FASTNESS PROPERTIES OF FRESH AND FERMENTED DYES EXTRACTED FROM CICHA PLANTS (INDIGOFERA TRINCTORIA) ON COTTON AND SYNTHETIC FABRICS (BORNO STATE)

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DEPARTMENT OF VOCATIONAL AND TECHNICAL EDUCATION, FACULTY OF EDUCATION AHMADU BELLO UNIVERSITY, ZARIA

NOVEMBER, 2014.

DECLARATION

I declare this thesis titled;Fastness Properties of Fresh and Fermented Dyes Extracted from *Cicha Plants* (Indigofera Trinctoria) on Cotton and Synthetic Fabrics (Borno State)has been carried out by me in the Department of Vocational and Technical EducationalAhmaduBello UniversityZaria,Faculty of Education, under the supervision of Dr.Martha F. Ahuwan and Dr. S.L. Ajayi. The information derived from literatures have been dully acknowledged in the text and in the list of references provided. This Thesis to the best of my knowledge has not been presented for another work previously or Diploma at any University or its equivalent.

_____ _____

Maimuna Timothy EMMANUELSignature Date

CERTIFICATION

This Thesis titled; Fastness Properties of Fresh and Fermented Dyes Extracted from *Cicha Plants* (Indigofera Trinctoria) on Cotton and Synthetic Fabrics (Borno State), by Maimuna Timothy EMMANUEL meet the requirements governing the award of degree of Masters in Education (M.Ed.) Vocational and Technical Education (Home Economics) of Ahmadu Bello University, Zaria and is approved for its contribution to knowledge and literary presentation.

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Prof. A.A Joshua Dean, School of Postgraduate Studies	Signature	Date

DEDICATION

This research work is dedicated to God Almighty, my late parents, husband and children.

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Maimuna Timothy EMMANUEL

ABSTRACT

This study was designed to examine the Fastness Properties of Fresh and Fermented Dyes Extracted from ‘Cicha’ Plants (Indigofera Trinctoria) on Cotton and Synthetic Fabrics (Borno State).The researcher used anindigenous plant leaves ‘cicha’ one of the indigo family plants to extract dye for this work. Scarcity of dye to use in the colleges and schools in the study area was one of the motivating problem of this research. Nine (9) objectives, research questions and hypotheses were stated and tested. Related literatures were reviewed. Experimental research design was adopted and five hundred (500) grams of fresh ‘cicha’ leaves is the sample of dye sourcing materials procured. All materials used in this study were collected and bought in Biu town. Fresh and fermented methods of dye extraction were adopted and used for dyeing the selected fabrics in each dye baths prepared. Cold and Hot dye were prepared with each extract of fresh and fermented dyes. All the samples of cotton and synthetic fabrics were immersed in each dye bath at the time and dyed for the same period of time. Researcher made rating scale was used for the study to rate observations. Fifteen(16) observers observed the samples to rate the colour changes that occur on the cotton and synthetic fabrics in each dye bath. Test re-test reliability for the rating scale yielded a coefficient statistics of .86 which was regarded adequate. The results of experiments were rated using 1-5 for minimum and maximum effects of dye. Chi square statistic was used at 0.05 alpha level of significance. Result shows that all null hypotheses were rejected for p-value of all the test were less than the alpha level of significance which stated statistically, there is significant difference in the effects of the mordants on cotton and synthetic fabrics dyed on the same dye bath.Among the major findings were, ‘cicha’ dye extracts using mordants (alum, ash/toka, and caustic soda) was regarded good for fastening properties on cotton and synthetic fabrics. Methods adopted gave variety of colours on both synthetic and cotton fabrics developed in all the dye baths. Test on fastness, bleeding and migrating properties showed good effects of the mordants usage. Therefore, ‘Cicha’ plant was recommended for dye extraction using other methods and mordants. This research using ‘cicha’ have added knowledge and source of natural material to Nigerians and filled the gap of using the extracts for dyeing synthetic fabrics.

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OPERATIONAL DEFINITION OF TERMS

Bleeding means loss of colour during washing that changes the colour leading to poor colour fastness in clothes.

Blends is the mixture of two to more different material sources in a fabric

Bull is a traditional black or blue cloth made of fine narrow bands usually in a gown form. It is also a used as a burial cloth among bura people.

Cichais an indigenous shrub used for extracting dye being the main material for this study in Bura language.

Colour Fastness is the quality of dye being fixed in the fabric that is permanency of colour in fabric.

Danbatir is a certain type of wrapper in bura language made of broad bands in blue and inferior in texture used mostly by women during household and farm activities.

Dye is the substance extracted from 'cicha' leaves for dyeing

Dyeing is the art of using the extract for colouring fabric in this study.

Extract means removing the substance dye from 'cicha 'leaves

Jabta is a name of a traditional woven wrapper in Bura language being the best wear for women.

Mordant is an assisting material added to the extract when dyeing aiming to create permanent bond attachment between the colorant and the fabric.

Munggil means black colour in bura language.

Synthetic is chemically processed fabric not made of natural fiber.

Kuzdir is a traditional cloth made of three narrow bands used by women usually in black colour (under wear).

Migrating means colour loose and at the same time staining parts of the same fabric having a different colour

Indigo is a family name of any dye sourcing material of blue and black colour of different shades.

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

The use of dye has ever been very important in creating variety of colours on fabrics used by human being. The need for dyes to beautify, renew and protect the natural appearance of clothes used is essential since cloth is one of the basic human needs. Man has tried to see that what he is wearing is attractive and presentable among his peer groups. Weber (1990) postulated that dyes create beautiful designs on cloths and colours produced serve many purposes including identity in the social life of man. The researcher developed interest to carry out a research using an indigenous plant called Cicha'. It is one of the indigo family plants, botanically known as ‘indigoferaTrinctoria’ and ‘Baba’ in Hausa.

Dye extraction is the process whereby natural dye sourcing materials plants, animals and minerals have been used to obtain colorant for dyeing textile materials. To extract dye from vegetables the dye material is covered with water and the solution heated to boiling point until the colour is transferred from the materials to the water. On the other hand the material is mixed in the water for a given period of time to allow the colour transferred into the water. Extraction of dye can be carried out by using solvent as the extraction medium.

This plant is available in southern part of Borno State. 'Cicha'is a seasonal plant grown in cluster. The plants have been a source of dye used for dyeing traditional clothes ‘jabta, ‘bull’ ‘danbatir,' and 'kudzirmunggil’ among *bura* people, but neglected after the advent of synthetic dyes. This plant ‘Cicha’ grows about one meter to at most two meters

tall above ground level. The stems have been used for making local bed frame and local door mats, the leaves were used to extract dye for dyeing traditional fabric and grey hair. 'Cicha' is not consumed by animals and no labour is given for its production.It is a wild plant which has been an economical plant in the society.

Aurora, (2011) opined that the art of using natural dye sourcing material like ‘indigo’ plants for extracting dye signifies wealth. In line with Aurora, the researcher think that any society that have natural dye sourcing plants available when used skillfully can add to the economical uplifting of that society, so the use of ‘cicha’ need to be revived. Dyeing is a skill that promotes the social norms and values of a society. The value of being creative and productive independent of a society is a crown in social status and religious learning including the cultural diversity and professional status. Human being's potentiality is seen through the beauty, riches, and uniqueness in craft work of any society (Ali and Gwari, 2011).

As a pride of any society art of dyeing is a skill that needs to be recorded, Natural dyeing in form of stained hides, decorated shells and feathers were recorded by the scientists in colours like black, white, yellow and reddish pigments were made from ochre by the primitive man in the cave over 15,000 BC (Grierson, 2000). Adding colour to textiles was around 7,000 - 2,000 BC when fixed settlements and agriculture started.

Prior to the using of dyeing, scientists have not been able to pinpoint the exact time when colour was added to fibers. Despitenot knowing when dyeing started, the method of dyeing has been stated (Grierson, 2000). Although dyeing methods practiced nowadays are many, Siobban (2000) said that the first method of dyeing was by staining item through rubbing parts of the fabric or soaking. There was no sort of chemical

fixation to preserve the colour used, pigmentation was the next method used for dyeing. True dyeing is when the colour is deposited on a substance in an insoluble form, forming a solution containing the colorant, and the art of dyeing might have started since the discovery of textiles by the primitive man (Benson, 2007).Dye and dyeing therefore is a process that involves using of different substances essential for the development of colours on fibers.This process also requires an organized procedure to achieve the result.

