International Journal of Multidisciplinary Research and Development
www.allsubjectjournal.com
ISSN Online: 2349-4182 ISSN Print: 2349-5979
Received: 14-11-2023, Accepted: 29-11-2023, Published: 15-12-2023
Volume 10, Issue 12, 2023, Page No. 22-26

The use of home-based material for tying and dyeing of clothing materials in Plateau state, Nigeria

Ochigbo S E*, Hemba A E
Department of Home Economics, Federal College of Education Pankshin, Plateau State, Nigeria

Abstract
This study responds to Nigeria's urgent need for economic diversification, emphasizing the utilization of locally produced materials to foster economic development and revive indigenous industries. Recognizing the detrimental environmental impact of synthetic textile dyes, the research explores the potential of natural dyes sourced from home-based materials. Specifically, the study focuses on tie and dye techniques, once a vibrant part of African culture but now underutilized. Employing an experimental research design, the research focuses on the laboratory production of home-based dye extracts for tying and dyeing fabrics. The methodology includes the extraction of dye components from indigo, Roselle plant, and turmeric using Soxhlet Extractor. The research also outlines a formalized production process for home-based dye extracts. Dyed fabrics undergo a thorough quality/acceptability assessment, considering color vibrancy, fastness to washing and sunlight, and overall aesthetic appeal. The study found that polar solvents (Absolute Ethanol, Ethyl Acetate) showed high extraction efficiency. The result also indicates high mean scores across all quality/acceptability criteria, reflecting positive responses. The low standard deviations suggest a consensus on the quality and acceptability of the home-based products. The study concludes that economic diversification through the revival of traditional tie and dye practices using locally sourced materials is feasible. It was recommended that further research to explore additional natural dye sources, collaboration with local artisans for industry integration, and community awareness programs to promote the environmental and health benefits of natural dyes.

Keywords: Home-based Material, Tying and Dyeing, Clothing Materials

Introduction

There is an urgent call in Nigeria today for economic diversification through the use of locally produce material to enhance economic development and emergent of indigenous industries. A critical look at the current scenario has shown that textile industries have gone moribund in Nigeria and there is a need to re-introduce such via locally produced materials.

Srivastava and Singh (2019) [11] opined that, textile production is one of the most polluting of all industrial sectors, and is considered the second largest source of water pollution in the world after agriculture. According to the World Bank, 17-20% of industrial water pollution comes from synthetic textile dyes, and about 40% of synthetic dyes contain known carcinogens. In addition to harming human health, chemical dyes can accumulate in rivers, releasing toxic, hormone disrupting chemicals that cause animal mutations and death. On the other hand, natural dyes come with many benefits related to human health environment. Natural dyes are biodegradable, easily available, non-toxic have lots of medicinal properties and also have large scale of tint and shades of various hues. Among the ways of reviving is the introduction of the tie and dyes of clothes which were predominantly part of African but it had been completely relegated Dyeing is the process of applying colour on cloth to produce a design. Tie-dyes is a method of tying or stitching fabric together to prevent the absorption of dye to a particular area (Olufunmilayo, 2014).

Production of different colourful fabrics have created many attractive fashions that is being celebrated today and there is need to re-introduce this such process using home-based materials for economic emancipation in the societies. Gausa and Abubakar (2015) view tie and dye as a method of introducing coloured or white pattern of cloth, by tying it with strong strings in various ways before immersing it in the dye bath; the colour is absorbed in all except the tied areas thus revealing a patterned result which is seen by untying the dyed material. Although the techniques of tie and dye vary from culture to culture, the concept of dying remains one of the oldest methods of printing design on fabric. Another viewpoint of tie and dye is expressed by Areo and Olatunde (2013) [2], who states that tie-dye resembles both printing and dyeing in different ways. It resembles printing in that it enables colour pattern to be introduced on the fabric as in textile printing, the technique employed is different. It also resembles printing in that, ordinary dye liquor and not a printing paste is used in each case, and yet can be applied to the fabric by immersing it in the dye solution containing the necessary fixation chemicals. Gausa (2013), opined that both methods of colouration employed dye resist printing to introduce patterns on clothes; that is, patterns are introduced by restricting or inhibiting the absorption of colour in selected area of the cloth. The design obtained from the placement of the pleats, stitches and ties can never be an absolute means of predetermining the final visual result as agreed by Areo and Area (2014) [1] also argued that the common African desire for a pattern of square is achieved by sewing plead variation. The thread is sewn through one or more layers of fabric and one end is knotted. The thread is then drawn up until the fabric is held tightly together in a closely packed pleats or folds. The desire for colorful pattern of clothes is highly peculiar to African, therefore there is a need to re-embrace this desire through the use of locally made material that are cost effective and highly acceptable.

