boorish ethnic groups of Africa, Polynesia and even America, and in addition, at times, by the white races who have imposed or barged in into those parts of the world, and received a local's portion propensities.

A different line of improvement, in any case, has been observed to be the normal result of the human personality. Nothing could shape a more pragmatic drinking vessel than the half of a coconut shell or a piece of a gourd. Such containers, then again, in the nations where the plants creating them are basic and common, would be effectively acquired, and each one, rich or poor, could have one or more. Altogether, subsequently, to recognize the chief's belonging from those of his inferiors, his vessel is frequently made with extraordinary work, from some more obdurate material, stone or wood, however, in for all intents and purposes the same structural form as that of the natural article.

The potter's creation workmanship where the plastic nature of the raw material renders it equipped for vast changes of structural form, offered rise to sort of vessels having no undeniable or fundamental connection to the constructions of nature. The drinking vessel having the most unbroken history is without a doubt the goblet of the Christian Church. Like other ritualistic articles it was most likely separated from the drinking

containers common utilization by a continuous shift, and in the early centuries it is not likely that it contrasted either in shape or material from the standard household vessel of the time.

The materials of which goblets were made in the early hundreds or centuries appear to have been as different as those of customary vessels. Glass was without a doubt a most loved substance, maybe from its loaning itself promptly to circumspect cleanliness; yet wood, horn, ivory and comparable materials were without a doubt being used, and were every now and then denounced as inappropriate by the Congregation's Fathers.

In spite of the fact that the utilization of wooden vessels pretty much intricately mounted was preceded with well into the 16th century as a trendy style, numerous different materials of far more noteworthy quality were being used among the affluent much sooner than that time. Gold, agate, gem and other hard stones, Chinese porcelain, ivory and additionally more normal products, were all being used, and also the valuable metals. The inventories of the 14th and 15th centuries are overflowing with passages demonstrating that such valuable drinking vessels were genuinely regular.

During the 15th and 16th centuries the shapes, enhancement and materials of drinking vessels were verging on interminable. A most loved item to be so adjusted was an ostrich egg, and numerous can be found in exhibition halls in extensive silver mounts; coconuts were likewise utilized as a part of the same way, and Chinese and other Oriental products then of extraordinary variety, were regularly transformed into

drinking cups and vases by cunningly formulated silver mounting. The utilization of drinking vessels either shaped of genuine horns or of different materials was normal in the 15th and 16th centuries, particularly in the north.

The utilization of glass drinking vessels was not basically common in Britain until the 16th century. A material that has one clear legitimacy, that of being for all intents and purposes unbreakable, is leather, and drinking mugs were regularly made of it. The flask called a "black jack" is the best-known, and samples are extremely common, for the most part of the 17th and 18th centuries. An interesting fashion was to have a leather drinking vessel made as a woman's shoe; this, in any case, was bound for Germany and may be thought to be in a fairly flawed taste. In those same centuries an extraordinary motivation was given to the generation of inquisitive drinking vessels in ceramics. In Britain at different preparing focuses an awesome number of mugs called "tygs" were made: a substantial mug with a few handles, three or four, round the sides so that the drinking vessel could be promptly given from one to another.

2.8.2 History of Leather Drinking Vessels

There are some historical accounts that show the existence of leather vessels stretching from ancient periods going through the times of great events like the Crimean war and even showing its existence in great empires like the Egyptian, Roman and British empires. Also, some moulded leather drinking vessels may era back to early Egyptian epochs when some pottery vessels followed the style and form of skin stacks. England, Scotland and Wales have also been the home of leather vessels in the past, even to the present, in a greater numbers than anywhere else in history. Also the unique vessel existence has become characterized with the British society.

Hamilton (1997) confirmed leather as a vessel, he stated “although the potters craft is very old, long before this man was using a leather mug (black jacks) to drink from leather pouches to keep his food in and even bottles of a type of stone- leather crafts predates nearly all other craft articles. “The use of leather drinking vessels continued until Nelson’s period when it became popularly known as “Boots” hence the phrase “fill your boots “ implied “have a drink”.

During the Crimea, leather drinking vessel got another nickname tankards were used. They are light in weight, and made less to no noise on the fighting front and could be easily respired in the battle field. Even in the 20th century leather drinking vessel were used predominantly in the metal mining industries profuse amount of water were required due to the hot air, dust or smoke.

2.8.3 The Influence and Impact of Leather Vessels

Historians of leather artefacts are of the view that leather vessels stretch from ancient times, right from the pre-historic man through Egyptian civilization in the 21st century. Steven (2007) is of the view that, the leather vessels are extinct, he states “this projection would have been attached to the lid (probably originally of organic materials such as wood or leather, but now lost)”; but Sewell and Roberts (2011), are of a different view, they stated that, The Hidebound item range goes to the first's heart English convention, yet all our leather drinking vessels are proposed for today’s utilization and satisfaction. Therefore, this literature seeks to review the evidential studies of the leather vessel impact in the world in period past and present time. This statement is further corroborated by Sewell and Roberts (2011), that, Leather drinking

vessels are closely connected with the social history of their nation and the vessel utilization remains to the present day.

With a long heritage dating back to ancient epochs, leather drinking vessels are carefully-handcrafted cups, flasks and bottles, each made in a unique-possible measure of details and accuracy. Bring out a real representation of a medieval design to a lover of the antiquity.

A leather botteller, Hardwick (2012), is of the view that, the craft of making leather vessels has been around for thousands of years and really blossomed into a recognized craft and trade in medieval England where leather vessels were the norm. As other materials were regarded as undesirable or too costly for the general population, leather vessels were made in large numbers.

Indeed Leather vessels have an historical legacy which has had an influence on the social antiquity of the many cultures and their use remains even to the present-day. The statement is supported by Sewell and Roberts (2011), that, During Elizabethan times, wealthy merchant families would own just one wine glass because Venetian glass was costly. The glass was placed in the middle portion of the table and used mutually; it would be refilled when finished by a manservant who stood in the corner of the room with a leather drinking bottle known as the boteller or, in modern terms, the butler.

Gooding (2012) reported that some of life's best daily rituals revolve around drinks. Leather and glass mug seem to be the perfect match for such a timeless ritual. Recently the daily grommet web space featured in their web page a USA company called Holdster ; they covert mason jars into leather-bound travel mugs, which has the ability

to protect the hands from hot beverages. This proves the extent that the leather vessels industry has impacted the 21st century.