1.2 Statement of the Problem

Borno state is blessed with 'Cicha' plant a dye sourcing material but is neglected in this present time. Scarcity of synthetic dyes has been identified as the major problem for teachers' and lecturers' inability to perform effective practical skills in Schools and Colleges. As experienced by the researcher inadequate availability and supply of dyes have hindered the development and acquisition of the practical skills by students because teachers resorted to theoretical lessons only. 'Cicha' plant,have been a means of dye used in Borno state prior to the advent of synthetic dyes, but with the advent of the new dyes, traditional extracts from 'cicha' plant have been neglected this,then led to this research.

This was buttressed by Bappa and Isa (2009), when they stated that scarcity of dye is a problem confronting local dyers in Nigeria.With the problem of unemployment confronting Nigerian youths, particularly in Borno state, there is need to develop the indigenous dye sourcing materials. This, when done will provide self-employment and sufficiency for the youths and other members of the society. This is in line with Mohammed (2010) who asserted that 'self-employment enables one to recognize some potentiality and makes the individual a productive member of the society.

Based on these problems, the researcher embarked on this study to assess dye extracted from ‘cicha’ plant for possible variety of colours so that it can effectively be utilized to enhance creativity in the dyeing skills among students and interested individuals in the area.

1.3 Objectives of the study.

The main aim of this study was to test the Fastness Properties of Fresh and Fermented Dye extracted from 'cicha' plant in Borno State on Cotton and synthetic fabrics.

The specific objectives were to -

1. Adoptthe fresh and fermented method of extracting dye from cicha leaves to identify the best fastness quality on cotton and synthetic fabrics.
2. Identify the colours produced on cotton fabric types when dyed in the fresh and fermented extracts without mordant in the cold and hot (boiling) dye baths.
3. Identify the colours produced on synthetic fabric types when dyed in the fresh and fermented extracts without mordant in the cold and hot (boiling) dye baths.
4. Assess the effects of alum, ash/toka and caustic soda on-colour fastness on cotton fabric types dyed in the fresh dye of cichca extract and fermented extracts when washed with sunlight detergent powder and B29 soap.
5. Assess the effects of alum, ash/toka and caustic soda on-colour fastness on synthetic fabric types dyed in the fresh dye of cichca extract and fermented extracts when washed with sunlight detergent powder and B29 soap.
6. Ascertain the effects of alum, ash/toka and caustic soda mordant in controlling the bleeding quality of the dye on cotton fabric types.

7. Ascertain the effects of alum, ash/toka and caustic soda mordant in controlling the bleeding quality of the dye on synthetic fabric types.
8. Ascertain the effects of alum, ash/toka and caustic soda mordant in controlling migrating quality of the dye on cotton fabric types.
9. Ascertain the effects of alum, ash/toka and caustic soda mordant in controlling migrating quality of the dye on synthetic fabric types.

1.4 Research Questions

In line with each specific objectives the following research questions were raised and answered.

1. Between the fresh and fermented method of extracting dye from cicha leaves, which extract produces the best fastness quality on cotton and synthetic fabric?
2. What colours are produced on cotton fabric types when dyed in the fresh and fermented extracts without mordant in the cold and hot (boiling) dye baths?
3. What colours are produced on synthetic fabric types when dyed in the fresh and fermented extracts without mordant in the cold and hot (boiling) dye baths?
4. What are the effects of alum, ash/toka and caustic soda on-colour fastness on cotton fabric types dyed in the fresh dye of cichca extract and fermented extracts when washed with sunlight detergent powder and B29 soap?
5. What are the effects of alum, ash/toka and caustic soda on-colour fastness on synthetic fabric types dyed in the fresh dye of cichca extract and fermented extracts when washed with sunlight detergent powder and B29 soap?
6. What are the effects of alum, ash/toka and caustic soda mordant in controlling the bleeding quality of the dye on cotton fabric types?

7. What are the effects of alum, ash/toka and caustic soda mordant in controlling the bleeding quality of the dye on synthetic fabric types?
8. What are the effects of alum, ash/toka and caustic soda mordant in controlling migrating quality of the dye on cotton fabric types?
9. What are the effects of alum, ash/toka and caustic soda mordant in controlling migrating quality of the dye on synthetic fabric types?

1.5 Research Hypotheses

The following null hypotheses were testedwith the appropriate statistic at 0.05 level of significant.

Ho1 There is no significant difference between the fastnessproperties of fresh and fermented extract on cotton and synthetic fabric.

Ho2 There is no significant difference between the colours produced on the cotton using alum, ash/toka and caustic soda in the fresh and fermented extracts.

Ho3 There is no significant difference between the colours produced on synthetic fabric using alum, ash/toka and caustic soda in the fresh and fermented extracts.

Ho4 There is no significant difference among the effect of alum, ash/toka and caustic soda on colour fastness in the fresh and fermented extracts on cotton.

Ho5 There is no significant difference among the effect of alum, ash/toka and caustic soda on colour fastness in the fresh and fermented extracts on synthetic fabrics.

Ho6 There is no significant difference among the effects of alum, ash/toka and caustic soda on dye bleeding control on cotton.

Ho7 There is no significant difference among the effects of alum, ash/toka and caustic soda on dye bleeding control on synthetic fabric

Ho8 There is no significant difference among the effect of alum, ash/toka and caustic soda on the migrating control of dye on cotton tested.

Ho9 There is no significant difference among the effect of alum, ash/toka and caustic soda on the migrating control of dye on synthetic fabric tested.

1.6 Significance of the Study

The researcher is of the opinion that the finding is going to help students and youths in Borno State in particular and Nigeria in general will acquire the methods of extracting dye from indigenous plants for the practical lesson in clothing and textile and small scale dyeing centers. Methods used will be useful for Home Economics teachers when extracting dye using other indigenous plants to extract different dye for teaching learning purpose.Youths from the study area will benefit from the findings as it will keep a record on 'cicha' plant being an important plant for economic development which has been neglected by the past generation.

1.7 Basic Assumption of the Study

The assumptions of this study were that:

1. Extracted dye from 'cicha'leaves canonly be suitable for dyeing natural fabric effectively using the fresh and fermented methods of dye extraction.
2. Extracted dye from cicha leaves using the fresh and fermented dye extraction cannot dye synthetics fabrics effectively, it will only stain it.

3. Without the use of mordant, dyeing using fresh and fermented dye extraction methods using water cannot prevent colour loose in washing test.

Finally everybody in Nigeria will benefit from this research. Interested Individuals who are creative will use the plants to extract dye for dyeing in schools, at home and at small scale dying centres. This will make unemployed youths secure jobs and be self employed by operating small scale dyeing centers.

1.8 Delimitation of the study

This study was delimited to use of ‘cicha’ leaves adopting fresh and fermented methods of extracting dye using water only as the main solvent for the extraction- This is because the two methods of extraction can be carried out successfully by individuals in the schools located in the rural areas inBorno state. The leaves of the plants is also easy to collect because the plant produces many leaves when in season which shows that there will be no scarcity. The selection of the mordantswas delimited to alum, ash/toka and caustic soda as bonding agent because of their availability and easy to lay hands upon. They are also cheap and obtainable at any time in the study area. The selections of the fabrics for dyeing experiment were delimited to cotton and synthetic traditional woven. Calico cotton, cotton blend, and nylon are among the common types of fabrics in use and are obtained at any time in the markets in the study area. Cotton fabric especially is said to be the best fabric for hand dyeing (manual).The researcher based the research on the availability of the plant cicha and can easily be obtained by students and youths in the area.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1 Theoretical Frame work

Dye and dyeing is a process whereby dye is being extracted from dye sourcing materials. Dyeing is the process of applying colour on fiber apartfrom the natural colour of the fiber using dye extracted.

Theories of Dyeing.

A review of the history of textile dyeing shows that the art of textile dyeing develops on four fronts namely the artistic, mechanical, chemical and technological. Sometimes one front goes ahead leaving the other. Previous reviews of research work directed toward a greater understanding of the way which dye molecules are transferred from the dyeing medium to the polymer or substrate phase stresses that a unified fundamental theory, applicable to all dyeing processes is stillfar from a reality and may never beattained(Jones,2008).However the followingwere considered as theories of dyeing; Traditional Theory, Physico-Chemical theory and Modern Theory.