Dyeing is a way of impacting planned patterns and colours unto fabrics using dye. Dye is a molecule of organic compound which is responsible for dyeing material. Before

the discovery and importation of man-made synthetic dyes, people of Nigeria and Plateau in particular depended on plants for their sources of dyes. This suggests that all the raw material used for dyeing of textile materials were locally sourced. But with the advent of synthetic dyes, the production of local dyes dropped. Local dyes are natural dyes which are obtained naturally from the local environment without recourse to industrial by-products. Natural dyes are unique as they are eco-friendly and non-carcinogenic. Synthetic dyes are problematic because the families of chemical compounds that make good dyes are toxic to human. With the world becoming more conscious towards ecology and environment, the revitalization of the tradition of natural dye and dyeing techniques as an alternative to hazardous and expensive synthetic dyes are most desired. Based on the above, the research will be executed to see how the use of synthetic dyes will be minimized and improve diversification through the use of local and home-based materials in the study area. Also, to have the home-based dyes extract in large quantity that can serve as commercial purpose within the community.

Literature Review

Adire, the patterned dyed cloth is extant and is practiced in almost all part of the country, Areo and Olatunde, (2013) [2]. Traditional dyeing with many indigenous plants as a vocation and art tradition especially indigo dyeing is a specialized art which has become a legacy of the Yoruba's. Dyeing among the Yoruba is of two types: total-dyed cloth called Amure, without covering any part for dye resistance or pattern 'formation' and Adire which involves creating patterns on the fabric through any of a variety of available techniques before immersing the cloth inside dye. Indigo still remains the oldest natural dyestuff of world textile tradition and with Tyrian 'purple' it is believed to predate the time of Moses.

Morse and Staley (2009) [9] posited that, skin diseases, such as allergic contact dermatitis, irritant dermatitis and inflammation of mucous · membrane has been found to be associated with adire production. These have been associated with the effects of chemicals and dyes as major chemicals that are associated with the production and aesthetics of the fabrics (Ogunduyile, 2001) [10]. International Labour Organization (ILO, 2008) reported that more than 2 million people die from occupational accidents and work-related diseases such as dermatitis, itching, cough etc. accounting for a large number of occupational diseases Grosick, (2004) [7]. There are 270 million occupational accidents and 160 million cases of occupational diseases. Hazardous substances such as sulfur dioxide, hydrogen sulphite, asbestos kill 100,000 workers worldwide each year (ILO, 2008).

A lot has been written about dyes and dyeing processes in Journals, Textbooks, magazines; where dye has been described as colouring agents. It cannot be directly applied on fabric, but has to be mixed with some chemicals (mordants) and water. According to Areo and Area (2014) [1]. Which stated that "dye must be dissolved before it can work". When fabrics are placed into a dye-bath, there occur two forces in action that is the force of attraction and the force of repulsion. The fiber absorbes the dye molecules through the help of the force of attraction while the force of repulsion occurrs between the water and the dye molecule via its separation from water. The molecules give the fibres a desired colour. Dyed textile varies in their ability to hold colour. Colour fast fabric does not fade under sunlight, washing, perspiration or rubbing when in use. Gausa and Abubakar (2015) describe dye as complex organic compounds that are intensely coloured and are utilized to colour other materials because of the presence of chromophores and auxochrome radicals. Olufunmilayo (2014), says dyed shades are obtained by treating the fabric with a solution of dye, which in most cases has an affinity for the material either with or without special preparation through an event of the yarn or fabric by the dye liquor is of most importance and is basic of all successful dyeing. Gausa and Abubakar (2015) define dye as a coloured substance used to impart more or less permanent colour to other substances. Dye colour is used in the manufacture of plastic products, but their most important use, is in colouring of textile fibre and fabrics. Areo and Olatunde (2013) [2] defines dye as organic or inorganic compounds of the so-called transaction metal which are generally those elements that have incomplete electronic orbit present in intense colours. Dyes are chemical substances used to impart colour to material such as textiles, paper, leather and wood. Dyes are different from paints because they bond with the fabric and have no hand (the feel touched with hand) unlike the paint which lie on top of the fabric I do have hand.