CHAPTER THREE METHODOLOGY

3.1 Overview

This chapter looks at the methodology of the study. It explains the sources where the raw materials were obtained, the research design, experiments conducted, a description of the processes followed in processing the raw material. It also assesses the suitability of the material in producing a leather vessel.

3.2 Research Design

The researcher employed the qualitative research, using the descriptive and experimental methods in this study. The descriptive method was employed to describe the processes followed to execute the experiments conducted towards the production of the local Ghanaian vegetable tanned leather vessel. It is relevant to state that although the experimental method was chosen to explore the local Ghanaian vegetable tanned leather as a viable and reliable material in leather vessel manufacturing. The leather was also taking through some "cuir bouilli" techniques to determine which technique will be more suitable for the production of the leather vessel and the ranging effect on the various parts. Tools, materials, practical tests and the results are described in detail.

3.3 Library Research

Literatures documented for the study were gathered from the following libraries:

- KNUST Main, library. Kumasi

- Faculty of Art Library. Kumasi: Other sources included data collected from internet and unpublished thesis, journals, documentary sources from books.

3.4 Population for the Study

According to Fraenkel and Wallen (2009), the term *population*, as used in research, refers to all the members of a particular group. It is the group of interest to the researcher, the group to whom the researcher would like to generalize the results of a study. Therefore the researcher's population for the study was heterogeneous and it was made up of leather experts and ceramics experts, vessel manufacturers, leather artisans and leather sellers. Even though the population consisted of experts having varied backgrounds in terms of their specialty, the same approach but different questions were used to collect data for the study. The total population for the study is shown in Table 3.1

Table 3.1: Population of the Study

LOCATIONS	IRAI (KNUST)	Kumasi Culture Centre	Industrial Art (Ceramic Section) KNUST	TOTAL
TYPES	Leather experts	Leather and ceramic artisans	Ceramic experts	
NUMBERS	10	20	15	45

Source: Researcher's Population Results (2015)

3.4.1 Target Population

Table 3.2: The Target Population

LOCATIONS	IRAI (KNUST)	Kumasi Culture Centre	Industrial Art (Ceramic Section) KNUST	TOTAL
TYPES	Leather experts	Leather and ceramic artisans	Ceramic experts	
NUMBERS	5	15	10	30

Source: Researcher's Population Results (2015)

3.4.2 Accessible population

Accessible population is a group or section that the researcher collected data from. In the study the accessible population comprises of 3 leather experts from Integrated Rural Art and Industry, 7 leather and ceramic artisans in the Kumasi Culture Centre, 4 ceramic experts from Industrial Art (ceramic section).

3.5 Sampling Technique

Due to limiting factors of expenses, time and accessibility, it was not possible or particle to obtain data from the entire population. In this regard the researcher collected data from the accessible population in such a way that the information gained is representative of the total population under study. Sampling according to Asare-Forjour (2009), has taken a portion of the population a representation of the entire population. It may be described as relying on a cross section of a target population to perform an experiment or an observational study. Therefore, without bias there is the need to select a representative for the population. The researcher therefore used convenience and purposive sampling techniques.

3.5.1 Purposive Sampling and Convenience Sampling

According to Ross (2002), a purposive sampling technique involves selecting members of a population to comprise a sample because they possess specific attribute of interest that addresses the purpose of a particular research problem under investigation. The purposive sampling technique was adopted to select the leather and ceramic artisans at the Kumasi Culture Centre. Whiles convince sampling technique was adopted to select the leather and ceramic experts for the convenience and time factor on the part of the researcher.

3.6 Data Collection Instruments

Owusu (2010), refers to instrumentation as a process used to solicit information in research. Considering the nature of the study and data required, interviews and observation were combined and found to be most suited for the study.

3.6.1 Observation

McMillan (1993), defines observation as a particular kind of data gathering tool, in which the researcher observes visually and systematically records the outcome of the observation. To this end the researcher observed the use of various parts of the leather and its effect on the finished product. Also the researcher observed the effect of the “cuir bouilli” techniques when applied to the indigenous tanned leather specimens.

3.6.2 Interview

According to McMillan, (1993) an interview consists of a direct verbal interaction between the interviewer and the subject. Similarly, Ndagi (1997) also explained that interview is unique in that it involves the collection of data through direct verbal interaction between the interviewee and the interviewer. This data collection instrument was used to gather information from the leather and ceramic experts and artisans.

3.6.3 Validation of Instruments

The interview and observation guide were prepared by the researcher to help him collect the kind of data. The data collection instruments were vetted by the supervisor.

3.6.4 Data Collection Procedure

The researcher sort permission from the experts and artisans in the accessible group. Two days after the researcher meet the leather experts at the department of integrated

rural art and industry KNUST. An interview section was held with the three experts over a period of 40min. After a week the researcher arranged with the ceramic experts in the accessible population and had an interview section with them. This took a period of 30mins. A week after the researcher arrange with some leather and ceramic artisans in the accessible population and had some interview section with them. This took a period of 4 hours.

The observation was done in the course of the experiment this lasted for 1 year.

3.6.5 Data Analysis Plan

Data collected in the form of field notes were transcribed and assembled in a narrative form, pictures to vividly support described items. Also tables were used to describe the physical properties of Ghanaian vegetable tanned leather as affected by the “cuir bouilli” techniques. The detail of this has been provided in chapter four.

3.7 Ethical consideration

In all research ethics should be considered. Ethical consideration provides a statement on how respondents will be advised of the nature of the study and how their consent will be sought for in conducting the research. The researcher made respondent aware of the nature of the study. Also, respondents were informed of the fact that the research will consider the information by them as confidential and hence pseudonyms will be used to cover their identity.

3.8 Source of Materials

The pelts of a cow were obtained from the Kumasi abattoir. Bee wax was also obtained from a bee farming community in the Central Region of Ghana called

Infante Nyankumasi.

3.9 Preparation of Material

The procedure outline in Encyclopedia Britannica (1977) was used in processing the cow pelt into leather. At the tannery, the pelt was taken through beaming where the hide was put in a pit containing lime, soda ash, caustic soda to help open up fibrous structure, this procedure is termed liming. The reason for this operation is to encourage the removal of hair, tissue, fat (somewhat), inter-fibrillary protein and to open-up the fibrous structure for osmotic swelling.