Traditional Theory of dyeing:

The traditional theory of dyeing explains the interaction between dye,fiber, water and dye auxiliary(Modern concepts,2011).This mechanism of dyeing depend on the nature of both the dye and the fiber.The source of dye and fiber were both obtainable from natural materials and the dyeing process was considered only from the mechanical stand point without paying due regard to chemical essence.Although dye extracting and dyeing was not formally taught, the ancient Egyptians produced coloured linen cloths of

fine construction. In the,far east the Indians and the Chinese were also known to have worn cloth coloured with natural dyes obtained from ‘woad’ or indigo. This theory explains that the process was entirely on practical experience(Herman and Fletcher, 2011). Hence natural dyes were synthesized and were gradually supplanted by manufactured colours.Today very few natural dyesare used.

In relation with traditional dyeing, although there was no record found ‘cicha’ dye was used in Borno state. Oral reports revealed that among the people of southern Borno ‘Bura tribe’ ‘cicha’ was used to dye their traditional fibers for many reasons. The dye extract was used for identity, royalty and makeup during special occasions. Regardless to the staining quality due to poor bonding material during dyeing process ,the shiny blue black dye remain the best colour for dyeing hair in the society until the advent of the synthetic dyes.

The Physico- Chemical Theory:

Physico –Chemical theory dyeing process is one kind of system or way which shows how dye penetrates or enters into the fiber. The dyeing process is essentially a distributing process. The dye is distributed over at least two phase systems, the dye bath and textile materials. When equilibrium dyeing is reached, the following subsidiary equilibrium is established(Theory of dyeing, 2012).This theory shows the process and time dye molecules follow to enter completely on the fiber. This theory enumerated the following steps in dyeing process.

1. Dye dispersed in the dye bath.

2. Dye in the diffusion layer

3. Dye in the electrical double layer.

4. Dye absorbed on the fiber surface.

5. Dye diffused in the fiber.

6. Dye physically and chemically bond in the fiber.

According to this theory dyeing is planned and directed from one step to the next. Fixation being the last step implies the action of reactive dyes where fixation is in one way because dye molecules become attached to fiber polymer by strong covalent bonds. In the case of all other dyes, fixation is in two ways for dyes are fixed with fiber by weak hydrogen or salt linkage(Theory of dyeing, 2012).This therefore give the complete procedure to follow in dyeing regardless to the type of dye one is using.

Modern Theory of Dyeing:

The modern theory was a result of research carried by two groups of English chemist S. Neale collaborators and J. Belton. The theory states that the process of dyeing was first absorbed by the external surface on the fibrous material and then diffuse inside in the molecular disperse state, this was the determining feature of the kinetics of the process(modern concepts, 2011/12).This theory is more technical. It work s with the third type of fibers, the artificial and synthetic fiber rayon cellulose type and nylons .They state that protein type macro molecules contain a great number of identical or similar atoms linked by converting bond. The theory asserts that most high polymers from which the fibers are composed contain active functional groups such as hydroxyl, carboxyl, nitrate

and amino groups. This theory is the technical way of dyeing synthetic processed fibers using strong acids.

Dyeing is the art of giving colour to a piece of fabric providing a change of colour from the original, forming a permanent bond with the fabric. Garfield (2000) stated that colour has always fascinated human kind for both aesthetic and social reasons and that the process has been carried out using different techniques including tie-dyeing and batik dyeing which lead to creating beautiful designs and patterns on white fabric before immersing it in the dye bath. Dyeing is a fun that when carried but make the individual fell great and happy. According to Munro, (2007) the fun of dyeing is in the mixing of colours to produce something that is individual. To achieve new shades during tie-dyeing and batik dyeing, it is important to have knowledge of how colours works that is the three colours red, blue and yellow. The process of applying the colours to the fabric was by staining an item, a temporary means of coloration where the colour is rubbed or soaked into an item Hussain, (2012) explained that dye is a substance used to impart colour to textiles, paper, leather and other material that colouring is not readily altered by washing,

2.2 Historical Review of dye and dyeing.

Dyeing of textiles has been practiced for thousands of years with the first written record of the use of dyestuff dated at 2600 BC in China. All dyes were natural substances obtained from plants, animals or mineral sources. In 1856, William Henry Perkin, while searching for a cure for malaria, discovered the first synthetic dye, Mauve. The mauve dye was a brilliant fuchsia colour, but faded easily. Since that time a great number of synthetic dyes have been manufactured and their resistance to running and fading has been almost eliminated (Katz, 2003).Dyes used for fabric such as cotton, wool and silk

are complex organic molecules that contain what is known as a chromosome group, that is they contain some types of conjugated, alternating double and single bonds in part of the molecule. These molecules can absorb certain wavelengths of visible light and reflect the remaining light and, thus give a fabric its colour.

Dye and dyeing process was an old motivating skill due to its practical output. The theoretical and historical origin of natural textile dyeing with natural dye sourcing in the world was based on raw materials found in the locality. The art of dyeing using natural dyes was one of the ancient crafts traced back to at least four thousand (4000) years. Schetky,(2000) and Reed, (2000) stated that dyed flax fibers have been used in the prehistoric cave in the republic of Georgia far back from 36,000 BC; as recorded by archaeologists and anthropologists. Dyeing is forming a permanent bond between dye and fabric in a prepared dye bath. Schetky (2000) said, 'dyeing of textiles is, giving the fabric colours of comparative permanence'. The use of dye from vegetables, animals and minerals were elaborated processes for hundreds of years before the middle ages (Michel 2001). By the end of the 19th century only a small percentage of textile dyes were extracted from plants.

Vegetable dyes in India was dated back to the Indus valley period between the forth and second millennium BC. Indigo was patchy in Karate in 1298, dyeing was in practice since the time of the primitive man (Polo, 2009). The oldest art discovered by man was said to be since the discovery of textiles while the use of natural dyes extracted from indigo, madder, woad, purple and cochineal was popular in use in India and the eastern world, since 541 BC. Red dyes and reddish purple were discovered and was in

royal treasury when Susan was conquered, the Persian capital and Kermes (Driessen, 2011).

2.2.1 Dyeing in the Eastern and Western World.

The origin of textile dyeing however was based on the available records and evidences about the Eastern world being one of the early nations that use dye on textiles. Indigo was a popular dye obtained from "indigofera" which was indigenous to Asia (Garfield, 2000). Dyeing was then an established craft in Egypt when ‘Carthainus trinctorians’ were known to be common in Asia, before then extracted indigo dye was used in India and the record was based on the Indian religion and social practices belonging to 2500 BC referencing to coloured silk and gold brocades (Zollinger,2003).

Tyrian purple was believed to have originated in the Phoenician town of Tyre and dyer workshop excavated at Pompeii. Based on historical record, dyeing was an early craft in the Eastern world. Dyeing in the western world was recorded when the indigo brush application 'brush blue started in Europe. From the Roman history, it was known as woad used by the ancient Britain, a vegetable dye cultivated in France, Germany and Britain (Ethel, 1999). The use of batik as dye resisting method was also referred to India for batik was Indonesian in origin. According to Schetky (2000), throughout the middle age woad was the most important dye stuff used in Europe. The discovery of the western ‘hemsphere’ and opening of shopping routes brought fresh natural mordant dyes in the European markets. Among was the 'Brazil wood' known as ‘peach wood’ containing water-soluble colouring matter producing red-dye "Kermes" extracted from an insect native to Spain (Kvavadze et al, 2007).

Batik was a skill practiced in India, but the process was developed to perfection in Java. Batik resist dyeing started in India then spread to the western world. The other method of dyeing practiced in the western world was the tie-dye technique (Balter, 2009). This probably started in ancient Asia and spread down to sub-Indian continent Malaga and across Africa. Dye was popular in United State of America in the mid-1950s, the Japanese were known to have used tie-dye techniques as "shibori", and has been utilized by different cultures for over six thousand years (6000) (Robert, 2011).

Textile dye styles in South America have been credited to Mexico, Guatemala, Peru Bolivia, Paraguay and Argentina. In North America and other Indian tribe, craft works have been practiced for a long time and indigo dyeing was also practiced in Jamaica. History of dyeing stated that prehistoric man had already dyed textile and objects with natural substances mainly of vegetable over thousand years (David, 2003). Finally both the Eastern and Western world have contributed much to the development of dyeing craft in the world.

2.2.2 Dyeing in the African Countries: Nigeria

Africa blessed with a rich diversity of indigenous cultures, and dyed cloths with indigo have been considered as symbol of "wealth, abundance, and fertility in West Africa. The art of dyeing started as early as the invention of fabric construction (Okeke, 1993). A great demand for the Nigerian hand crafted woven dyed fabric in the recent decades was highly needed and suggested for continuous production due to the value attached to it by the society (Claire, 1994). Dyeing techniques have been practiced by early dyers and is well established, tie-dye was traditionally used in Africa (Drucling, 1997).