Natural dyes are dyes or colorants derived from plants, animals, or minerals. On the basis of origin, natural dyes are broadly classified into three categories: vegetable, mineral and animal origin. Vegetable origin dye coloring matter derived from root, leaf, bark, trunk or fruit of plants. Natural dyes are mostly non-substantive and must be applied on textiles by the help of mordant. Mordant allows many natural dyes which otherwise just washout to attain acceptable wash fastness. A mordant remains in the fiber permanently holding the dye, usually a metallic salt, having an affinity for both the colouring matter and the fiber. While synthetic dyes are referred to 'coal tar dyes', since they are manufactured from substances which until recently were only obtained from coal tar. All compound derivatives of hydrocarbon benzene (C6H6), which consist carbon atoms at the corner of an equal sided. Campbell (2019) [4]. In recent years, there has been a trend to revive the art of natural dyeing. This is mainly because of its advantages over synthetic dyes. Some of these advantages are listed below;

a. The shades produced by natural dyes are usually soft, lustrous and soothing to the human eye.
b. Natural dyestuff can produce a wide range of colours by mix and match system. A small variation in the dyeing technique or the use of different mordants with the same dye (polygenetic type natural dye) can shift the colours to a wide range or create totally new colours, which are not easily possible with synthetic dyestuffs.
c. Natural dyestuffs produce rare colour ideas and are automatically harmonizing.
d. Unlike non-renewable basic raw materials for synthetic dyes, the natural dyes are usually renewable, being agro-renewable/vegetable based and at the same time biodegradable.
e. In some cases like harda, indigo etc., the waste in the process becomes an ideal fertilizer for use in agricultural fields. Therefore, no disposal problem of this natural waste.

f. Many plants thrive on wastelands. Thus, wasteland utilization is an added merit of the natural dyes. Dyes like madder grow as host in tea gardens. So there is no additional cost or effort required to grow it.
g. This is a labour intensive industry, thereby providing job opportunities for all those engaged in cultivation, extraction and application of these dyes on textile/food/leather etc.
h. Application of natural dyes has potential to earn carbon credit by reducing consumption of fossil fuel (petroleum) based synthetic dyes.

So, by considering all the facts, it is found that there are so many benefits of natural dye, these resources are not only environment friendly, bio degradable but some of them also have medical values. Best Rushessays (2017) [3]

Methodology

Pankshin is a Local Government Area in Plateau State, Nigeria. Its headquarters is in the town of Pankshin. It has an area of 1,524km. The study will be carried out at the department of Home Economics, F.C.E Pankshin. The research design is experimental research. This will involve the laboratory production of the home-based dye extract for tying and dyeing of clothing materials. The data to be collected are in two categories these are the laboratory analysis of the extract and the production quality/acceptability of selected fabrics. The instrument for data collection will be proforma and observation checklist, the proforma will be used to obtain laboratory analysis result of the home-based extract for dyes while the checklist will be used to observe the quality and acceptability of the tye and dye selected fabrics produced using the home-based dye extract. The Method of Data Analysis will be the use of descriptive statistics precisely percentage mean and standard deviation.

1. Extraction of the Dye Using Soxhlet Extractor

Extraction of colour component from source natural dye material is important step for dyeing any textile substrate to maximize the colour yield. Moreover, standardization of extraction process and optimizing the extraction variables both, for a particular source natural dye material have technical and commercial importance on colour yield and cost of extraction process as well as dyeing cost. The natural dyes can be taken from various vegetable sources like flowers, plants, roots, etc. as well as animal sources and mineral sources. The colour component present in these sources needs to be extracted so that it can be applied suitably on textile fabrics (Chakrabarti and Vignes, 2014)

The sample of (indogofera tentoria), roselle plant (Hibiscus sabdariffa) and turmeric

(curcuma longa) will be obtained from local farmers (LF) in different locations, (Jos south, Shemdem and Pankshin).The different textile fabrics use were obtain from the same locations. The sample will be washed, pre-dried in the sun and then weighed using digital weighing scale. Therefore, the weighted sample is dried, crushed, pound with pestle and mortal, and passed through a 2mm sieve not to classify the powder into size, but to remove particles present to obtain a fine powder and to have a maximum intimate contact with the solvent. 500g of the powder will be fed into the Soxhlet Extractor (SE) and normal hexane, ethyl acetate, absolute ethanol and distilled water will be used in turns as the extracting solvent. This will be refluxed for about 3 hours for each of the solvent. The solvent will be evaporated to dryness using a Hot Plate (HP) to obtain the solid dye sample, the sample is weighed and the percentage yield is calculated. This process will be repeated many times to obtain large quantity of the solid dye samples.

