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RESEARCH ARTICLE

Simulating Sirigu Pottery for Sustainable Ornamental Purposes: Ghanaian Indigenous Vegetable-Tanned Leather for Studio-Based Experimentation

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Abstract

In Ghana, pots are closely related to the social history of the people, even to the present times. They are commonly manufactured from clay and used to serve varied domestic purposes such as water storage, local beer (Pito) storage, cooking, bathing, planting flowers, to mention a few. The women of Sirigu in the Upper East Region of Ghana are highly engaged in the production of pots from clay, and paint them artistically with traditional colours, and symbols for the local and international markets. This lucrative economic activity has contributed to improved livelihood of the Sirigu women, and also positioned the Sirigu village as a destination for tourists. Considering the weight of clay pots and their fragile nature, visa-vis transportation issues, this study found it interesting to follow studio-based research approach to create mimicked versions of Sirigu pots for ornamental purposes as a means of expanding the frontiers of the indigenous pottery and painting concepts to contribute to the sustainability of the socio-economic significance of the pottery heritage of the area. In this studio-based research, indigenous vegetable-tanned leather from Bolgatanga (Capital of the Upper East Region of Ghana) has been identified, manipulated into pot samples, and painted to have artistic semblance as the Sirigu clay pots to serve ornamental purposes in homes, offices, hotel to mention a few. It was found that the indigenous vegetable tanned leather possesses the ability to respond to manipulations into pots of various shapes and forms, and be painted to simulate clay pots. The ornamental purpose of the leather pots was tested with both flowers of all kinds, and it proved positive for interior beautification.

Introduction

Reliance on indigenous raw materials to improve the living conditions of mankind has been a universal tradition from time immemorial. Although majority of resources that man depends on for survival exist as fundamental resources provided by nature, they become of greater

essence to man when there is the need to cater for his economic, social, cultural or religious needs (David, 2024) . Coleman (2007), the transformation of locally available resources to meet man's needs is pivotal in the creation of wealth in indigenous industries amounting to economic growth and stability. In Ghana, pots have been closely related to the socio-cultural and economic history of the people, even to the present-day. Pots are commonly manufactured from clay, a resource available in various localities, and used to serve diverse utility in homes such as storage of water, and local gin (Pito), preparing medicine, cooking, planting flowers, to mention a few. In the Upper East Region of the country, the women of Sirigu are highly engaged in the production of clay pots painted artistically with traditional colours, and symbols for domestic use, and to attract the local and international tourists (Wemegah, 2014). This lucrative economic activity has contributed to improved livelihood of the women, and also positioned the Sirigu village on the tourism map. Considering the weight of clay pots and their fragile nature, visa-vis transportation issues, this study found it interesting to follow art-based research approach to create mimicked versions of Sirigu pots with leather for ornamental purposes. This is to serve as a means of expanding the frontiers of the indigenous pottery and painting concepts to contribute to the sustainability of the socio-economic significance of the pottery heritage of the area, especially, as leather is traditionally produced in abundance in the Bolgatanga, the Upper East regional capital. The goal of this research is to explore the viability of the Ghanaian indigenous vegetable tanned leather to mould ornamental pots which mimic the original Sirigu pottery concept, and create a version which is light in weight for easy transportation, less susceptible to breakage, and basically be used for decoration and beautification purposes, rather than serving utilitarian purpose of water storage.

Literature Review

History of African Pottery Concept

Pottery artifacts are special component of the visual traditions of native peoples in most parts of the world. In sub-Saharan Africa, variety of pots produced in various societies, and are widely used for domestic, religious and cultural purposes. Speight and Toku (1999) traced the history of pot making in Africa from archaeological discoveries of pottery ruins from Sudan. Conceptually, traditional handmade African pottery is created by essentially forming flexible clay into objects and then firing them in pits or over an open fire to a temperature high enough to cause a permanent chemical and physical change (Lawson,1990). This is very common among tribes in African countries such as Togo, Benin, South Africa, Kenya, Sudan, Egypt and Mozambique to mention a few.