The hide was drained and piled using razor sharp knives to scrape the flesh and tissue from the inner side of the hide.

This was followed by dehairing where the hide was soaked for 3-7 days in a tank containing lime and sodium sulphide to remove hair. The hide was stirred in the tank each day to loosen the hair from the hides. After dehairing, bating was done to remove the lime which was used in dehairing to make the pelt soft. The pelts were washed with cold water and treated with bating materials like ammonium sulfate and ammonium chloride to eliminate the effect of the lime. This was done for 30 min – 4 hours. The pelts were then washed in cold water and bating material was allowed to drain off to obtain a white pelt, hence concluding the preparation stage of the leather, usually known as the „beam house operations“.

The pelt obtained from the beam house was pickled. The pelt was put in a pit with some small degree of acidity and salinity, and was allowed for 12 h to enable it obtain thorough penetration of the hide structures. Depickling was done to neutralize the acidity in the thick corium before the actual tanning.

After the pickling, the hide was taken through the tanning process known as vegetable tanning. The hide was suspended in a wooden vat of nonastringent liquor consisting of already used liquors originally prepared from a mixture of some natural tannic acids from tree barks, „bagaruwa“ pod, seeds and leaves. Then after 168 hours (7 days) the pre tanned hide was extracted from the suspended mixture in the wooden vat. Finally tanning was completed when the hide underwent a retannage process by suspending the pre tanned hide in a warm sumac infusion for 48 hours, after which, the leather was spread on the ground for drying for 12 hours and was later laid over a rope for further drying in the sun to obtain the leather finally.



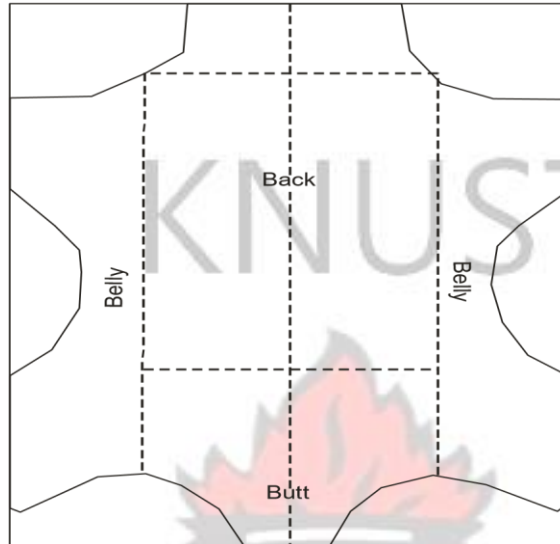
Source: Researcher's Field Activity at the Tannery

Plate 3.1: Pelt put in a pit with some small degree of acidity and salinity to obtain the leather (hide)

3.10 Cutting Leather Specimen

The objective of this research question is to experiment on the suitability of using “cuir bouilli” techniques for hardening the Ghanaian indigenous vegetable tanned leather for the purpose of vessel production. To answer the question, the following activities were carried out.

The leather was cut into the specimen (dimension 3x3 inches) based on the segment part (Figure 3.1) and were subjected to 4 standard “cuir bouilli” methods and 5 application as shown in Table 3.3.



Source: *Drawing Activity at the Studio (2015)*

Figure 3.1: The segmented parts of the local hide

The segmented parts of the ingenious tanned hide (Figure 3.1) consist of butt, belly and back parts. The butt part is the strongest and forms the thickest part of the hide, while the belly parts being quite thin has a much looser fibre structures. The back part has a fairly thick fibre structure.

Table 3.3: Leather hardening methods (“cuir bouilli”)

Methods	Applications
Baking	Electric oven
	Soaking in boiling water
Hot water	
Hot wax	a. Surface waxing
	b. Soaking in hot wax

From Table 3.1 an electric oven was pre-heated to a temperature of about 30 °C, at this temperature the segmented parts of the leather would start to experience moisture lost. The specimens of the segmented parts of the leather were placed in the oven. The temperature was gradually increased to 74 °C at an interval of 10 °C per min. Because beyond 75 °C, further shrinkage will cause cracks.

Another leather hardening method was the Soaking in hot water method. Water was heated to a temperature of 60 °C, the specimens of the segmented parts of the leather were placed in the warm water for about 1 hour and observed. Beyond the 61 °C and above the leather will over cook causing the leather to shrivel. It was observed that specimens became hard.

From the experiments on the leather hardening method (Table 3.1), bee wax was heated to its melting point in a metallic frying pan. A brittle brush was dipped into the melting wax and was quickly smeared onto the surfaces of the specimen of the segmented parts of the leather. This treatment did not give the right hardening result rather the grain side of the leather specimens was hardened leaving the flush side unhardened.

The Soaking in hot wax achieved the required result. Bee wax was heated to its melting point in a metallic frying pan and the specimens of the segmented parts of the leather were soaked in it for about 4 min with the help of a tong. Bobbles began to appear on the surface of the specimens indicating the wax occupying the pose of the leather.

The Soaking in tap water and air drying method made use of 3 lit of water were poured into a container and the specimens of the segmented parts of the leather was placed in it for a day and air dried overnight. The duration of soaking in tap water was meant to

achieve the total absorption of water by the specimen, while the overnight drying was meant to render the specimen totally dry devoid of moisture making it hard.

3.11 Data Collection for Research Question Two

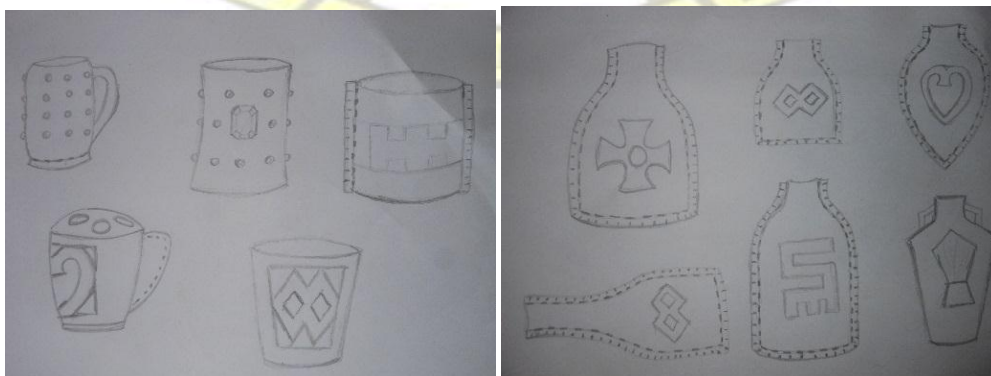
What effect would leather forming techniques have on the use of back, belly and butt of indigenous vegetable tanned leather in the production of leather vessels?