2. Preparation of the Dye Bath and Textile Fabrics

The powdered dye will be made into solution and warmed to enable proper dissolution of the dye and use to dye different fabrics. In the preparation of the textile fabrics, the fabric will be wetted with warm water in other to open up the pores for easy penetration by the dye molecules. Some of the fabrics will be mordanted using solutions of Stannous Chloride (SC), iron alum, mordanting agent. The outcome of the sample produced from the local dye will be used to train the research assistant (students).

Results

1. Extraction of Home-Based Dye Components

Hibiscus sabdariffa

Curcuma longa

Indigofera tinctoria

Table 1: Percentage yield for each solvent used.

Sample		Extraction solvent		
	Hexane	Ethyl acetate	Absolute Ethanol	Distilled water
Indigofera tentoria	5.2%	6.8%	7.5%	4.3%
Hibiscus sabdariffa	8.1%	9.2%	7.9%	6.5%
curcuma longa	4.5%	5.0%	6.2%	3.8%

The extraction process using Soxhlet Extractor resulted in successful isolation of dye components from indigo (Indigofera tinctoria), Roselle plant (Hibiscus sabdariffa), and turmeric (Curcuma longa). The percentage yield for each solvent (hexane, ethyl acetate, absolute ethanol, and distilled water) was determined, providing valuable data on the efficiency of the extraction process.

Indigo (Indigofera tinctoria)
The results indicate that Absolute Ethanol yielded the highest percentage of dye components (7.5%), followed by Ethyl Acetate (6.8%), Hexane (5.2%), and Distilled Water (4.3%). This suggests that indigo extraction is more efficient with polar solvents like ethanol and ethyl acetate compared to non-polar solvents like hexane or water.

Roselle (Hibiscus sabdariffa)
Ethyl Acetate produced the highest yield (9.2%) for Roselle extraction, followed by Hexane (8.1%), Absolute Ethanol (7.9%), and Distilled Water (6.5%). Similar to indigo, the results highlight the effectiveness of ethyl acetate in extracting dye components from plant materials.

Turmeric (Curcuma longa)
Absolute Ethanol yielded the highest percentage (6.2%) for turmeric, followed by Hexane (4.5%), Ethyl Acetate (5.0%), and Distilled Water (3.8%). The results suggest that turmeric extraction is more efficient with polar solvents, particularly ethanol.
The results indicate that polar solvents (Absolute Ethanol, Ethyl Acetate) generally show higher extraction efficiency compared to non-polar solvents (Hexane). That is to say, the choice of solvent significantly influences the yield, indicating the importance of selecting an appropriate solvent for each source material. Distilled Water, being a polar solvent, shows moderate efficiency in some cases (Roselle) but is less effective for others (indigo). In a nutshell, the result indicates the potential for sustainable and eco-friendly dyeing practices using locally sourced materials. The extraction process yielded significant quantities of dye components, providing a foundation for large-scale production.

2. Formalized Production Process
A systematic and formalized production process for home-based dye extracts was established based on the extracted components. This process involved converting the solid dye samples into solution, ensuring proper dissolution for effective dyeing of fabrics. Mordanting agents such as Stannous Chloride and iron alum were added to enhance the colorfastness and quality of the dyed fabrics. The formalized production process ensures consistency and repeatability in the creation of home-based dye extracts.

3. Production of Home-Based Dyes in Commercialized Quantities
The study successfully scaled up the production of home-based dyes, demonstrating the feasibility of large-scale manufacturing within the community. This is crucial for economic emancipation and the revival of indigenous industries.

4. Quality and Acceptability Assessment

Table 2: Mean and Standard deviations for Quality and Acceptability Assessment

Sample	Quality						Acceptability	
	Color Vibrancy		Fastness to washing		Fastness to sunlight		Overall Aesthetic appeal	
	Mean	Std. Dev.	Std. Mean Dev.		Mean	Std. Dev.	Std. Mean Dev.	
Indigofera tentoria	4.5	0.3	4.2	0.4	4.3	0.2	4.4	0.3
Hibiscus sabdariffa	4.2	0.2	4.1	0.3	4.0	0.4	4.2	0.2
curcuma longa	4.3	0.4	4.0	0.2	4.1	0.3	4.3	0.3

The dyed fabrics, produced using the home-based dye extracts, underwent thorough quality assessment. The fabrics were evaluated for color vibrancy, fastness to washing and sunlight, and overall aesthetic appeal. Feedback was gathered to gauge the acceptability of the home-based products.

Color Vibrancy
The mean color vibrancy score across all fabrics is 4.33, indicating a high level of vibrancy. The small standard deviation of 0.10 suggests consistency in the perception of color intensity. This result implies that the home-based dye extracts successfully imparted vibrant colors to the fabrics.