Today natural indigo dyeing is done by the Dogon woman in Mall and Mossier, and the Doula in Burkina Faso. Batik was a developed design with starch paste resist, stencils and indigo dye used in West Africa (Ojomoh, 2000). Garfield, (2000) opined that dyeing concept was devised by the Egyptians. The art of traditional dyeing in Africa was reported since 1935 by travelers. The practice started in Senegal, Sierra Leone, Ivory Coast, Liberia and Nigeria. Weaving was long an acquired skill among the Yoruba and matching the fabric with a high skill of fabric decoration dyeing to appeal their dressing age (Michel, 2001).

History recorded that Yoruba and Benin people were praised for the fine quality cloths and were sought by explorers and traders as vessels for trade with other African nations. Some scholars opined that the art of weaving was introduced to the north across the Sahara, by the immigrants from Mali Empire where large cotton industry flourished. In the I950's Kano cloth was well known in Nigeria.In 1900, nearly every one living in the central and Eastern Sahara and two third of the population in the Sudan zone used Kano cloth (Zaharadeen, 2001).

The Hausa people of Nigeria practiced dyeing using deep vat indigo for dyeing 'adire' cloth. The skill was performed by men and lasted until the mid-twentieth century. Benson,(2007) postulated that the Hausa in the north and Yoruba in the south western part of the country were well known for their skills in dyeing. Other tribes in Nigeria well known in dyeing craft are the TIV and Nupe. Although, there was no record on when they started, it was recorded that dyeing in the ancient Yoruba areas was well established for dyeing was practiced everywhere, even in small villages. Visitors visiting a Yoruba market for the first time were impressed by the blueness of the scene'. Both the leading

groups practiced the same method only that among the Hausa, men were the dyers, while women do the art among the Yoruba (Benson, 2007). It was stated that, the art of dyeing came to Kano by Arabs through Borno, for the word "Shuri" is used among the Kano dyers which is a Kanuri word meaning dyeing place (Nkeonye, 2009).

Textile dyes and dyeing in Nigeria may be worthwhile considering its origin and to when it have been practiced widely by the Hausa and Yoruba. Holme, (2007) said that history of fabric dyeing can be traced back to fabric weaving in Nigeria although it may be possible that dyeing was practiced before weaving in Nigeria. The fact remain whether the Hausa's and Yoruba's have been weaving or not they were privilege to have earlier contact with textile fabric and developed more interest than the other tribes of the Nigeria. Indigo was the favorite colour of the Yoruba accomplished in "adire" which has been worn for many years by both sexes. Indigo blue dyed cloth traditionally signified wealth (William, 2008).

Benson, (2007) opined that weaving in Nigeria can be traced through archaeological discoveries in the Eastern part of Nigeria over thousand years ago. Weaving was a reputable skill in Kano as early as 1512, and in 1851, woven and dyed fabrics were recorded as the main products of Kano. Dyeing with indigo has become a legacy of Nigerian craft men and indigo clothes have contributed much to textile in the African countries and the world (Mckinley, 2011). Another backing history of dyeing techniques in Africa was the history of Joseph son of Jacob which said his brothers envied his beautiful coat which indicates the existence of dyed article since then. The

time when dyeing started in Africa is not certain, but available records and varied opinions of scholars favors the fact that, the art of dyeing was practiced long before the era of colonization (Aurora, 2011).

2.3 Natural Dyes sourcing materials

These were dyes directly extracted from natural materials like plants, animals and minerals. The extracts were used accidentally by the early man. Dyes obtained from the raw materials were grouped based on what have been obtained on the fabric dyed. Siobban, (2000) stated that natural dyes were in two categories namely substantive and additive or direct dyes. A substantive dye does not need mordant or additives while additive dyes need mordant for colour fastness and only few natural dyes have good fastness all round. Plants like indigo, ‘woad’, and madder were the oldest source of dyes used in the Eastern and Western world, since the beginning f dyeing. Kvavadze. Bar-Yosef. Belfer Cohen. Boaretto, Jakeli, Matskeyishand Meshveliam, (2009) stated that amongst all dyes used by the dyers of the world, "indigofera trinctoria" and "carthamies trinctorious" were the oldest plant used for dye sourcing.

The invention of the oldest most widely known and used natural dyes to synthetic colours was in the 1950s, Indigo the oldest dyes used in textile dyeing and printing was used by most Asian countries India, China, and South East Asian nations.Indigo dyes have beenused for silk dyeing and by the (16th) sixteenth century France and Germany imported indigo to protect the local woad dye industry. The ability of natural dyes to colour textile has been known since ancient times. The earliest written records that stated the use of natural dyes was found in china dated 2,600BC (Driessen, 2011).

Indigo, the blue was regarded as the best dye. It is a substantive dye, needing no mordant yet colour achieved is extremely fast to washing and light that quality made it to last long into early 1900s (Grierson, 2000). Driessen (2011) reported that plants used for extracting dye must be collected when young and vigorous. In this regard any natural dye sourcing materials should be harvested during its pick period of production to obtain the best quality of dye.

2.3.1 Categories of natural dye.

Dyes as many other substances have been grouped/ classified based on how they were used. Siobban, (2000) stated that natural dyes were grouped into two categories namely substantive and additive dyes. The grouping was based on how the colours obtained from the dye bond on the fabric. Me cloy (2000) stated that substantives or direct dyes were chemically fixed to the fiber without any chemical addition but adjective or mordant dyes requires some sort of substance usually metal salt to prevent the colour from washing or fight-bleaching out. Nkeonye (2009) stated that most natural dyes were additive dyes so the need of mordant application is necessary but indigo and few others are substantive.

2.3.2 Dye Sourcing Material; Collection and Preparation for Extraction

Plants used for extracting dye must be collected when young and vigorous. All natural dye sourcing material should be harvested during its pick period of production so that the best quality of dye is obtained (Microsoft Encarta, (2000), Natural dyes sourcing materials are plants procured from various places that can be found. These parts of plant are flowers, leaves, seeds, barks and roots in order to collect these various parts of the plant there is need to consider where, when and how" to collect the materials (Herb,

2000). There is an optimum time of harvesting most vegetable dyestuff, flowers and leaves source should be collected in spring or summer while berries and roots in autumn. Plant parts source yield more colours if harvested during rainy season rather than in dry season because of long exposure to sunlight. Tree barks and roots should be collected between February and June when more intense because the time for collection affects the colour yielding properties (Herb, 2000).

The life of the plant should be considered, especially when collecting the barks, wrong cutting method affect the tree and deprive it from getting its nutrients from the roots. Avoid ring or circle cutting. Both stored and fresh plant parts can be used for dyeing. Good dyes can be obtained from properly stored material. After collecting the material, there is need to prepare it for extraction. This includes cleaning sorting and chopping of the material before the actual extraction (Driessen, 2011).

When procuring the dye sourcing material Cummings, (2011) considered three stages:

1. Tender -delicate leaves and flower parts and very ripped.
2. Fibrous - tough leaves and stems.
3. Woody- branches and nuts. Roots can be treated as fibrous or woody depending on how tough.

Fresh vegetable dye materials should be soaked in water for some hours before boiling or drying and powdering the rotten leaves then mix with water and boil until thick light blue substance is formed. Soaking in water as fermentation of the leaves converts

the glycoside toxin present in the plant to the blue indigo (Aurora, 2011).

2.3.3 Preparing a Dye Bath

A dye bath is a container that can be used for mixing the dyes for dyeing procedure. The bath can be any big bowl in tin, plastic, enamel or earthen ware finishes suitable for dyeing. Preparation of the dye bath is getting the needed mixture ready for use. Agarwal, (2009) opined that the preparation depends on the type of the fabric, dye substances and pre-works necessary for fabric and dye mixture is necessary. Dyeing material and the method for applying the dye is very important in dye bath preparation. The texture of the dye should meet the desire of the dyer, so that preparation time and desired depth of the colour is achieved (Mckinley, 20ll). Japanese methods involve mixing the leaves with wheat husk powder, lime stone powder, and lye ash then allow the mixture to ferment for about one week to form dye pigment called "sukuwo' (Griffith, 2011).

A dyer should also learn how to preserve the dye bath. Griffith further suggested that freezing method was good in preserving the dye bath and the use of chemical (sodium benzoate) in preserving the vegetable dye bath with a gallon of water in the bath was very important. In the preparation of the dye bath all fabrics to be dyed must be clean and wet before immersing into the dye bath and must be immersed into the dye bath at the same time. Top quality dyeing is always achieved when the fabric is well prepared that is starch free (Bappa and Isa, 2009). They further advised the dyers to prepare the dye bath to the needed temperature when using extracted dye from vegetables.

