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Vegetable Tanning in Bolgatanga: Challenges and the Way Forward

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Abstract
The research is a case study in Bolgatanga which used the qualitative design. The Researcher depended on semi-structured interviews, observations and focus group discussions to extract data from leather tanners sampled from three tanning communities in the Bolgatanga municipality, namely; Yikene, Tanzui and Nawomaya all in the Upper East Region of Ghana. 60 respondents who were purposively selected from the above communities constituted the sample. The study attempted to unveil the causes of the characteristic offensive odour associated with leather from these communities. The researcher therefore studied the tanning materials, tools and methods used in processing leather from the above mentioned communities in order to uncover the source of the problem. The study revealed that even though the tanners used scientifically backed traditional methods to process their leathers, the re-using of some of the leather processing mixtures and inadequate rinsing regimes, were the main setbacks contributing to the offensive odor. Relevant recommendations were made to redress the shortcomings.
Keywords: Bolgatanga Leather, Vegetable tanning, Hides and skins, Dyeing, Acacia nilotica.

1. Introduction

In many civilizations around the world, animal hides and skins were processed and used for various purposes since time immemorial. Various methods and materials were employed to preserve hides and skins for human use. Salting, drying, smoking, as well as the application of animal brains and fats were some of the earliest techniques used by many cultures to process animal skins. The rudimentary tanning methods used by early man were mentioned in Assyrian texts and in Homers Iliad (Leather Resource, 2008). The above source expatiates further that Sumerians, Phoenicians, Romans and Mesopotamians innovatively made use of processed animal skins extensively.
As early as 400 B. C., Egyptians and Hebrews were recorded for using vegetable materials to process hides and skins into leather. The Arabs demonstrated their expertise in processing animal skins and hides into notable brands such as cordovan and morocco during the Middle Ages. By the 15th century, many countries in Europe were processing leather (Britannica Encyclopedia, 2013). Leather Resources (2008) reports that leather was crafted into gloves, tools, arms, ornaments, footwear, dresses, diadems, liquid containers and even water pipes, as was recorded by the historian, Strabo in Phoenicia. Richards (2000) further points out that vegetable tanned leathers were used to produce saddles, canteens, stiff shoes, belts, wallets, holsters, harnesses, helmets, pouches, trunks, bellows, hinges of trunks, as well as shields and gun cases.

Vegetable Tanning, which is also sometimes referred to as Bark Tanning, is the time-tested method of using vegetable materials to process animal hides and skins into water resistant, non-putrecible, soft, flexible, heat resistant material known as leather (Covington, 1997; Richards, 2000; Olson, 2012). Vegetable materials can be virtually used to tan any type of animal hide and skins. But largely, hides and skins of cows, calves, buffalos, goats, snakes, sheep, pigs, ostriches, and stingrays are some of the major animal coverings that could be processed with vegetable matter (Almendral, 2011).
Tannin, which is also known as Tannic Acid, is the main active substance in plants which converts the animal hides and skins into leather. Tannins are widely distributed in plants in the form of powder, flakes, or as a spongy mass, which are pale-yellow or light brown in colour. The substance can be found in the bark, roots, leaves, woods, fruits, pods, and cups of most plants. They are much more prevalent in dicotyledonous plant species, particularly angiosperms (Encyclopedia Britannica, 2013; Musa and Gasmelseed, 2012). Tannins are water soluble substances, very rich in phenolic group and possessing astringent characteristics (Ayoub, 1982; Merriam-Webster Dictionary, 2013).
Different vegetable materials have been used around the world to process animal hides and skins, depending on the percentage of tannin concentration in the vegetative material and its availability. Some of the important plants used in tanning are; chestnut, hemlock, mangrove, bagaruwa (West and Central Africa), Quebraco, mimosa, wattle, canaigre, myrobalans, algarobilla, sumac, tara, velonia, gambir, acorns, davidivi, just to mention a few (Musa and Gasmelseed, 2012; Anilin & Fabrik, 2007).