Fastness to Washing
The mean score for fastness to washing is 4.08, signifying good resistance to color fading during washing. The standard deviation of 0.12 suggests a moderate level of variability in the perception of washing fastness. Overall, the fabrics demonstrate resilience to color loss, contributing to their longevity.

Fastness to Sunlight
The mean score for fastness to sunlight is 4.15, indicating a high level of resistance to color fading when exposed to sunlight. The small standard deviation of 0.11 suggests consistent perceptions of sunlight fastness. This is crucial for fabrics that may be used outdoors or exposed to natural light.

Overall Aesthetic Appeal
The mean score for overall aesthetic appeal is 4.25, highlighting a strong positive response from the community and potential consumers. The low standard deviation of 0.09 indicates a high level of agreement in the assessment of aesthetic appeal. This suggests that the dyed fabrics are not only functional but also visually pleasing.
The high mean scores across all criteria indicate that the dyed fabrics are well-received in terms of color vibrancy, resistance to washing and sunlight, and overall aesthetic appeal. The low standard deviations suggest a general consensus regarding the quality and acceptability of the home-based products. These positive results have significant implications for the economic viability of the project, as the community's positive perception can drive demand and potential commercialization of the home-based dye extracts. The use of mordants contributed to improved colorfastness, addressing concerns related to the durability of dyed fabrics. The community's response to the dyed fabrics, as gauged

through acceptability assessments, highlights the cultural and economic viability of reintroducing traditional tie and dye methods.

Conclusion

Conclusively, the research successfully demonstrated the feasibility of economic diversification through the revitalization of traditional tie and dye practices using locally sourced materials. The extraction and production processes were optimized, resulting in the creation of home-based dye extracts suitable for large-scale commercialization. The acceptance of the dyed fabrics within the community underscores the potential for economic growth and cultural preservation. This study lays the groundwork for sustainable economic development through the revival of traditional practices, contributing to the broader goal of promoting indigenous dye industries in Nigeria.

Recommendations

1. Further research should explore additional natural dye sources to diversify the color palette and enhance the range of products.
2. Collaboration with local artisans and entrepreneurs can facilitate the integration of home-based dyeing practices into existing industries.
3. Community awareness programs should be initiated to promote the environmental and health benefits of natural dyes, fostering increased adoption.

Acknowledgment: We are thankful to the Tertiary Education Trust fund (TETfund) for sponsoring this research

References

1. Areo AB, Area M0. The Utility of Adire: Women Entrepreneurship, Attitude and Marketing Strategies for Competitive Edge. African Journal of Social Sciences,2014:4(3):28-41.
2. Areo M. Olugbemisola and Kalilu, R. Olatunde. Adire in South-western Nigeria". Geography of the Centres, an International Multidisciplinary Journal, Ethiopia, 2013.
3. Rushessays B. Identification, 2017. Characterization and Application of Natural Dyes from local plants retrieved from https://bestrushessay.com
4. Campbell, Uma, 2019. The Importance of Natural Dyes retrieved from https://biofriendlyplanet.com/green-attractive/natural Chakrabarti, R. and Vignesh, A. (2014). Natural Dyes: Application, Identification and Standardization, retrieved from https://primastoria.files.wordpress.com/2014/09/
5. Gausa (2013). Tie-die (adire) Among the Jukun People". Unpublished B.Tech thesis Federal University of Technology Yola. Gausa (2013)."An Adaptive Study of Jukun Cultural Symbols for Textile Design. "Unpublished Master of Fine Arts (MFA) Thesis University of Nigeria Nsukka.
6. Gausa Solomon and Abubakar Ezra (2015) Tie -Dye (Adire) Among the Jukun People. Mgbakoigba: Journal of African Studies, 4, 2015. Pp. 1-13.
7. Grosick Z. Watson's Textile Design and Colour for elementary Weavers. Fifth Edition. London. Butter Worths Inc, 2004.
8. International Labour Organisation (ILO) (2008). "Superman has fallen": Managing Risk in the Work Environment. World Day for Safety and Health at work.
9. Morse R, Staley B. Industrial Toxicology Handbook. NY, Chemical Publi$hing Co, 2009.
10. Ogunduyile SR. Cottage Dyeing Industry and Environmental Hazards Created by the use of Commercial Dyes and Chemicals. Ile-ife, Journal of Arts and Ideas, Obafemi j'\. wolowo University, 2009.
11. Srivastava R, Singh N. Importance of Natural Dye over Synthetic Dye. International Journal of Home Science,2019:5(2):148-150.