After experimenting on the suitability of using cuir bouilli techniques for hardening the Ghanaian indigenous vegetable tanned leather for the purpose of vessel production.

The researcher proceeded to identify and experiment the effect of leather vessel forming techniques on the use of back, belly or butt parts of indigenous vegetable tanned leather in the production of leather vessel. To answer the question the following activities were carried out in constructing a Leather bottle from each part of the local leather using the Sand Pounding Technique to ascertain the effect on each vessel.

The experiment comprises of three main areas, which involves drawing preliminary sketches of the bottle, organization of tools and materials, Constructing of the leather bottles assembling the leather bottle, (cutting and sewing), filling the bottle with sand (for shaping), and sealing and harden the vessel using “cuir bouilli” techniques (baking and waxing).

3.11.1 Activity 1: Preliminary Sketches



Source: Researcher's Experimental activities (2015)

Plate 3. 2: Sketches of some Leather Bottles and Cups in Pencil

A series of sketches of the bottle were made for the intended purpose. This helps the researcher to select of the right design that can serve the purpose of objective two.

3.11.2 Activity 2: Organization of Tools and Materials

a. Tools:

- 2-5 (Easy Thread) needles
- 2 4-hole stitching chisel (1/16")
- 2 circular punch (1/4")
- 3 stitching awl
- 1 tracing scribe
- 2 pair of scissors or straight razor knife
- 1 wooden mallet
- 1 pencil
- 2 funnel

b. Materials:

- Leather (indigenous vegetable tanned hide)
- Artificial sinew thread
- Beeswax
- Paraffin wax
- Sand
- 1" wooden dowel

The experiment comprises of three main areas, which involves drawing preliminary sketches of the bottle, organization of tools and materials, Constructing of the leather

bottles assembling the leather bottle, (cutting and sewing), filling the bottle with sand (for shaping), and sealing and harden the vessel using “cuir bouilli” techniques (baking and waxing).

3.11.3 Activity 3: Constructing of the Leather Vessel (Bottle)

First, a suitable working area was set up and a dimensional pattern of the front section of the leather vessel using A4 sheet paper was made. The paper pattern of the cross section of the leather flask was placed onto the flesh side of the leather and traced using a pen or pencil leaving an allowance of 3 cm. A scissors or knife was used to cut out the traced outline on the leather. This served as the front side panel of the leather flask. The procedure was repeated to get the back side panel of the leather flask. Both the front and the back side were compared and trimmed to match in order to get equal edges, size and shape.



Source: Researcher's Experimental activities (2015)

Plate 3.3: Making and transferring the pattern of the leather bottle

3.11.4 Activity 4: Punching and Sewing

Both panels were put together and a scribe/over-stitch spacer was used to mark out evenly spaces to be punched for sowing. In a continuous manner, the incised marks on the leather were punched, from the top where there was be an open (the mouth of the bottle) thought from the bottom of the curve back to the top.

Using a controlled pressing action as an alternative to a stabbing motion, the leather was penetrated with the awl and in a stitching sequence; the sinew thread was picked with the awl over and over again until the end point was reached. Once the last stitch was done, the stitching direction was reverse four holes and the thread secured; a flat leather bottle was the final result.



Source: Researcher's Experimental activities (2015)

Plate 3. 4: With the Help of an Awl Stitching on the Drawn Pattern

3.11.5 Activity 6: Fill the Bottle with Sand (for Shaping)

The flat leather bottle was soaked in warm water and allowed to soak as much water as possible. The bottle is then removed from the warm water. A funnel was put the mouth of the bottle and clean sand was used to fill the flat leather bottle relatively. The wooden dowel was used to keep the sand flowing through the mouth into the bottle until almost full up. With the help of the dowel and mallet the sand was pound in the

bottle to pack it. The bottle was filled, packed and pounded until the bottle was fully filled to the brim. The filled bottle was air dried for about 2 days to completely dry.



Source: Researcher's Experimental activities (2015)

Plate 3. 5: The sawn leather soaked in warm water and sand being filled with it to bring the shape

3.11.6 Activity 7: Sealing the Bottle using “Cuir Bouilli” Techniques

a. Exterior “cuir bouilli”

After the sand packed leather bottle had dried completely, part of the sand was removed from the bottle to a depth of about 3” to allow a similar length wooden dowel was inserted in the mouth to the neck of the bottle. An electric oven was used to bake the sand packed bottle at a temperature of 30 °C and gradually increased to 74°C.

Paraffin wax was melted in a large pot over low heat with the help of an electric burner. After the paraffin had melted completely, the baked bottle filled with sand was submerged in the melting paraffin wax for 90 sec. While the bottle was submerged, trails of air bubbles appeared from the bottle. These bubbles were indications of the existence of air from the air pockets in the leather bottle. The bottle was kept submerged until the bubbles dissipated. After all exterior surfaces were coated with wax; the bottle still having the sand in it was set aside to cool.

Once the waxed bottle was cooled, the sand was removed from the bottle with the help of the wooden mallet to become empty and hollow. There were small amounts of

paraffin wax always leaching through the seams; the bottle was knocked about a bit to break up the sand-wax chunks. After the removal of the waxed sand from the interior, the bottle was washed with soap and water. The washed leather bottle was set aside to air dry completely.

b. Interior “cuir bouilli”

Using a metallic cup, the bee wax was melted over low heat with the help of an electric burner. When the beeswax was completely melted, the wax was poured into the washed hollow leather bottle through the mouth. The leather bottle was revolved to ensure evenly spread of the wax inside the bottle. This wax was then emptied back into the pot at a fairly fast rate. The process was repeated once again to ensure proper coating of the bee wax. The bottle was allowed to cool and tested for leakage by pouring water inside. If there are some leaks, the process was repeated.