Wemegah (2014) asserts that in Ghana, pottery has a long tradition among the ethnic groups found in Mfensi, Pankrono in the Ashanti region, Kukuo in the North, Abompe in the Eastern

and Kpando Fesi in the Volta region respectively. Larbi (2009) has also emphasized that, in the Upper East Region of Ghana, the Nankana indigenes are engaged in indigenous pottery which resonate their heritage, and generally, in most Nankana pottery communities, pots are manufactured by hand in small quantities for the local market. Although pottery manufacturing processes and artifacts are still traditional, and focused on meeting local needs, patronage of the local pottery is still on the rise in Nankana communities and is invaluable for their aesthetics, socio-cultural and religious significance (Sarker, 2005). The most remarkable feature about pot making in the Nankana communities is the absolute simplicity of raw materials and tools involved (Nortey & Asiamoaso, 2019). The Ministry of Local Government and Rural Development (2006) indicates that, clay, the chief raw material for pot manufacturing, is still in abundance in Nankana and its surrounding villages making it easily accessible for pots manufacturing. Clay preparation methods such as pounding, wedging, pinching, coiling, firing, and sometimes smoking are the main production processes for pots production with much emphasis on pinching and coiling as the main forming methods.

Empirically, Robbert (2015) has explained that in Ghana, clay deposits have been recognized as a natural and geological source of the major material used in both industrial and indigenous pottery and ceramics. It often abounds everywhere and possesses the special ability to be readily shaped into a wide range of shapes. Craven (2007), however argues that since clay is a natural exhaustible material, there is an anticipation that clay as primary resource can be exhausted upon continuous utilization, the strategic framework needed for the nation's indigenous pottery industry to advance is established on national policies that safeguard sources of raw materials for guaranteed perpetual supply, upgrading, reformation and repackaging towards solving societal needs and demands. Ghana Poverty Reduction Strategy 2003 Annual Progress Report National Development Planning Commission (2004) highlights that, resilient economies, structured on enhanced traditional materials and artifacts and driven by the appropriate policy frameworks assist in reducing poverty and accelerating national economic growth. Boahin (2015) therefore encourages the exploration of available methods and techniques which have the potential to improve the abilities and application of local resources to create varieties of economically viable products for improved livelihoods. He stresses further that such strategies, contribute to the growth of local economies and create possibilities for cultural sustainability and job opportunities.

Sirigu Pottery Decoration Concepts

Sirigu is a scenic village in the Kassena Nanakana District in the Upper East Region of Ghana with a travelling distance of 30 kilometers from the regional capital, Bolgatanga. The people are predominantly peasant farmers who are into the growing and rearing of grains livestock,

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and guinea fowls respectively. In Sirigu, dry season is the most appropriate period to produce pottery in larger scale (Wemegah, 2014) . In the making of pots in Sirigu community, the vocation is dominated by females, however, in spite of their usage in domestic settings for carrying and storage of water, as well as for preparing food and local gin (Pito), they are also for aesthetic, religious and commercial purposes. According to Wemegah (2014), although it is impossible to trace the historical account of pottery production in the Sirigu, the craft has been practiced since ancient times, by the forbearers of the present people in the community and the symbolic paintings are most done by the women. The information collaborates Anaba's (1995) study regarding wall paintings (mural) amongst the inhabitants of Kassena-Nankana community. A small number of men are however presently involved in wall and pots symbol decorations due to its economic gains.