2.4 Dye Mordant/ Additives.

Natural dyes need additives to fix colour to the fiber and increase light fastness. Additives are substances used in mixing dyes to create bond attachment between the colour (dye) and the fabric dyed. Wipplinger (2004) defined additives as "chemical link that fixes the dye to a substrate'. It is combined with dye pigment to form an insoluble compound. This chemical can be salt or any hydroxide of aluminum groups. The reaction differs in dyeing of different fabric made and origin. According to Wipplinger (2004), ‘potassium aluminum sulfate’, the best alum to use for craft dyers and artisans because it is available and inexpensive. Iron-free grade aluminum sulfate is also a good mordant for natural dyeing, although it is more expensive than the later. Both are used interchangeably since the differences are unclear.

Alum is the most successful mordant for textiles and is available at any dye or chemical store. Use alum to all protein fibers and cellulose fibers that are classified as leaf (Hofenkde, 2004). Additives were used by Tudors to fix the dye on the fabrics and changing colours (Lambert, 2008).The use of mordant's in dyeing processes was to create bond relationship between the dye and the fabric dyed. When dyes were combined with mordants fibers like wool, blends, silk, cotton and other modified cellulose fibers gave a good result. The result of mordants combined with dye substances depends on the kind used and its characteristics. The use therefore need to be observed to get the best result of dyed articles since only few natural dyes are substantive, (Wipplinger, 2004 and Nkeonye, 2009).

2.5 Colour Fastness

Colour in clothing is an essential and important substance in dyeing for the beauty of any clothes is seen by its colour combination. (Madaki, 1994) stated that the importance of colours can be seen in three distinct terms which are: hue, value and intensity. The qualities of colour fastness in fabric make consumers happy, it became an important factor that any method of dyeing must strive to achieve. On the other hand Lambert (2008) stated that the use of additive is very important in achieving the best result in dyeing and maintaining colour in the fabric. Colour can always fascinate mankind for both aesthetic and social reasons. It has the characteristics of making one to look happy or unhappy, depressed, lively or guilty. Colours also make one appear dull, withdrawn, dignified or serious gay and sparking (Balter 2009).

Coloured fabrics is therefore of no value to the consumer if it is not considered fast. Nkeonye (2009) postulated that, the beauty of colour in any fabric is of no value to the consumer unless the dye is considered fast under the conditions in which the fabric will be used which is fast to light and the degree of fastness depends on the end use. Progressive deterioration of material was also another factor that leads to discoloration and colour fading of coloured fabrics. Sunlight is far more damaging than most electric light and indirect day light is less damaging especially in reflected form (Holme, 2003). The highest degree of fastness is demanded for outer wears and frequently washed articles, including time exposure, light sources and actual material composition. Coloured materials absorb light of a particular wave length (Gotti and Sedlak, 2009). Dyed fabrics fad and loss of colour occurs through the following ways;-

a. Bleeding- colour loss in water

b. Crocking - colour loss from rubbing and abrasion

c. Migration- stuffing of colour to the surrounding areas to any adjacent surface (Set Dye and prevent bleeding, nd). Fabric gain their qualities when the colours used were fast under the condition the fabric were being used before it can be regarded value full to consumers.

2.6 Empirical Studies

Research studies have been conducted by many researchers on issue of natural dye extraction and colour fastness properties on cotton fabric. Among such as Erukanure, (1986) carried out a study on Exploratory study of local dyes on cotton fabric, in Samaruin Kaduna State and Niger Delta. The aim was to identify local raw materials with suitable colouring characteristics for dyeing cotton fabric. The sample size was randomly selected in Samaru in Kaduna State and Niger Delta state. Sixteen different types of dye sourcing raw materials were selected in the two areas of study. These included leaves, barks, fruits, seed, husk and rhyzone. Water with mordant was used for extraction of the dye. Each sample extracted was used to dye 5cm by 5cm of cotton fabric. Test on fastness properties were carried out. Data were collected through observing the colours of each sample. The experiment covered testing of the colour fastness properties using different detergents. The selection of the sample was randomly done that prove no bias selection.

Findings from this research stated that local dye substances have produced shades of brown, yellow, cream, khaki, orange, pink and crimson colours. These raw materials used were leaves, barks of trees, tubers, seeds, and husks. Tree barks of locos bean (dorawa), madachi, kadanya, cashew and walnut brown leaves with the addition of alum

produced brighter hue shades of brown. Bixa produced khaki, while the seeds and fruits with alum and caustic soda produced orange colour.

Variety of colours were produced using mordant alum and caustic soda with the different parts of the collected local dye materials. Some dye substances like madachi leaves, bixa seed and husk, cashewbark, ewon seed, wanut tree bark, ginger and camwood are substantive dye sourcing although better results are with mordants. Both cold and hot dye baths gave good results but better results were from the hot dye baths. Washing and light tests had little or no significant effects and colours like green, red and black were not obtained. The best cold bath results was by using kadanya, dorawa and walnut tree bark, dorawa, and cashew leaves, bixa and dorawa seed husk and walnut husk. Hot dye bath best results were from madachi, cashew, comwood, ginger, ewon seed and bixa seed and leaves.

Erukanure and the present research with ‘cicha’ leaves were similar in almost all the procedures for collecting results. The gap between the two researches was in the areas of testing the dye fastness properties, the fabric in use which included synthetic and the, cleaning agents used during colour fastness, bleeding and migrating control of the dye extracted on both cotton and synthetic fabrics.

Bako, (1989) conducted a research on dye extraction from cashew using selected mordant in Kaduna State. Raw materials were selected and gathered from farms, gardens and market places between the months of September and March, The selection was from four selected Local Government Areas in Kaduna State namely Jema'a, Kachaia, Kaduna and Zaria out of the seven Local Government Areas. The aim was to find out which part of the plant (Cashew) can produce the best colour and maximum quantity of dye content.

The research design used was experimental design. Data collections were through observing the changes of the dye extracted when mordant were added and samples were dyed. The samples used for extraction were leaves, fruits, nuts, barks and roots.

The dyeing procedure went through two different room temperatures of boiling for one to four hours. The results were compared to verify the difference in colour shades of each sample. The findings on quantity and quality of colour produced by each sample stated that cashew was a good local dye material. Cashew extract proved that direct dyed samples had the least fastness to washing and abject fabric areas were heavily stained for the absence of metallic oxides to bind the dye on the fabric. Dyed fabrics with salt, alum and sodium hydro Sulphite possessed good fastness to washing with no staining.

Mordanted dyed fabric samples proved to have better light fastness than unmordanted ones. Water and benzene were found to be the best solvents in dissolution of cashew powder, decanting techniques can be employed in extracting process in order to obtain qualitative and quantitative dye from cashew. Different colours were produced using different mordants with the same dyestuff. Mordants like salt, alum and hydro sulphite appeared to be appropriate when using cashew dye extract, In conclusion there was need to research further on cashew dye extract using other fabrics like synthetics.

The research studies on cicha and cashew were both on natural dye extraction and colour fastness properties of the dyes. Both studies used cotton fabric, but the study on ‘cicha' work further used cotton blend and synthetic fabrics 'nylon’ to see whether natural extracted dye can dye synthetic fabric not treated by Bako, Both research studies depended on the use of mordant for colour development and colour fastness testing. The difference between the two studies indicated was to find out if ‘cicha’ extractcan be

effective for dyeing synthetic fabric using two different dye bath mixtures namely cold and hot dye baths. The plants used for dye extraction also differed in structure; 'Cicha' is a seasonal plant and only the leaves were used for dye extraction. Descriptive statistic were used to explain the results in the research.

Ogboli (1990) conducted a research on Investigating dye extraction methods; colour fastness properties and suitable mordant on locally obtained indigo from Kano. Tests were made on leaves, pods and stems and then examined how much dye could be extracted from each. The researcher gathered information from experimental design research by observation and manipulating the dependant variables. The findings revealed that dye substance varied with the mordant used and the quantity also affected the colour fastness properties. Dye yielding was based on extracting method used and the time given for the preparation.

The findings stated that the best mordant for indigo dyed fabric were toka, katsi, and sodium hydro sulphite. Cold extraction through fermented method was time consuming, only indigo blue- black was economical in use. There was high level impurities in the dye pit which might affect colour fastness. A dye bath prepared using boiling water cut off 36 hours from the dye bath preparation and 50% of all local plant parts used in the dye pit possessed no indigo blue value.