Source: Researcher's Experimental activities (2015)

Plate 3.6: Baking the vessel; immersing the baked vessel in melting wax and washing the interior of the waxed vessel

3.11.7 Activity 8: Final Dressing of the Leather Bottle

There were few wax drippings or runs, this effect was corrected with the help of a blow dryer and wipe towel while the wax melted. For long-term use and durability the leather bottle was re-sealed with the beeswax.

3.12 Data collection for Research Question Three

How would Ghanaian indigenous vegetable tanned leather be used to produce samples of leather vessel?

After experimenting on the specimens of the indigenous tanned leather by using the cuir bouilli techniques, and the effect of forming a leather vessel in the back, belly and butt parts of the local leather, the researcher proceeded to produce samples of bottles and cups using the indigenous tanned leather.

3.12.1 Activity 1: Preliminary Sketches

A series of sketches were made for the production of the samples. This helped the researcher to select from the design sketches the cups and bottles to produce as the final works (see Plate 3.2).

3.12.2 Activity 2: Assemblage and Construction Method (Wood Last)

The shape of the vessel was drawn on a plain paper with the dimension. A wooden log was carved to obtain the shape of the vessel. Wet leather was then wrapped around the carved wooden log to take the shape and the two ends of the leather was clamped with the G - clamp device (Plate 4.3). This was allowed to dry overnight. The wooden structure was removed, leaving the shaped leather vessels. A design was then inscribed on the surface of the leather and the two ends were stitched together. The circumference of the based section of the stitched leather was drawn on a piece of plain paper and traced on the leather to be cut. It was then placed at the base of the stitched leather and stitched. The wooden model was fixed completely back into the stitched leather and baked in the oven for 30 min. With the wooden model still in the stitched leather, the wax method of “cuir bouilli” technique was applied. After which it was removed and allowed to cool before taking out the wooden model. A hollow plastic

hard leather vessel was obtained and this was washed thoroughly with soap and water and the leather vessel was allowed to dry. A bee wax was melted and poured into the leather vessel and swirl to ensure complete coating of the interior part of the vessel. This was then allowed to dry and water was poured in to check for leakage. If any leakage was observed, repeat the waxing technique again till there is no leakage.



Source: Researcher's Experimental activities (2015)

Plate 3.7: Leather wrapped around a carved wooden log with a G-clamp



Source: Researcher's Experimental activity (2015)

Plate 3. 8: Leather moulded to take the shape of a wooden carved log



Source: Researcher's Experimental activities (2015)

Plate 3.9: Making a design on a moulded leather vessel



Source: Researcher's Experimental activities (2015)

Plate 3.10: Stitching of a leather vessel



Source: Researcher's Experimental activities (2015)

Plate 3.11: Sand is packed in the stitched vessel and baked in an electric oven



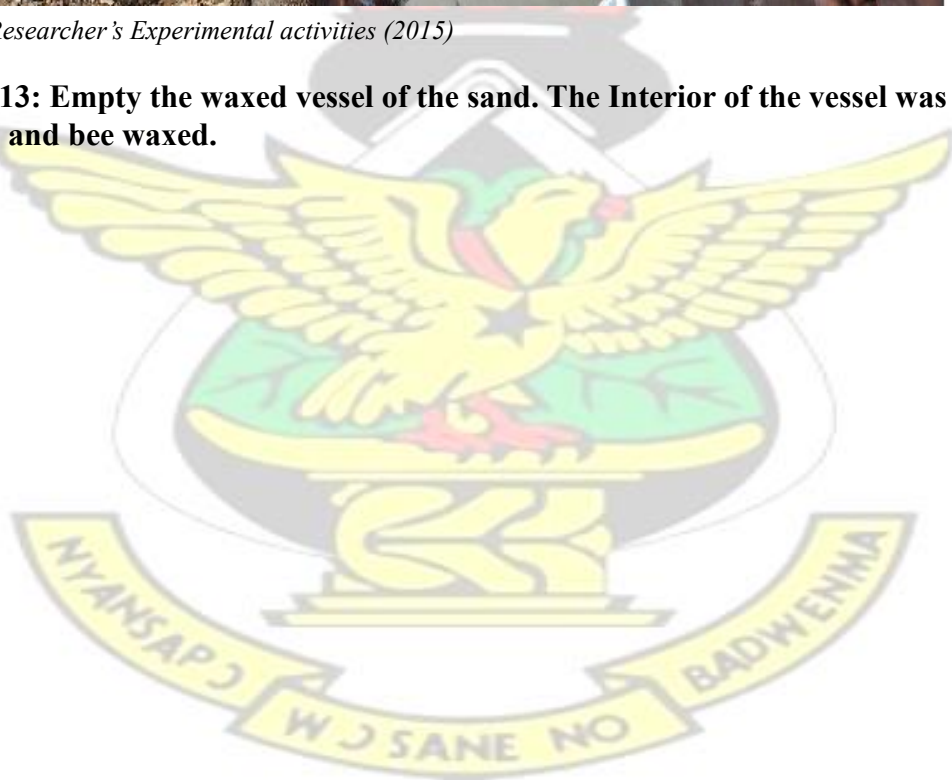
Source: Researcher's Experimental activities (2015)

Plate 3.12: After baking the vessel, put the baked vessel in a melting wax



Source: Researcher's Experimental activities (2015)

Plate 3.13: Empty the waxed vessel of the sand. The Interior of the vessel was washed and bee waxed.



CHAPTER FOUR PRESENTATION AND DISCUSSION OF FINDINGS

4.1 Overview

The purpose of this study is to discover the suitability of the Ghanaian indigenous leather in leather vessels production. This chapter confronts the procedures used in arriving at the results of the study and presents them in tables and plates forms. It also shows observations made and compare and contrast the findings of previous studies.

4.2 Demographics of Respondents

Table 4.1 shows the details of respondent demographics on the study. Pseudo names are used in capturing respondent's details in order to shield their identity. This was made clear to respondents in the ethical consideration of the study in chapter 3.