Characteristics of Sirigu Pot Painting Techniques

The painting type practiced by the Sirigu women is traditionally unique and artistically attractive. According to Asante & Opoku–Asare (2011) a careful study of the paintings on the clay pots produced by the women indicate that their paintings mostly follow patterns based on the use of lines, repetition of particular colours (red, white, and black). They have explained that the paintings symbolically depict life matters based on animal representations and meanings. The designs which are generally inspired by geometric shapes are usually illustrative and depicted proportionally either in vertical or horizontal manner across the peripheral and interiors of the pottery works. Observations made during painting sessions clearly shows that the experienced painters analyze the surface of the pot and colour arrangements prior to colour rendition and are mostly accompanied by singing, clapping, dancing and general merry making (Asante & Opoku–Asare, 2011). Skilled decorators always record the right framework of the symbols on the walls and pottery before other less skillful decorators, join in painting the other colours. Again, aside the painting, the Sirigu people are also engaged in low relief works as additional creative methods used by the artisans.

Figure 1: Pottery and symbolic wall paintings of Sirigu women
(Source: https://www.alamy.com/)

Versatile Properties of Ghanaian Indigenous Vegetable Tanned Leather

Leather is most the preferred substitute material is due to the vast properties and how it is able to adapt to several to manipulation for varied usage. Boahin (2011) has stated that unlike leatherette, leather offers a wide range of uses due to its versatility and unique properties such as durability, high tensile strength and ability to develop patina with age. As a material, leather exhibits properties which gives it stretching ability, suppleness as fabric or as hard as wood, and breathability. Leather lends itself to be coloured using dyes or pigment and polished to have a sheen finish. Boahin et al. (2015) also stress that leather is primarily obtained from domestic animals, which are endlessly renewable natural resources that can be replenished with the right animal husbandry techniques. According to Anini et al. (2012), leather surfaces can be embellished using a range of decorative techniques, such as painting, dyeing, embossing, marbling, and coatings, to improve their visual appeal. Given these characteristics, leather can be manipulated to create pots using a technique called cuir bouilli, which involves soaking vegetable-tanned leather in water until it is completely soaked, then shaping it into the desired shape and drying it at a constant temperature 50°C (Baidu, 2019).
Asubonteng (2010) cites Howes (1953), Sharphouse (1995), and Sarker (2005) as saying that the history of vegetable tanning is obscured by the haze of antiquity. The use of aqueous extracts from plant sources to alter the raw skins and hides to leather was the first tanning method discovered by the early man during the prehistoric era. Subjecting skin and hides to this tanning technique enhance leather properties and characteristics and promotes its usage for functional items.

According to Larbi (2009), the practice converting skin and hides to leather has been in Ghana for over a century and acacia nilotica commonly known as Bagaruwa in Hausa is the most used plant source for tanning in Ghana. Boahin (2011) as cited in Asubonteng (2010) emphasized that Bagaruwa (Acacia nilotica) is Ghana's primary and most reliable source of astringency for vegetable tanning.

Again, since the local industries are a major pivot in strengthening macro-economic strategies for stability and long-term societal progress, Anquandah, (2006) believes that repackaging local products must help transform the indigenous art industry from its subsistence orientation to a dynamic sector that is economically viable, commercially appealing, and essential for achieving sustained equitable growth capable of improving livelihood in society.

Leather Manipulating Techniques and Processes

Leather as a versatile material allows itself to be used to form various shapes and forms, and this makes leather a versatile material for the production of varied products (Boahin 2008).

He has stated that leather is known for its traditional abilities in making conventional products such as shoes, bags, belts, jackets and hats, however, Asubonteng (2012) has emphasized that due to the versatile properties of leather, it has the ability to be manipulated into various non-conventional artifacts known in woodwork, metalwork, clay work to mention a few. He explains further that when the right manipulating techniques are carefully employed, and appropriate finishes and finishing methods are used, leather artifacts can be hard as fired clay, look like wood and feel like metal products. This is what accentuates the justification for leather utility in molding buckets, cups, masks, car parts and strange objects to serve the needs of humanity in diverse ways. However, many leather artists, and craftsmen prefer making conventional leather artifacts than the non-conventional due to already laid down procedures that makes its convenience to producing these artifacts, as the non-conventional artifacts making requires more manipulation skills and unravelling new methods to achieve the target object.