Indigo blue proved to be consistently faster to light than washing except in case of caustic soda and natron mordanted fabrics. Ogboli used dye extracts collected from dye pits, while the study using cicha dye was extracted by the researcher which give the difference, the research work with 'cicha' study was to find out the suitable mordant for

dyeing nylon fabric and cotton blend colour permanency on each of the fabrics to be dyed which was not treated by Ogboli.

Shinkafi (1995)conducted a research on" An Improvement of traditional dyeing as a potential small scale textile industry" in Katsina State. Survey research design was used for collecting data using questionnaire, interview and non- participant observation. Two hundred and fifty (250) copies of questionnaire were distributed. The researchers found out that majority of the industries were cottage in nature based on the locations. In the homes 57.5%, 40% within the locality and only 2.5% of the Industries were at the industrial site.

The educational standard of the entrepreneurs was poor for 40.2% were illiterates, 37.6% primary school leavers, while 16.2% of them were secondary school leavers. The researcher stated that none of them attained tertiary school education. Raw materials for dyeing were obtained locally. The results shared that modern dyeing and traditional dyes differed, for 95% of the modern dyers took about 30 minutes to one hour in the process of dyeing and only 5% of the modem dyers agreed that it took one to four hours to dye fabric using natural extracted dye.

The researcher discovered, that there were declines in the small scale industries which indicated that many problems contributed to the decline. This included poor management, bad site, low educational level of the dyers; raw materials were locally obtained, lack of proper patronizing the traditional dyeing industries due to few variety of design, monotony of colour and poor fastness. On the other hand traditional dyeing took longer time in processing than the modern dyeing which led to set-back.

Also more important was the negligence by the people and the government to upgrade the traditional skill in dyeing. Shinkafi (1995) used survey method to assess the problems of traditional dyeing Industries in Katsina state and the qualification of the entrepreneurs and the difficulties encountered in the dyeing processes, while the study on 'cicha' extract, the researcher concentrated on different methods of extracting dye using the plant leaves. The results were based on the method, mordant and cleaning agents reaction on the two different fabrics.

This study on 'cicha' also used the natural dye extracted to dye synthetic fabric (nylon) to see the effectiveness of the dye, Shinkafi tried to find out the problems traditional dyeing was facing, while this study is looked unto the suitable method of extracting dye and its effectiveness for further usage in the society.

Obi (1997) conducted a research on synthesis and properties of rnonoazo dyes derived from arylarriiness. The objectives of the research were to study methods of synthesizing some useful dyes for local consumption by the textile industries and to examine the colour fastness properties of the dyes and the effect of acid solvent polarity on the absorption wave length of the dyes synthesized.

The researcher used ozo dyes and the research design used was experimental. The materials used for the experiment were 100% Polyester, 100% Nylon, 100% Cotton fabrics and viscose rayon. The extraction was based on the percentage of the chemicals that yielded the dye. Acetone. Ethanol and Toluene were used. The result gave in order of polarity stated that Ethanol was greater than Acetone and Acetone greater than Toluene-

The analysis was carried out using extinction co-efficient (E) 2:4:0 Ethanol gave the best result for yielding the dye. The tests on washing revealed that polyester fiber had good wash fastness and also nylon with moderate fastness, while light fastness revealed

that nylon and polyester were generally moderate although it was slightly better on nylon than polyester.

The researcher tested all the effects of fastness on printed polyester and nylon fabrics and stated that polyester was slightly better than nylon because of the compact structure of polyester. Once the dye entered the crystalline region of the fiber it was not easily absorbed. Finding stated that all dyes synthesized showed positive effect of addition of few drops of hydro choric acid, typically ozo dyes. Obi research study on synthetic dye to find out the effects on polyester fabric, did not consider the natural dye extracted from the natural plants around to maintain the cultural skills which created the gap of interest between the ‘cicha’ extract and the past study.

This study on 'cicha’ extract was to assess the effect of dye extracted from leaves on traditional cotton, calico, cotton blend and nylon to see how suitable the dye on synthetic fabric. The mordant used by the researchers were not the same. The research study on ‘cicha’ and the synthesis and properties of monoazo were not similar in the colour fastness testing and the effect of the mordant's used The gap created was covered by using ‘cicha’ dye extract to dye synthetics in this research study.

Bappa and Isa (2009a) conducted a research on fastness properties of colorant extracted from onion scale leaves in Kaduna state. The objectives of the study was to find out the colorant that can be extracted from onion scale leaves. The sample size was 60 grams of onion scale. The researcher used experimental design. The solvents used were 100mls of water, ethanol and methanol. Two methods of dyeing were carried out. Direct dyeing and basic (mordant) dyeing in the extract was carried out for (45) minutes each. Testing of fastness properties were carried out on cotton fabrics only. Onion scale dye with water gave yellowish colour while ethanol extract gave the best yield of colorant.

Different mordants proved that dyed samples with iron had the best fastness to washing while methanol dyed sample had the best fastness among the different extracts. Mordanted samples had the highest rating to light fastness and ethanol had the best to perspiration. It was good in dyeing cotton either by direct or basic application method. Many shades were obtainable from onion scale using different mordant, but did not have all round fastness properties it was dependent on the types of solvent used and mordant. Further research was recommended for possible structural formula of the colorant. The researcher did not test other fabrics while 'cicha' research filled the gap by using synthetic fabrics.

Bappa and Isa (2009b) conducted a research on extracting dye from Gutta-perch tree (Gamji) in Kaduna State. The bark of the tree was used in the study. The research design used was experimental design. Extracting solvents used included water, ethanol and methanol. The objective of the study was to find out colour fastness properties of the colorant extracted from the bark of gutta-perch tree. The sample weight was 100g of the flakes and 1000mls of solvents were used for extraction.

Extraction was through boiling and keeping the mixture to stay overnight; 200mls of the extract was used to dye 5g cotton fabric when mixed with 2.5g powdered potash, then the mixture of both additives in the dyeing procedure. The period of time used for dyeing was one and half hours (90 minutes) with intermitted stirring for all the dye samples. Washing test was carried out in soapy tap water. The result after observing the samples revealed that the quality of dye from gutta-perch bark was good for dyeing cotton fabric, while samples dyed with ethanol and methanol extract proved to be fast to all test conducted. Water extract gave the best colour unlike ethanol and methanol but it has the highest evaporation time than the two other solvents.

The statistical analysis was based on descriptive statistics on observed reaction on the dyed samples of cotton. Both descriptive statistic and observation were used to explain the reaction of the extract on the fabrics. The differences between the two research studies were, that gutta-perch extract was used on cotton fabric only, while cicha extract was used to dye cotton of two different weaves and synthetic fabrics. Two brands of cleaning agents were used for testing the colour fastness, bleeding and migrating control of dye were also tested, and thus the gap of working with synthetic fabric filled the gap realized.

2.7 Summary of Reviewed Related Literatures

The reviewed related literatures showed the relationship of dye and the textile materials in the dyeing process. The researcher reviewed literatures were on the following subheadings, theoretical framework of dye and deying based on the interaction of the fabric in the dye bath where absorption takes place between the two Medias, historical review of dye and dyeing in other countries of the world including the eastern and western world and Nigeria. Other subheadings include natural dye sourcing materials, categories of natural dye being substantive and additive, dye sourcing materials, collection and preparation for extraction were being reviewed. The importance of preparing a dye bath and uses of mordants and fastness properties using natural dye extraction regarding bleeding and migrating control were also considered.

All empirical studies cited worked with natural dye extraction using different methods of extraction and tested colour fastness under different areas using natural fabric cotton only. Although variety of colours were produced as stated in the cited researches, the used of synthetic materials was not used and therefore, this research on *Cicha* extract tried to fill gap by using synthetic fabrics.

CHAPTER THREE

RESEARCH DESIGN AND METHODOLOGY

3.1 Research Design

This research adopted Experimental research design. This design involves systematic manipulation of independent variables to find out the effects, where the researcher identify, explain or treat causes and effects of events in a given situation. Kolo (2003) stated that experimental research design permits the researcher to manipulate independent variable on dependent variables to compare or find out causes and effect through observing the changes in behavior or action. This helps the researcher to record and describe attribute observed.

This research design was selected because it helps in detecting the true cause effect relationship between the variables. The researcher therefore being interested to find out the effects of dye extracted from 'cicha' leaves using fresh and fermented extraction method find this design the appropriate to use. The researcher used the extract to dye the fabric samples by direct application method to serve as the pre -test samples and quality of the extracts affinity.