Table 4.1: Respondents' Demographic details

Respondents	Pseudo name	Gender	Educational level	Working experience
Leather experts	Kwaku	Male	Doctoral degree	20 years
	Ama	Female	Master's degree	8
	Kojo	Male	Doctoral degree	10
Ceramic experts	Kofi	Male	Doctoral degree	10
	Kwame	Male	Master's degree	8
	Yaa	Female	First degree	5
	Kwasi	Male	First degree	5
Leather artisan	Ato	Male	"O" level	13
	Asare	Male	"O" level	6
	Jojo	Male	JHS	9
	Larbi	Male	Uneducated	6
Ceramic artisan	Maame Ama	Female	"O" level	8
	Kukua	Female	SHS	4
	Yaw	Male	Uneducated	9

Source: Researcher's Experimental Results (2015)

Table 4.2: Respondent's knowledge of leather vessel

Opinion of respondent on whether leather can be used for vessels		
Responses	Yes	No

Leather Experts and Artesian	2	5
Ceramics Experts and Artesian	1	6
Percentage	21%	79%

Source: Researcher's Experimental Results (2015)

A significant number, 79% of respondent were ignorant of the fact that the Ghanaian indigenous leather can be used for vessels (cups and bottles). The remaining 21% responded yes based on a number of reasons: previously skins were used to store water while travelling as pouches mainly in the northern part of Ghana. Also leather can be used to cover already existing vessels as decorative or protective covers. Therefore, based on the response from experts and artesian the knowledge on leather vessels (cups and bottles) production is limited. This corroborates the study of Waterer (1950), who claim that leather vessel has received relatively little attention, scholarly or otherwise.

4.3 Discussion of results for Objective One:

To experiment on the suitability of using “cuir bouilli” techniques for hardening the Ghanaian indigenous vegetable tanned leather for the purpose of vessel production.

4.4 Findings of the Study

The tables below indicate the technique suitable for leather hardening. The thickness of the leather specimen and the length were measured before and after applying the hardened technique to determine the effect on the leather specimen.

4.4.1 Deep Waxing Technique

Table 4.1 shows the changes in thickness and length when leather is immersed in deep melting wax. The leather specimen was first measured in terms of length and thickness. Wax was put on fire in a silver bowl to melt and just at the melting point the leather specimen was immersed completely in the melted wax for some time after which the thickness and length was measured again to observe any change.

Table 4. 3: Physical properties of vegetable tanned leather as affected by deep waxing

Leather Part	Thickness before (mm)	Length before (cm)	Thickness after (mm)	Length after (cm)
HA1	3.32	8.5	3.79	8.5
HB1	2.00	8	2.29	8
HC1	4.26	7.8	4.33	7.8
SA3	1.36	8	1.70	8
SB3	1.20	8	1.43	8
SC3	1.16	8.5	1.25	8
GA2	0.95	5.2	1.09	5.2
GB2	0.95	5.5	1.18	5.5
GC2	0.83	5.2	1.15	5.2

Source: Researcher's Experimental Results (2015)

There was a change in thickness after immersing the leather specimen in the deep melted wax, but no significant change was observed in the length.

4.1.1 Surface Waxing

When the wax was hot a brittle brush was immersed in the wax and used to the grain side of the leather (which then soaks it right up). This was kept on until the waxed surfaced cooled and the leather could not absorb any longer. Table 4.1 presents the changes that were observed before and after applying the wax onto the surface of the specimen leather.

Table 4.4: Physical properties of vegetable tanned leather as affected by surface waxing

Leather Part	Thickness before (mm)	Length before (cm)	Thickness after (mm)	Length after (cm)
HA1	2.00	8.5	2.19	8.5
HB1	1.96	7.8	2.08	7.8
HC1	4.21	7.8	4.28	7.8
SA3	1.64	8	1.78	8
SB3	1.55	8.7	1.57	8.7
SC3	1.66	8.5	1.83	8.5
GA2	0.92	5.5	0.95	5.5
GB2	0.93	5.5	1.01	5.5
GC2	0.79	5.2	0.83	5.2

Source: Researcher's Experimental Results (2015)

There was no change in length, but a slight increase in thickness of the leather after the application of surface waxing.

4.1.2 Hot Water Soaking

Table 4.3 shows the results of leather specimen after it has been immersed in hot water.

Table 4. 5: Physical properties of vegetable tanned leather as affected by hot water soaking

Leather Part	Thickness before (mm)	Length before (cm)	Thickness after (mm)	Length after (cm)
HA1	2.50	8.5	2.12	8
HB1	2.13	8	1.69	7.8
HC1	3.54	8.7	3.62	8.5
SA3	1.55	8.7	1.34	9
SB3	1.27	9	0.95	9

SC3	1.51	8.5	1.26	8.5
GA2	0.85	5.2	0.72	5.5
GB2	0.87	5.2	0.78	5.5
GC2	0.80	5.2	0.85	5.2

Source: Researcher's Experimental Results (2015)

There was a general drop in thickness, but not in length of the leather specimen. However, the butt part of the cowhide and goat skin experienced a slight increase in thickness.

4.1.3 Soaking In Tap Water

Here the leather specimen was immersed in water while on fire. The results showed in Table 4.4 is similar to that observed when the leather specimen was immersed in a hot water. Thus, there was a decrease in thickness for all the segment part of the leather specimen but the length remained unchanged.

Table 4. 6: Physical properties of vegetable tanned leather as affected by soaking in tap water

Leather Part	Thickness before (mm)	Length before (cm)	Thickness after (mm)	Length after (cm)
HA1	2.38	8.5	2.34	8
HB1	2.29	7.8	2.09	7.8
HC1	3.84	8	3.63	7.8
SA3	1.32	9	1.14	9
SB3	1.24	8.5	1.13	8.5
SC3	1.76	8.5	1.67	8.5
GA2	1.00	5.2	0.95	5.2
GB2	0.94	5.2	0.84	5.2
GC2	0.88	5.2	0.85	5.2

Source: Researcher's Experimental Results (2015)

4.1.4 Baking Method

An electric oven was pre-heated to a specified temperature and the segmented parts of the leather specimens were placed in it for a period of time. The result of the changed in thickness and length is shown in Table 4.5.

Table 4. 7: Physical properties of vegetable tanned leather as affected by baking

Leather Part	Thickness before (mm)	Length before (cm)	Thickness after (mm)	Length after (cm)
HA1	2.76	7.8	2.47	7.7
HB1	2.22	8	2.14	7.7
HC1	4.27	8	3.68	8
SA3	1.30	8.5	0.89	8
SB3	1.33	8.5	1.12	8
SC3	1.74	8	1.30	8
GA2	0.89	5.2	0.70	4.6
GB2	0.82	5.2	0.63	5.2
GC2	0.75	5.2	0.60	5.2

Source: Researcher's Experimental Results (2015)

A general decrease in thickness was observed in all the segmented parts of the leather specimen used. However, few drops in length were observed, but was not significant.