According to Boahin et al. (2015) leather manipulation refers to skillful handling of leather to alter its properties to make the material responsive to the process of artifact manufacturing. He indicates that since the physical, chemical and biological properties of leather are inherent, one needs to understand the material and apply the right technical manipulating approach in order to influence or control it to respond the production process being used to manufacture a particular leather artifact like bowls, wall tiles and ceiling panels. It is popularly acclaimed by the medieval leather craftsmen in England that although leather is a soft-sculpture material, it was used to mould bottle, mugs and hollow objects to serve their immediate needs (Carlson, n.d.) The most commonly used leather for such manipulated process is the vegetable tanned leather, due to its responsive nature to diverse manipulating techniques such as pounding, boiling, steaming, frying, burnishing, stretching, fat liquoring, molding into shapes and tooling.

Methods

The intention of this research was to explore the viability of Ghanaian vegetable tanned leather as a material to mimic the Sirigu indigenous clay pots and symbolic painting techniques, and create versions of leather pots for the purposes of interior ornamentation, towards expanding the frontiers of locally made leather utility in non-conventional artifact production, and also contribute to the preservation of the indigenous pottery and painting concepts, and add to strategic sustainability of the socio-economic significance of the pottery heritage of the area. Since the clay pots already exists in varieties, the researchers used the convenience sampling method to select three Sirigu indigenous pot samples (Bagadokor pot, Yore pot and Yogila pot) for a case study, and used studio-based research method to explore the manipulation techniques to cause the local vegetable tanned leather to conform to the

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shapes of the pots through moulding. Since the studio experiment aimed at imitating the Sirigu pots without altering any of the peculiar feature which give traditional identity to the Sirigu pottery, emphasis was laid on achieving semblance, by paying particular attention to details of each of the three pots. The study is therefore based on the theories of aesthetics and functionality for conservation as proposed by Kant (1764) as cited in Wenzel (2009) that traditional resources such as objects, music, dance etc, of value can be conserved, sustained or made more popular when imitation is permitted towards creating diverse versions for varied functionalities to expand the scope of the object or resource. Similarly, the imitation theory as found in aesthetics assumes a flawless replica or illusion of the immediate, direct, and unconditional outside reality

(Wenzel, 2009) . The manipulation techniques employed bothered on secondary treatment, moulding, pounding and casing. The main material used was vegetable tanned leather from Bolgatanga, which is known for traditional leather making, and other materials such as white glue, paper, paints served as the major materials for the pot production. Measuring tools, scissors, compasses, brushes, pestle, mortar and moddlers were employed were some of the tools employed during the studio activities. Technically, the manipulation process paid critical attention to managing the mouldability properties of the leather to conform to the shapes and form of the selected pots, without compromising on the cultural characteristics of the Sirigu clay pots.

Project One: Production of Bagadokor Pot

Since the Bagadokor pot is specifically characterized by wide mouth, projected studs on the body and a lid, there was the need to give adequate attention to details at every stage of the production process.

Figure 1: Bagadokor clay pot selected for moulding into ornamental leather pot
(Source: fieldwork, 2019)

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Step 1: As part of the manipulation process, the indigenous vegetable tanned leather was taken through the secondary treatment process which involved sanding, soaking, washing, and stretching. This was to ensure that the leather was refined and conditioned for the pot mouldling. The sanding was done with 60 grit sandpaper to refined the flesh side of the leather by removing all the loose fibres as shown figure 2.

Figure 2: Sanding the flesh side of the vegetable tanned leather.
(Source: fieldwork, 2019)

Step 2. The leather was soaked in clean water for two hours to cause adequate absorption leading to proper hydration. Pounding was done in a mortar with pestle to facilitate softness prior to moulding.

Figure 3: Soaking the vegetable tanned leather in a bucket of water
(Source: fieldwork, 2019)

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Figure 4: Leathers stretched on a wooden board prior to drying
(Source: fieldwork, 2019)

Step 3: Mark and cut out the template at the flesh side of the prior to casing.