3.2 Collection of Experimental material for the study

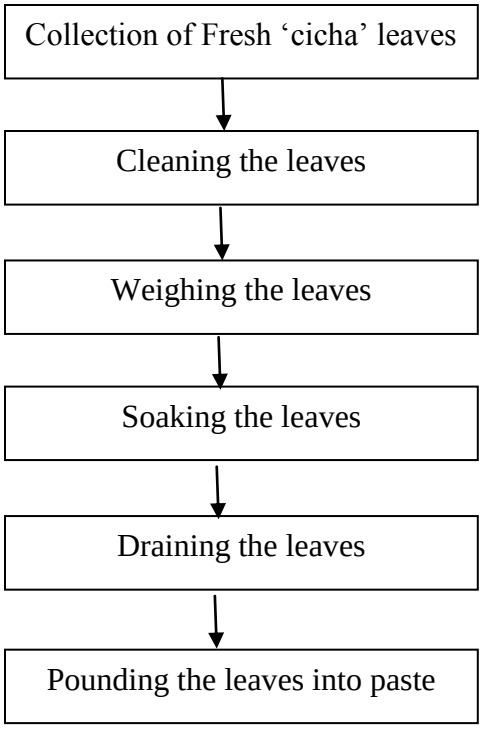
The experimental materials for this study were cicha leaves a seasonal plant grown wildly in southern part of Borno state. The plant grow in cluster and have plenty oval shape leaves. Five hundred grams of the fresh leaves were collected between the months of June to October 2013 in Biu Local Government Area in Borno state when the plant leaves were in their full maturity period. Being an infinite subject 500 grams of 'cicha' fresh leaves were used for feasibility for the extraction of dye. Water, alum,

ash/toka and caustic soda were measured based on the quality of the dye solution using table spoon and cup, which were procured in the study area Biu town. The selected fabric types of cotton and synthetic fabric were purchased in Biu market and ash/toka were collected from firewood residues in the kitchens.

3.3 Procedure for Method of Extracting the Dye.

Although there are other methods to extract dye from local, water extraction method using fresh and fermented materials was used. This was chosen because the aim of this study was to extract dye from ‘cicha’ leaves using water.

This chart below shows the general procedure in preparation for extracting “cicha” dye for both fresh and fermented dye extracting methods.



This procedure made the material ready for the two methods of extraction.

Table 3.1: Quantity of dye materials used for each dye baths

S/No	Condition of dyeing	Extracts volume	Quality of mordant 1.	Quantity of mordant 2.	Quantity of mordant 3.	Time allocated for dyeing.
			Alum	Ash/toka	Caustic soda	
1.	Cold dye baths	3lits	2 table spoon	5 table spoon	2 table spoon	1 hour
2.	Hot (boiling) dye baths	500mls	2 table spoon	5 table spoon	2 table spoon	30 min

Source: Field work 2013 by the researcher.

Extracting Procedure

The quantities of the materials used in the two extracting methods were shown in the tables blow

Table 3.2: Quantities of the extraction solvents and time allocated: Fresh extraction

Cicha leaves paste	Volume of water	Extraction period
500 grams	Three liters of cold water	1 hour

Source: Field study 2013 by the Researcher

The extract was then strained out after intervals of stirring within the period of one hour a green bluish mixture was formed with blue stain inside the bucket. The paste was squeezed out completely.

Table 3.3: Fermented extraction

Cicha leaves paste	Volume of water	Fermentation period
500 grams	Three liters of hot water	Three days

Source: Field study 2013 by the Researcher

After three days, the extract was strained out of the paste which was partially rotten and smelling. The solution was thick and dark in colour.

3.4 Instrument for Data Collection

The instrument used for this research was rating scale prepared by the researcher. A sheet list was also prepared by the researcher and visual observation was carried out to record the chances that occur on the cotton and synthetic fabric dyed in the record sheet.

3.4.1 Validity of the Instruments

The items on the rating scale for the study were given to the experts in the field of Home Economics section Department of Vocational and Technical Education, Ahmadu Bello University Zaria and a statistician for the face and content validity. This was to ensure that the instrument measure accurately what it intended to measure. The corrected scale was used for the pilot test to recode observations.

3.4.2 Pilot Test.

Fresh 'cicha' leaves were collected from Gujba Local Government Area inYobe state. This location was selected because the plant 'cicha' available in the area as wild plant just as in some parts of Borno State, the study area. The structure and nature of the plant leaves were the same and were seasonal too. One hundred grams (100g) of the fresh leaves were processed using 50g for fresh extraction of dye and the other 50g for fermented extraction. The extracts from each method of dye extraction used 10cm by 10cm of each cotton and synthetic fabric to test the colours absorbed using fresh extract in cold and hot dye baths.

The dyeing of the samples was carried out in cold dye bath at(10^{o}c) degrees centigrade and hot dye bath at (100^{o}c) degree centigrade mixture. The researcher carried out the experiment on both dye extraction using the fresh and fermented extracting method with water as the extracting solvent. Direct dye application and mordant dye processes were applied on the selected fabrics in the study.

3.4.3 Reliability of the Instrument.

The rating scale used was regarded to be reliable for it was tested using the data collected during the pilot test. Test – retest reliability co-efficient gave a result of 0.86. This was regarded reliable because the decision rule was if the reliability co-efficient result is close to 1it could be regarded as reliable. Since 0.86 is close to 1 therefore the scale was regarded reliable.

3.5 Procedure for Data Collection

The researcher collected an introduction letter from Vocational and Technical Education Ahmadu Bello University, Zaria. The letter collected was given to College of Education Waka – Biu seeking for permission to use Home Economic Department Clothing Laboratory.The researcher hadthe privilege to use the clothing laboratory of Home Economics Department for six weeks conducting the experiment. The extracts obtained from the two methods of dye extraction were used to carry out dyeing tests on the selected fabrics of cotton and synthetic. Direct dye and mordanted dye application were carried out in this work. Although therewere three methods of mordanting namely:

1. Mordanting before dyeing.
2. Mordanting during dyeing and
3. Mordanting before and after dyeing, this study used mordantng during dyeing only.

Data collected using visual observation method was carried out by 15 observersrecording their opinions on the record sheet for each dye bath in each dye extracting method of fresh and fermented cold and hot dye bath on colours produced on cotton and synthetic fabrics. Then the researcher records the changes observed on colour

fastness, bleeding and migrating control of dye on cotton and synthetic fabrics during the experiment.

3.6 Procedure of data Analysis

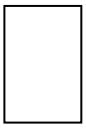
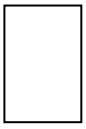
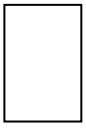
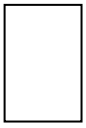
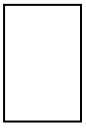
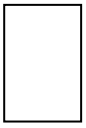
The researcher used descriptive statistic for each colour developed on cotton and synthetic fabrics onfastness, bleeding and migrating controls of the dye. This was done by recording the effect on each dyed sample in each dye bath observed using rating scale 1 for minimum effects and 5 for maximum effects. The null hypotheses were tested using chi-square statistic at 0.05 alpha level of significance.

CHAPTER FOUR

PRESENTATION AND ANALYSIS OF DATA

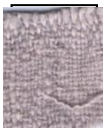
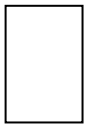
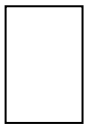
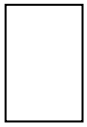
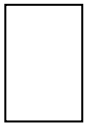
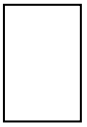
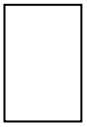
4.1 Results of colours developed using Cicha extraction in cold and hot dye baths.

Table 4.1.1 Fresh Extract, direct and Mordant Application.