4.2 Hardening and Stiffening Technique

Hardening and stiffening of the leather may affect the thickness of leather as a result of shrinkage. Shrinkage occurred when the protein molecules denature as a result of heat applications. The shrinkage temperature of leather was influenced by many different factors during the “cuir bouilli” activities, most of which appeared to affect the number and nature of cross linking interactions between adjacent polypeptide chains of the collagen protein molecules.

The value of the shrinkage temperature of leather was commonly used as an indicator and to the extent the hide could be hardened. The internal expansion of the hide is reversible below the shrinkage temperature. The increase in volume occurs over a range of temperatures rather than at a sharp point on the temperature scale, and it appears that shrinkage is probably a rate removal of air from the interstices in the leather.

The wax hardening techniques for both deep and surface waxing experience increased in leather thickness and the reason being that as the molten wax get dried up in its interstices, the wax stick more to the leather making it bulky. Whiles the leather is left in the wax it bubbles, and these bubbles appears almost proximately and begins to rise up to the surface, making way for the wax to be absorbed properly into the leather polypeptide chains thereby increasing its thickness upon drying.

Almost to no shrinkage was observed for the wax technique because the leather in the cooked wax was carefully observed to prevent the leather from over cooking or shriveling.

Although the strength of the leather, of the wax hardened method was not to the standard as the hot water or baking hardened method, the method had its advantage in terms of waterproofing the leather. Although wax hardened leather become stiff, it is easy to cut and work with.

In all the hardening techniques employed, the hot water method recorded a decrease in the thickness of the segmented part of the leather specimen. This was observed as a result of the shrinkage that occurred when the temperature of the water was high. This observation made in this study agrees Salcedo and Highberger (1941) and Wilson and Porth (1943) that contraction should occur during shrinkage. The indication that transition is a process occurring over a temperature interval is at variance with a

statement by Wohlsch (1932) to the effect that shrinkage takes place above a sharply defined temperature.

Tap water hardened methods as opposed to the wax method is not more susceptible to heat, but needs to be baked hardened to enable it to stand high humidity. The longer the period that the leather is left in the oven, the more shrinkage occurs, the thinner the width of the leather becomes and the harder the end product becomes. Ample time given to the leather in the oven will solidify it into something like wood. Nevertheless, as with most natural material, the baking method does have a natural rule, being that the harder the leather, the more brittle the leather becomes.

All this implies that, after the baking method is applied to the finished leather item could be 1/4th the size before the application harden method. Therefore, if a leather article is left in the oven, the longer the period, the more it shrinks, the thinner the width of the leather becomes and the harder it becomes. Also to note that the “cuir bouilli” process do not only affect the leather physically by shriveling into plastic hardness to brittle hardness ultimately cracking when over applied, it also affects the leather chemically by causing the chemicals in the leather to polymerize and liquefy in the wax method.

Table 4. 8: summary of the results on the suitability of using leather hardening techniques on the local leather

Leather Hardening Methods	Effect on thickness and length	Hardness
Baking method	<ul style="list-style-type: none"> • significant decrease in thickness • few drops in length 	Very Hard
Hot waxing	<ul style="list-style-type: none"> • increase in thickness • no change in length 	Extremely Hard

Tap water	<ul style="list-style-type: none"> • Insignificant decrease in thickness • no change in length 	Hard
Hot water soaking	<ul style="list-style-type: none"> • decrease in thickness • few drops in length 	Relatively Hard

Source: Researcher's Experimental Results (2015)

4.3 Discussion of Results for Objective Two

To identify and experiment the effect of vessel forming techniques on the use of back, belly and butt of indigenous vegetable tanned leather in the production of leather vessel.

4.3.1 Assessment of the Parts of the Hide Suitable for Leather Bottle

The thickness of the cow leather (hide) varies based on the various parts and from Table 4.1 to 4.5, it is obvious that the part with much thickness is the butts, followed by the shoulder and then the belly. These parts were used to form a leather bottle using the assemblage and construction method.



a) Hide from belly

b) Hide from butts

c) Hide from back Plate

4. 1(a, b, c): Leather drinking vessel made from the three main parts of the cowhide

Source: Research outcome from studio activities (2015)

4.3.2 The Suitability of the Leather Part in Moulding Leather Bottles

The leather bottles made from the various part of the cow leather (hide) are shown in Plate 4.1. From all the part of the cow leather (hide), the butts part was the thickness and even when compared with the other animal skin (sheep and goat) making the cow leather more appropriate for moulding leather bottles.

The butt part which is the thickest when the “cuir bouilli” technique was applied became plastic hard. This hardness helped maintain the moulded shape. The design emboss and engraved on the leather bottle (Plate 4.1) was more obvious for the leather bottle made from the butts part of the hide than the rest after taking it through the various hardening techniques. This could be due to the thickness of the butt’s parts being a factor.

With the back part of the cow leather, when the “cuir bouilli” technique was applied to form the bottle, the finished product became moderately hard. The shape was a little distorted and after waxing, there was moderate leakage.

The third part which is the belly part of the same hides became hard after the application of the “cuir bouilli” technique. However, the shape was more distorted compared to that of the back part. The design emboss and engraved on the surface of the leather bottle also disappeared after the application of the hardening technique. This observation was due to the fact that from all the parts, it is the belly part that is less thick.

From the various hardening techniques employed, it was obvious that only the waxing method increased the thickness of the leather. Hence, since the thickness of the hide is a factor in maintaining the shape or form and the design on the leather, it is more appropriate to use the part which is thickest for designs (emboss and engraved) and also avoid the hardening technique that will adversely affect the thickness.

4.4 Discussion of Results for Objective Three

To produce samples of the leather vessel using the Ghanaian indigenous vegetable tanned leather.

4.4.1 Improving the quality of the leather vessel making use of the butt, belly and back parts of the local leather

The various part of the local leather (belly, butt and back) due to their visual appreciation and features tends to affect the end product of the leather vessel when used solely for the vessel. Using the parts for different purposes as shown in Plate 4.2 helped to improve the durability and the quality of the leather vessel.