Figure 5: Tracing the template at the flesh side of the leather
(Source: fieldwork, 2019)

Step 4: The pieces of cutout leather are soaked in clean water to get them wet and soft.

Figure 6: Spreading of PVA glue on the grain side of the leather.
(Source: fieldwork, 2019)

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Step 5: The selected pot is placed on the working table and the wet pieces of leather are spread on the pot with the grain side of the leather touching the pot.

Figure 7: The first piece of leather placed on the pot during the moulding process (Source: fieldwork, 2019)

Step 6: A third layer is secured by spreading the pieces of leathers over the second layer with the grain side up.

Figure 8: Overlapping the second and third layer of cased leather on the Bagadokor pot. (Source: fieldwork, 2019)

Step 7: White (PVA) glue is spread over the overturn pattern for final overlaying.

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Figure 9: Spreading white glue on the mould leather prior to the laying of the last layer.
(Source: fieldwork, 2019)

Step 8: After allowing the glue to set, the last layer is spread on the mould for a complete Bagadokor pot. This will serve as the exterior of the Bagadokor pot.

Figure 10: Pasting the final leather on the glued moulded leather
(Source: fieldwork, 2019)

Figure 11: Final Design of Bagadokor leather pot
(Source: field photograph, 2019)

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Figure 12: Drawing of Sirigu symbols on the molded leather Bagadokor pot
(Source: field photograph, 2019)

Figure 13: Final Bagadokor pot after executing the Sirigu symbolic painting to decorate it.
(Source: fieldwork, 2019)

Project Two: Production of YORE POT in five (5) leather layers

Figure 14: Yore Pot
(Source: fieldwork, 2019)

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Step 1: Mark and cut the templates for the Yore pot. Traced the templates on the leather and cut them out with a scissor. Case the leathers and pound to make them soft.

Figure 15: Cutting the various layers (5) of leather to serve as reinforcement.
(Source: fieldwork, 2019)

Step 2: spread the cut-out pieces of leathers on the pot by overlapping the layer to pick the shape of the pot.

Figure 16: Covering the Yore pot with the cut-out pieces of leather
(Source: fieldwork, 2019)

Step 3: Fabric and rubber layers spread on the mould (clay pot) to enhance durability.

Figure 17: Reinforcing the five layers of leather with fabric and rubber
(Source: fieldwork, 2019)

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Step 4: Spread glue on the leather is and lay the outer layer of the leathers to complete Yore pot

Figure 18: Spreading white glue and covering the overturn pattern with the last layer of leather

(Source: fieldwork, 2019)

Figure 19: Final Design of yore leather pot
(Source: fieldwork, 2019)

Step 5: The entire surface of the Yore leather pot was primed with white paint. Measurements were taken and geometric shapes were drawn.

Figure 20: Drawing of Sirigu symbols on the molded leather Yore pot
(Source: fieldwork, 2019)

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Step 6: The geometric shapes of expertly painted with and finished with clear and hardener.

Figure 21: Painted Yore leather pot
(Source: fieldwork, 2019)

Project Three: Production of YOGILA in four layers:

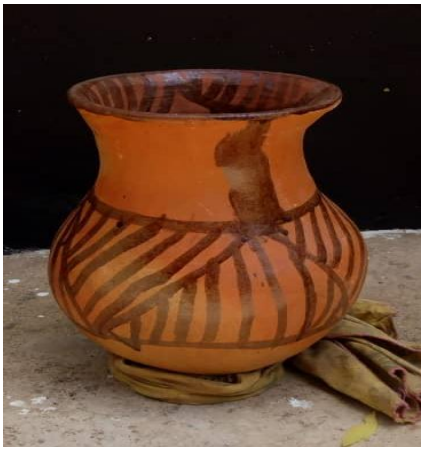

Figure 22: Selected pot for the project
(Source: fieldwork, 2019)

Step 1: Varied templates of different shapes were drawn on a bond paper and cut out.