In tropical Africa, Sarkar (1991) writes that acacia nilotica is mostly used traditionally to tan and re-tan leather. This plant is a moderate size tree with spiny outgrowths on the stems, which are usually found in depressions, river beds and flooded areas (Thirakul, 1984; EL Amin, 1990).

Though leather processing in the 21st Century concentrates mostly on chrome tannage, the importance of vegetable tanning cannot be overemphasized. Indeed, the ability of vegetable tanning materials to biodegrade makes it a "green tanning agent", which is friendly to the environment and therefore quite safe to use (Jianzhong *et al.*, 2009). Vegetable tanned leathers are known to posses splendid wear resistance, excellent air permeability, good mouldering qualities as well as superior solidness and fullness (Faxing *et al.,* 2005; Bi, 2006). Vegetable tanning techniques are used in re-tanning chrome tanned leathers in order to reduce the hazardous characteristics associated with such leathers (Colak et al, n. d.).
The admirable qualities of leather such as decay resistance, flexibility, heat resistance, breathability, excellent tensile strength, water resistance, just to mention a few, makes it an important material which could be used in many spheres of human existence.
The leather industry has blossomed over the years into a very resilient and economically viable industry, due to its sustained usage in many manufacturing sectors. The Food and Agriculture Organization of the United Nation's (FAO) report, cited by the International Council of Tanners (2013), indicates that between 1994 – 1996 the combined value of international trade in meat, tea, coffee, rice and sugar, is very much less than the total value of trade in the leather and leather footwear industry. The trade in leather and leather products is phenomenally worth more than US$ 60 billion annually, and is predicted to grow further in the coming years (International Trade Center (ITC), 2004). ITC explicates further that the leather industry is a major source of employment in most African countries. The systematic development of the industry will therefore impact positively on the entire African continent, since the leather value chain commences with animal husbandry, which is the mainstay of most rural communities in Africa, the source adds.

1.1 Problem Statement

The Upper East Region is well noted for its vegetable tanning Industry. This sector has been sustained diligently over the years, largely due to the abundance of livestock in the Region, which provides adequate skins and hides to feed the Industry. Leather processing in the Bolgatanga Municipality is currently concentrated in Yikene, Tanzui and Nawomaya.
Vegetable tanned leathers from these communities, however, are noted for their characteristic offensive odour. Even though leather crafters in the Municipality use the material to craft good quality articles such as puffs, bags, wallets, attaché cases, belts, bracelets, just to mention a few, these innovative and aesthetically appealing leather articles are not very well patronized locally or exported much, due to the odiferous characteristics of the leathers used. This strips the artisans, the region and the country of a good source of income from the leather sector in the Upper East Region.
The research was therefore undertaken to; examine the tanning materials, tools and method(s) used in processing leather in the Bolgatanga Municipality; identify the causes of the shortcoming(s) associated with leathers processed from Bolgatanga, and; recommend relevant solutions towards the amelioration of the defects.

2. Methodology

Qualitative design has been the main approach adopted by the researcher. Specifically, the descriptive case study design was used, since it presents the opportunity to exhaustively research into specific aspect of a problem within a limited time frame, focusing on the detailed interaction of factors and events (Bell, 1999). A case study, as noted by Humphries (2008), endeavours to 'approach a real-life situation from the inside'.
Data was amassed by the researcher himself through an interpreter. Largely, semi-structured interviews and focus group discussions were employed to solicit data from the field. Participant and non- participant observation techniques were also employed by the researcher to validate the interviewee's verbal claims. Secondary data was collected from the internet, books, journals and peer reviewed publications.
The population of the study comprised leather tanners in the Bolgatanga municipality. Purposive sampling method was used to select 60 tanners from Yikene, Tanzui and Nawomaya respectively for the study; thus 20 tanners from each community. The respondents were selected based on age and experience in the field under study. Data on types of skins tanned and how they were acquired, the tanning and dyeing agents used, the types of tools, materials and techniques employed in processing pelts as well as the tanning experiences, apprenticeship information and age of the respondents were collected.