Source: Research outcome from studio activities (2015)

Plate 4. 2: Schematic diagram of a leather vessel showing



Source: Research outcome from studio activities (2015)

Plate 4. 3: Samples of finished leather vessel

4.4.2 Improving the quality of the leather vessels by incorporating the back, belly or butt parts

The upper back part of the hide has medium soft features and this was used for the base of the vessel and the lower part of the back is fairly hard and this was used for the handle of the leather vessel. The back part of the hide tends to crease easily as this part of the hide is affected by movements of the head. The belly part of the hide is quite thin and has a much looser fibre structure than the back and often stretches under stress. This part was also used for the base due to its characteristics. The butt's part of the hide is tightly packed and hence the strongest and the thickest part of the hide. This part was therefore used for the body of the vessel (front and back) and also the portion where most designs were affected.

CHAPTER FIVE SUMMARY, CONCLUSION AND RECOMMENDATION

5.0 Summary

This study experimented the production of leather vessels from the indigenous Ghanaian tanned leather. The study was conducted as a result of the need to add leather as a supplementary material to the traditional materials such as clay, metal, wood and half-gourd used for producing vessels in Ghana. To achieve this, the following objectives were set:

1. To experiment on the suitability of using “cuir bouilli” techniques for hardening the Ghanaian indigenous vegetable tanned leather for the purpose of vessel production.
2. To identify and experiment the effect of vessel forming techniques on the use of back, belly and butt parts of the indigenous vegetable tanned leather in the production of leather vessel.
3. To produce samples of leather vessels using the Ghanaian indigenous vegetable tanned leather.

The qualitative research method was employed in the study. It was observed that the butt part of the segmented parts of the Ghanaian indigenous vegetable tanned leather are much more effective when used to design and produce the body of the vessels. The study also revealed that the belly and back parts of the leathers experimented in the production of the vessels were more suitable for producing the base and handle of the leather vessels. In addition to the above findings, the hot wax and baking methods of the “cuir bouilli” techniques on the Ghanaian tanned leather for the purpose of leather vessels production, proved to be more effective.

5.1 Conclusions

The research has shown that the use of the hot water and tap water treatment had little effect on the thickness, length and hardness of the local leather, except the deep waxing and baking methods. Using one particular part of the local hide (back, belly or butt) affected the quality of the vessel due to their individual characteristics. However, incorporating the various parts of the hide helped improve the quality and stability of the leather vessels.

5.2 Recommendations

With these observations noted, the researcher recommends the following:

1. The wax and baking harden methods are recommended for leather vessel production. The researcher suggests that the Department of Integrated Rural Art and Industry (lecturers in charge of leather) at KNUST, Kumasi, organize seminars and workshops regularly for experts in the field of leather who may be interested in exploring how to harden the indigenous leather for different purposes. Moreover, it is recommended that artesian could use the Ghanaian tanned leather for leather vessel production.
2. It is recommended that in producing leather vessels with the indigenous leather, the back, belly and butt parts are not appropriate, since due to the unfavourable characteristics they possess. On the contrary, the belly and back parts are suitable for producing the handle and base of leather vessels. Additionally, the butt part of the indigenous leather should be used for vessels which requires surface decorations (embossing and engraving), and also for the production of the body part of leather vessels. The education on the use of the various parts (back, belly and butt) for production of leather vessels may be sought for, from the Department of Integrated Rural Art and Industry (specifically lecturers in charge of leather) at KNUST, Kumasi.

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APPENDIX A: RESEARCH QUESTIONNAIRE FOR LEATHER EXPERTS AND ARTISANS

Kwame Nkrumah University of Science and Technology, Kumasi

Department of Integrated Rural Art and Industry

College of Art and Built Environment

TOPIC: PRODUCTION OF LEATHER VESSELS FROM THE INDIGENOUS GHANAIAN LEATHER

The study is about the production of leather vessels. The purpose of this questionnaire is to find out the respondents' knowledge about leather vessels production in Ghana. Please be informed that every response to this questionnaire will be treated confidential.

Below are the questions:

- 1) What is your occupation?
- 2) What is your age range? 25-27 ☐, 28-30 ☐, 30-32 ☐, 33-35 ☐ ☐
, 36+ ☐
- 3) Sex: Male ☐ Female ☐
- 4) Highest educational level SHS ☐ HND ☐ Degree ☐ Masters ☐ PhD ☐
- 5) How many years have you been using leather?
 - a) What do you know about leather in Ghana?
 - b) What do you know about leather Hardening?
 - c) Do you think the Ghanaian indigenous leather can be hardened?
- 6) What do you know about vessels used for containers like cups and bottle?
 - a) What materials do you know vessels are made from in Ghana?
- 7) Do you know anything about leather vessels?
 - a) Do you have an idea on how leather can be used to produce vessels?
- 8) Can you mention the part of the leather that you know?

- a) How effective do you think the part you mentioned in 8 could be used to form leather vessel?

APPENDIX B: RESEARCH QUESTIONNAIRE FOR CERAMIC EXPERTS AND ARTISANS

Kwame Nkrumah University of Science and Technology, Kumasi

Department of Integrated Rural Art and Industry

College of Art and Built Environment

TOPIC: PRODUCTION OF LEATHER VESSELS FROM THE INDIGENOUS GHANAIAN LEATHER

The study is about the production of leather vessels. The purpose of this questionnaire is to find out the respondents' knowledge about leather vessels production in Ghana. Please be informed that every responds to this questioner will be treated confidential.

Below are the questions:

- 1) What is your occupation?
- 2) What is your age range? 25-27 ☐, 28-30 ☐, 30-32 ☐, 33-35 ☐ ☐
, 36+ ☐
- 3) Sex: Male ☐ Female ☐
- 4) Highest educational level SHS ☐ HND ☐ Degree ☐ Masters ☐ PhD ☐
- 5) How many years have you been producing ceramic wears?
- 6) What are vessels in your view?
- 7) Are vessels always functional or decorative?
- 8) Can you mention materials vessels (cups and bottles) are made from in Ghana?
- 9) Do you think the leather can be used as a supplementary material to produce vessels?
- 10) Have you come across leather cups and bottles?

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