Figure 23: Tracing the template at the flesh side of the leather
(Source: fieldwork, 2019)

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Step 2: The templates were marked and cut with scissor from the leather. These served the base for the production. Four different layers were cut out, immersed in water and pounded to attain softness. The leathers were laid on the Yogila pots in overlapped layers.

Figure 24: Laying cut out pieces of leathers on the Yogila pot
(Source: fieldwork, 2019)

Figure 25: Applying white glue prior to laying the second set of leather layers
(Source: fieldwork, 2019)

Step 3: The templates used in step two (2) were used to mark the second set of leather layers. The white glue was spread at the flesh sides of the second set of leather layers and on the first set of leather wrapped around the pot. The glue was allowed to set for five minutes before the second layers were wrapped on the pot to serve as outer layer of the pot.

Figure 26: Wrapping the second layers of leathers
(Source: fieldwork, 2019)

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Figure 27: Yogila leather pot after molding
(Source: field photograph, 2019)

Step 4: The surface of the Yogila leather pot was painted with white acrylic paint to serve as the base colour of the pot. The outline of the geometric shapes was drawn with black paint to help bolden the demarcated line surface prior to the painting of the geometric shapes in red colour.

Figure 28: Decorative painting been rendered on the YOGILA leather pot
(Source: fieldwork, 2019)

Figure 29: Final Yogila pot decorated in Sirigu symbols
(Source: fieldwork, 2019)

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Results and Discussion

Material Selection, and the Use of Appropriate Tools and Materials

Since the pots existed already, the selection of the local vegetable tanned leather and the other materials was done carefully to ensure conformity. The leather used were from the indigenous tanneries in Bolgatanga, which are known to be hydrophilic making casing easy. The goat leathers used were soft but firm, had good grains, measured 1.7 mm in thickness and were without surface defects. These qualities made the use of the leather supportive to the mouldling process. Since the belly part was very soft, they were used to mould the curvy part of the pots (neck, and belly). The butt and the back portions of the hide were used for mouldling the bottom part to achieve firmness. Since softness was very key to the success of the moulding process, crumbling the leather at the flesh and pounding in their cased state in a mortar with the pestle was done to ensure the leather attained the right softness and flexibility needed.

Technical Considerations for Successful Manipulation of Leather into Sirigu Pots

Technically, the manipulation guidelines followed to converting the leather into pots mainly involved the secondary treatment (sanding, soaking, and washing), and pounding. The pounding really helped to enhance the softness and pliability of the leathers, thereby making moulding process executed smoothly. The application oil and intermittent sprinkling of water on the leather also helped to sustain softness throughout the process, and this made the leather cling to the clay pots better to assume the various shapes.

Painting and Integrated Techniques

In the processes of painting of the leather pots, it was found necessary to choose colours and patterns which are traditionally known and found on the Sirigu clay pots and their local buildings as stressed by Wemegah (2014). This was to ensure close simulation of the painting culture practiced by the women of Sirigu. Looking at the finished pots as displayed in figure 30, the colours used, their distribution and the patterns created artistic impression of the symbolic wall paintings of the Sirigu women. The white acrylic painting spreading from the bellies of the three pots to the bottom areas serve as the base colour projecting the geometric patterns created with the black colour. The constant application of red, white and black colours to contrast the earth colour of the pots makes the aesthetic appeal well projected, thereby making the leather pots pleasantly prominent from external looks. The square and triangular shape patterns created with the colours on the three pots also introduce a sense of conformity with the aesthetic balance with the shapes and contours of the pots. These characteristics enhancement the intended purpose of the pots for ornamentation.