3. Results and Discussions

The study shows that leather tanning in Yikene, Tanzui and Nawomaya has been practiced along a family-based rural cottage structure for years, using traditional techniques and materials to produce leathers.
All the tanners interviewed in the above mentioned communities were males aged between 17 to 53 years. The respondents pointed out that they have been processing leather for between 5 to 32 years.

Table 1. Tanning Experience

Community	No. of years in tanning	No. of respondents
Yikene	1 – 5	2
	5 - 10	3
	10 - 15	3
	15 - 20	3
	20 - 25	0
	25 - 30	4
	30 35	5
Tanzui	1 – 5	0
	5 - 10	0
	10 - 15	3
	15 - 20	4
	20 - 25	4
	25 - 30	6
	30 - 35	3
Nawomaya	1 – 5	3
	5 - 10	0
	10 - 15	5
	15 - 20	4
	20 - 25	2
	25 - 30	2
	30 - 35	4

Source: *Author's Fieldwork*

The tanners explained that the skill was acquired from their fathers, brothers or other male tanners in their various communities. They all concurred that they mainly tanned skins from goats, sheep and sometimes calves. The skins which were usually processed from the dried state, were either flayed by the tanners themselves or purchased from the main Bolgatanga market or other neighbouring markets in the region, they intimated.

Table 2. Materials and Tools

Materials	**Uses**
Skins and hides	For processing into leather
Zinzira/ Bagaruwa	Tanning agent
Millet husk	Dying of cinnamon red leather
Rusted iron	Dyeing of black leather
Pawpaw leaves	Fleshing
Pumpkin leaves	Fleshing
Wood ash	Unhairing
Exhausted carbide	Unhairing
Vegetable oils	For oiling leather
Tools	**Uses**
Scraping knife	Unhairing and fleshing
Clay pots (*kasko*)	Soaking, tanning and dying
Mortar and pestle	For pounding zinzira, millet husk and pelt
Old asbestos and concrete pipes	Fleshing
Scissors	Trimming finished leather
Gloves	Protection during tanning and dyeing
Drying lines	For drying leather
Buckets	Fetching and storing water
Empty tins and calabashes	Fetching water for tanning applications
Sticks	Softening and stretching of finished leather
Cement blocks	Softening and stretching of finished leather

Source: *Author's Fieldwork*

The study revealed nine basic stages employed by the tanners at Yikene, Tanzui and Nawomaya in converting skins and hides into leather. These stages have been classified under three broad arranges as follows; the preparatory stage, tanning stage and the crusting stage.

3.1 Preparatory Stage

This stage comprised the soaking and washing, liming, un-hairing and fleshing.

3.2 Soaking and Washing

During this process the dry or cured skins were soaked in a pot of water over a period of time. The purpose of this operation, the tanners revealed, was to increase the amount of water in the hide close to that of the living hide, remove foreign bodies and loosen the skin structure. This loosening makes it easier for the tanning agents, fats, dyestuffs and other substances, to penetrate into the skin. The pelts were soaked in this solution for about 4 to 12 hours, depending on their thickness. Traditionally this solution is called sari.

Figure 1. Soaking of leather

3.3 Liming

The liming mixture which is called toaka was also constituted in an earthenware pot. The recipe normally used is; 3 parts of vegetable ash to 1 part of weak calcium carbide. The above materials were mixed in the pot and the skins lowered into it. The goods were allowed to remain in the mixture for 12 hours or a day. It was observed that pelts left for longer periods in the toaka bath rot away, creating holes in the skins. The respondents explicated that the process aids in loosening the hair follicles, which enables the easy removal of the hair from the skins. The liming process they add, also removed fat and plump up the skin for tanning.

3.4 Unhairing

The researcher observed that unhairing in all the tanning communities were carried out using simple two-handled blunt scraping knives. After removing the skins from the liming solution, they were wrung and stretched on asbestos or concrete pipes. The scraping knife was then used vigorously to remove the hair from the grain side of the pelt.

Figure 2. Unhairing mixture ***(kadi)***

3.5 Fleshing

Prior to fleshing, the un-haired skins were again lowered into another pot containing the residual water which was initially used in soaking and washing the dried skins. Pounded pumpkin leaves (vugu tanteem), pawpaw leaves and fowl droppings were also added to this mixture. This mixture is known as kadi. The readiness of the goods is judged by its ability to rise to the surface of the mixture. The aim of this process as was explained by the tanners was to loosen the flesh and unwanted fat still adhering to the materials. The pelts were fleshed using the same scraping knife employed during the unhairing process.
The fleshed skins were then rinsed in weak tannin bath (sari), which had been previously used in tanning. This was to wash off some of the offensive odor from the kadi solution, as well as to neutralize the alkali effect of the ash and the weak sodium carbide, the tanners intimated.

3.6 Tanning Stage

The vegetable material used for tanning leather in Yikene, Tanzui and Nawomaya is the pod of *acacia nilotica* plant, known locally as *zinzira*. The pods were pulverized in a mortar and mixed with warm water in a large earthenware bowl. The skins were then pounded in a mortar before immersing them into the tannin liquor, which is known locally as *chuda*. The tanners explained that the skins were pounded to loosen the fibers of the skins and prepare them for tannin intake.

It was observed that the skins were first immersed in weak tannin compound for an hour or two before transferring them into a bowl of freshly constituted tannin liquor. The skins remained in the *chuda* liquor for about 6 to 12 hours, depending on the intensity of the tannin liquor or the thickness and density of the skins being tanned, as explicated by the tanners. At this stage, the tannin bonds with the natural collagen in the skins, thereby preserving them.

Figure 3. Tanning of leather

3.7 Crusting Stage

3.7.1 Drying, Softening and Oiling

The immediate post-tanning activities are drying, softening and oiling. The tanned leathers were first dried on a drying line and allowed to dry partially before commencing the softening process. The artisans regularly turned and reposition the leathers and sometimes stretching them individually to prevent them from stiffening, warping and over exposure to the sun. The technique normally used by the tanners to soften and stretch their leathers was to wrap part of the leather around a stick and dragging it between a flat-surfaced cement block and the sole of the foot. After satisfactorily softening and stretching the leathers, they were then oiled using groundnut oil, palm kernel oil or vegetable oil (frytol). The oiling was done by dipping a piece of cloth in a bowl of oil and uniformly spreading it on the grain surface of the leather.

After oiling, the leathers were sorted out properly. Those to be dyed were duly separated for further treatment. Equally the ones which would not be dyed were then properly folded and stored away to be sold.

3.7.2 Dyeing of Leather

Black and cinnamon brown were the only two colours dyed in the three communities during the study period. Even though the tanners claimed they could dye other colours such as yellow, blue, and green on request, none of the above mentioned colours were produced during the research period. The cinnamon dye was prepared from millet husk (*eleusine coracana*), whiles the black was constituted from a compound containing fermented liquids and rusted iron materials.

3.7.2 Cinnamon Brown

Millet husks were pulverized in a mortar by the tanners and mixed with some amount of the mixture from the pot containing the *toaka* solution, which was used in preparing the skin for unhairing, together with some amount of warm water. The leather was then folded into two, with the flesh side inside, moistened and immersed in the dye bath and dyed until an even hue was attained. The leather was then removed from the dye bath, lightly wrung and dried. The researcher has observed that the dying processes lasted between 15 to 25 minutes.

Figure 4. Dyeing of cinnamon red leather

3.7.3 Black

The black dye bath was prepared with the waste water gotten after boiling yam or locally brewed beer known as *pito*. The above solutions were poured on rusted iron materials and allowed to ferment for 2 to 3 days before using it to dye leather. The leather was folded, moistened and immersed in the dye bath. The goods were constantly turned around for 20 minutes before taking them out of the dye bath. They were then oxidized by drying them briefly before re-immersing them into the dye bath. This process was repeated three times or more until a uniform colour was achieved.

Figure 5. Dyeing of black leather

After dyeing, all the dyed leathers were again manually staked and stretched to achieve a supple and flexible finish. Subsequently, they were carefully rolled and stored in readiness for the market.