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Figure 30: Samples of finished leather pots.
(Source: fieldwork, 2019)

Ornamental Utility of the Simulated Sirigu Pots

The three pots, though were made in leather, had semblance of the original Sirigu clay pots in terms of shapes and form, however, since the intention of the study was to divert the functionality of the Sirigu clay pots from storage of water, millet and preparation of medicine to ornamental purposes, the intentional finishing of the colourful paintings executed on the leather pots made them look traditionally decorative to augment the intended purpose. At this stage, it needs to be emphasized that when the ornamental intention was tested, it was observed that the pots could contain various types of flowers to beautify different interior spaces (offices, receptions, lobbies of hotels etc.). Also, the colours on the pots as a result of the painting complement the colours of the flowers, and made them look and feel brighter.

Figure 32: Sirigu leather pots serving as interior flower holder

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Figure 33: Sirigu leather pots with flowers mounted on a metal pedestal.
(Source: fieldwork, 2019)

In terms of positioning of the pots to achieve optimal effect in the used as ornamental pots, it was observed that since none of them had flat bottom surfaces, each of them needed support in order to stand independently. By creating metal stands which allow the base of the pots rest in circular spaces, the pots could then stand balanced on the metal pedestals in interior spaces where height is necessary, and make the flowers easily noticeable from where it is positioned. It was however observed that for pots with rounded or curved bases to stand firm, appropriate pedestals are necessary to optimize functionality. This became obvious when attempts were made for the pots to stand unsupported without the bamboo rings used as stands as shown in figure 34.

Figure 34: Sirigu leather pots with flowers mounted on a bamboo pedestal
(Source: fieldwork, 2019)

Conclusion and Recommendation

The study achieved its intended objective successfully by manipulating the local vegetable tanned leather produced in Ghana to mould simulate Sirigu pots purposely for ornamentation. The leather responded positively to the moulding process, and conformed to the shapes of the selected Sirigu clay pots. Pounding was the main impactful manipulation technique to improve leather softness and pliability for facilitating the moulding processes to produce leather pots which are comparatively light in weight for easy transportation and mobility. Decorative and ornamental utility of the simulated versions of the Sirigu pots contributes to the quest to innovatively create products and artifacts which have the ability to contribute to the cultural preservation and sustainability, and also guarantees the maximization of the socio-economic benefits of the Sirigu pots towards contributing to the expanding the scope of Sirigu pots. It has also created opportunities to enhance livelihoods in a community for the Sirigu pots to be considered for decorative purposes due to their unique paintings. Currently, the leather pots are extremely significant decorative items that can be used to adorn important modern spaces like conference rooms, banking halls, hotel receptions, living rooms, and offices of different organizations. This has contributed to the expansion of the scope of utility, and relevance of the Sirigu pottery and painting concepts as an indigenous resource.

Since the success of this research was to open another page of extended technique of pot moulding and utility, local leather craftsmen and potters across Ghana are encouraged to explore and venture into the production of pots with vegetable-tanned leather. This will contribute to developing their capacity for creativity, expand their knowledge and skills in converting non-conventional pottery materials into pots. Further research into the use of other locally available materials should be explored in the pottery industry towards cultural preservation and maximization of indigenous resources to meet contemporary needs of humanity is encouraged.

Author Contributions

Conceptualization – S. Napodoo, Owusu Kwame F, Asubonteng K and V.W. Okpattah; methodology – S. Napodoo, Owusu Kwame F, Asubonteng K and V.W. Okpattah; formal analysis – Owusu Kwame F, Asubonteng K and S. Napodoo; investigation – Asubonteng K and V.W. Okpattah; resources – Owusu Kwame F and Asubonteng K; writing-original draft preparation– S. Napodoo, Owusu Kwame F, Asubonteng V.W. Okpattah and Boahin J O B; writing-review and editing – V.W. Okpattah, Asubonteng K, S. Napodoo; visualization – Owusu Kwame F, Asubonteng K and S. Napodoo; supervision – Asubonteng K and Boahin J O B. All authors have read and agreed to the published version of the manuscript.

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