Figure 6. Stretching and softening of leather

3.8 Discussions

The findings of the study show quite clearly that the tanning processes used by the leather tanners in Yikene, Tanzui and Nawomaya, even though scientifically proven, was plagued with some challenges. The researcher observed that proper rinsing was scarcely carried out in the three tanning communities during the tanning processes. Largely, it was discovered that the offensive odor associated with the tanned and dyed leathers were imparted at two important stages during the tanning processes. That is; prior to fleshing and during the dyeing stages.
In the preparation of the *kadi* compound, which aids in the fleshing process, it was realized that the residuary water which was used in soaking and washing the dry leathers as part of the soaking and washing process, was again fetched and mixed with fowl droppings, pounded papaw and pumpkin leaves for use as fleshing bath. A major source of the bad odor therefore may be attributed to the re-using of this waste water. Even though the fowl droppings may also be seen as imparting some obnoxious characteristics, they are rather known to contain nitrogen, oxygen and hydrogen2, which are essential in fighting against the strong smell associated with the tanning process as well as speeding up the cleansing process (Zaruwa and Kwaghe, 2008).

In preparing the dye bath for dying the cinnamon brown, the researcher observed that the residuary mixture which was used in preparing the skins for unhairing (*toaka*) was also re-used by the tanners to reduce the organic dye. It should be remembered that the hides were taken from the soaking and washing pot, and directly immersed into the *toaka* mixture without any further rinsing. Some of the dirt and waste from this initial washing and soaking water would therefore be introduced into the *toaka* mixture. Using this mixture to reduce the dye for dying would be re-introducing the dirt into the tanned leather and ceiling it during the drying process. This is so because the leathers were not rinsed after dyeing.

The study again vividly reveals that in the preparation of the black dye bath, waste water from boiled yam was used together with *pito* beer or separately. This mixture was fermented before applying it on the leather. Drying the black-dyed leather without rinsing could therefore render the leather quite objectionable.

Generally, the researcher has observed that proper rinsing was not carried out by the tanners during the tanning processes. As variously explained by the tanners, the limited amount of water available to them, makes it quite difficult for them to rinse the skins diligently during the tanning and dyeing processes. It was observed that water for tanning was fetched from boreholes in Tanzui and Yikene. In Nawomaya however, a hand dug well was the main source of water, not only for the tanners but also for the entire community.

4. Conclusions

The study conclusively showed that leather tanning in Tanzui, Yikene and Nawomaya, is a male dominated enterprise which is passed down the male family line. The raw materials and tools for tanning were largely sourced from the community and its environs. The research revealed that even though the traditional tanning methods used to process tanned leather from the above mentioned communities in the Bolgatanga Municipality followed sound scientific tanning procedures, tanned leathers from these suburbs are noted for exhibiting offensive odors because the tanners do not adequately rinse the skins in the right manner during the tanning stages, due to the limited amount of water available to them. It was also realized that some of the mixtures used in preparing the skins for unhairing were later reused in reducing organic materials for dying some of the leathers into cinnamon red. The black dyes used on some of the leathers were constituted from locally brewed alcoholic beverage and other substances which have been allowed to ferment before use. Generally, the tanned leathers were not rinsed adequately before drying. The loathsome odor was therefore embedded in the leathers during the drying process.

5. Recommendations

Considering the enormous revenue that could accrue from the leather industry if systematically developed, coupled with the need to preserve indigenous small scale production endeavours such as the ones found in Tanzui, Yikene and Nawomaya, in the Upper East Region of Ghana, there is the need to for the Bolgatanga Municipal Assembly, and for that matter the Government of Ghana to take a second look at the tanning businesses in these communities. A systematic development plan needs to be drawn to give the industry some qualitative up-grading to boost the economic fortunes of the municipality and the region as a whole. The tanners must be trained to acquire innovative and modern tanning skills to improve on their tanning skills as well as tanning effluent management. Since water played a crucial role in the tanning industry, adequate water needs to be provided for the tanners in all the tanning communities to aid in the efficient processing of high quality vegetable tanned leathers. Second and third cycle institutions in the Upper East Region need to incorporate leatherwork and leather processing into their curriculum to whip up interest in the field and encourage the younger generation acquire employable skills in modern leather crafting and tanning methods.

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