		Pretest		Alum		Ash/Toka		Caustic soda	
	Original Fabric colour	Cold	Hot	Cold	Hot	Cold	Hot	Cold	Hot
1. Traditional woven cotton fabric		 Dark cream	 Light brown	 Yellow	 Carton colour	 Bluish green	 Carton colour	 Blue	 Light army
2.Calico Cotton fabric	 White	 Bluish green	Light Brown	 Yellow	Light brown	 Light bluish green	 Army	 Blue	 Light army
3.Cotton blend	 White	cream	 Light purple	Light yellow	Light brown	Light bluish	Light brown	 Light sky blue	 Grey
4.Nylon fabric	 White	 No colour change	 Light purple	Cream	 No colour change	 Bluish green	 No colour change	 Sky blue	 Grey

Source: Field study 2013 by the Researcher

Table 4.1.2 Fermented extract; Direct and Mordant, Application:

		Pretest		Alum		Ash/Toka		Caustic soda	
	Original Fabric colour	Cold	Hot	Cold	Hot	Cold	Hot	Cold	Hot
1. Traditin cotton fabric		 Dark cream	 Light Brown	 Dark yellow	 Yellow	 coffee	 Bright Army	 army	 Golden brown
2.Calico Cotton fabric		 Light brown	 Light Brown	 Yellow	 Yellow	 Coffee	 Light Army	 Army	 Golden brown
3.Cotton blend		Light brown	 Light purple	Light cream	 brown	Light cream	 Purple	Cream	 Light purple
4.Nylon fabric		 No colour change	 Light purple	 No colour change	 Brown	Cream	 Purple	 No colour change	 Purple

Source: Field study 2013 by the Researcher

Table 4.3 and 4.4 vividly show the different colour shades developed using the two extracts of fresh and fermented leaves dye extraction. Traditional woven and calico cotton samples developed colours ranging from cream, yellow bluish green, carton and army colours of different shades in hot fresh extract dye baths. The synthetic fabrics of cotton blend and nylon developed colour shade of light cream, purple, yellow, brown,

bluish/green, sky blue and grey in both cold and hot dye baths, with nylon fabric in direct cold dye bath not dye bath with alum and hot dye bath with wood ash had no dye effect. That is nylon fabric could not absorb cicha dye fresh extract in cold direct dye application and hot dye bath with alum and ash.

Fermented extract dye baths proved that cotton fabric sample produces colour shades of yellow, coffee, army and golden brown with the mordants in both cold and hot dye bath of fermented extract. In addition it can only produce light brown colours in direct dye bath of cold and hot fermented extracts of cicha leaves. Synthetic fabric samples developed various colour shades of cream, purple and brown in direct and mordanted dye bath. Nylon fabric proved that direct and mordanted dyeing methods with alum and caustic soda in cold dye baths had no dye affinity.

Table 4.1.3 Record of observation of 16 observers during the experiment.

s/n	Opinions	SD	A	D	SD
1	There is differences in colours produced on the cotton fabrics in fresh cold and hot dye bath using fresh and fermented extract in direct application	5	11	0	0
2	There is no difference in colours developed on cotton fabrics in fermented cold and hot dye bath using direct application	0	11	5	0
3	Synthetic fabrics absorbed no dye in fresh cold and hot dye bath using direct dyeing	0	0	11	5
4	Synthetic fabrics have no colour change in fermented cold and hot dye bath using direct dyeing	0	0	7	9
5	Fresh cold and hot dye bath with alum developed colours on cotton fabrics well	5	11	0	0
6	Fermented cold and hot dye bath with alum developed no colour on cotton fabrics	0	0	0	16
7	Synthetic fabric in fresh cold and hot dye bath with alum showed the same colour hue	2	10	4	0
8	Synthetic fabrics dye in fermented cold and hot dye bath with alum developed varieties of colour	0	4	8	4
9	Cotton fabric in fresh cold and hot dye bath with ash developed different colours in each bath	6	10	0	0
10	Fermented cold and hot dye bath with ash result in different colours on cotton fabrics	0	4	11	1
11	Fresh cold and hot dye bath with ash developed no colour on synthetic fabrics	0	0	5	11
12	Fermented cold and hot dye bath with ash developed colours on synthetic fabrics	1	15	0	0
13	Fresh cold and hot dye bath with caustic soda on cotton gave no colour	0	0	0	16
14	Fresh cold and hot dye bath with caustic soda on synthetic fabrics developed colours	16	0	0	0
15	Fermented cold and hot dye bath with caustic soda on cotton fabrics gave colours	2	9	5	0
16	Synthetic fabrics dyed in fermented cold and hot dye bath with caustic soda had no colour effect	0	0	14	2
17	Fresh extract of cold dye bath with all the mordants have poor dyeing effects on cotton fabrics	0	0	0	16
18	Fresh extract of cold dye bath with all the mordants have good dyeing effects on synthetic fabrics	0	0	10	6
19	Fermented extract of cold dye bath with all the mordants have good dyeing effects on cotton fabrics	2	14	0	0
20	Fermented extract of hot dye bath with all the mordants gave the best dyeing effects on synthetic fabrics	9	6	1	0

Based on the observation report, it was found out that 16 observers agreed that there is difference in colours produced on the cotton fabrics in fresh cold and hot dye bath using fresh and fermented extract in direct application while, 11 agreed and 5 disagreed

that there is no difference in colours developed on cotton fabrics in fermented cold and hot dye bath using direct application. It was also disagreed by 16 observers that synthetic fabrics absorbed no dye in fresh cold and hot dye bath using direct dyeing, while 16 also disagreed that synthetic fabrics have no colour change in fermented cold and hot dye bath using direct dyeing. Also, 16 agreed that fresh cold and hot dye bath with alum developed colours on cotton fabrics well, 16 disagreed that fermented cold and hot dye bath with alum developed no colour on cotton fabrics.

It was also found that 12 observers as against 4 reported that synthetic fabric in fresh cold and hot dye bath with alum showed the same colour hue, while 12 observers as against 4 disagreed that synthetic fabrics dye in fermented cold and hot dye bath with alum developed varieties of colour. All observers agreed that cotton fabric in fresh cold and hot dye bath with ash developed different colours in each bath while 4 agreed and 12 disagreed that fermented cold and hot dye bath with ash result in different colours on cotton fabrics. All observers disagreed that fresh cold and hot dye bath with ash developed no colour on synthetic fabrics. All of them agreed that fermented cold and hot dye bath with ash developed colours on synthetic fabrics, just as they disagreed that fresh cold and hot dye bath with caustic soda on cotton gave no colour. Item 14 indicated that 16 agreed that fresh cold and hot dye bath with caustic soda on synthetic fabrics developed colours, while 11 agreed and 5 disagreed that Fermented cold and hot dye bath with caustic soda on cotton fabrics gave colours. All observers disagreed that synthetic fabrics dyed in fermented cold and hot dye bath with caustic soda had no colour effect, just as they also disagreed that fresh extract of cold dye bath with all the mordants have poor dyeing effects on cotton fabrics and that fresh extract of cold dye bath with all the

mordants have good dyeing effects on synthetic fabrics. Also 16 agreed that fermented extract of cold dye bath with all the mordants have good dyeing effects on cotton fabrics, while 15 as against 1 observer agreed that fermented extract of hot dye bath with all the mordants gave the best dyeing effects on synthetic fabrics.

In conclusion therefore, the observers report stated that Cicha extract develops varieties of colours on both cotton and synthetic fabrics in cold and hot dye bath using the mordants.

4.2 (a)Wash fastness results on Mordanted dyed samples of cotton and synthetic fabrics using sunlight detergent powder

Table 4.2.1 Fresh extract results in cold and hot dye baths.

		Alum		**Ash/Toka**		**Caustic soda**	
	Cold temp. 10^0C, Hot temp. 100^oc	Cold	Hot	Cold	Hot	Cold	Hot
1.	Traditional woven cotton fabric	4	4	2	4	4	4
2.	Calico cotton fabric	4	4	2	4	4	4
3.	Cotton blend fabric	4	5	3	4	4	4
4.	Nylon fabric	4	-	4	-	4	4

Source: Field study 2013 by the Researcher

Key: 1 minimum fastness, 5 – maximum fastness.

Table 4.2.2: Fermented extract results in cold and hot dye bath

		Alum		**Ash/ Toka**		**Caustic soda**	
	Cold temp. 10^0C, Hot temp. 100^oc	Cold	Hot	Cold	Hot	Cold	Hot
1.	Traditional woven cotton fabric	4	4	2	4	2	4
2.	Calico cotton fabric	4	4	4	4	2	5
3.	Cotton blend fabric	4	4	4	5	4	5
4.	Nylon fabric	-	4	4	5	-	4

Source: Field study 2013 by the Researcher

Key. 1 – Minimum fastness, 5 maximum fastness

Results of tests on colour fastness using sunlight detergent on dyed samples in both fresh and fermented extracts. Based on the observation results during the experiment, both cotton and synthetic fabric dyed samples with alum, ash/toka and caustic soda mordants proved to be fast when washed with sunlight detergent powder. Results rated proved that both fresh and fermented method of dye extraction from cicha leaves have good fasting quality showing 4 and 5 as tested. Only dye bath with ash in cold dye bath rated 2 and 3, there was no affinity in hot dye baths with alum and ash on nylon. Fermented extract dye baths with alum, ash and caustic soda cold dye baths proved to be not effective on nylon and cotton fabrics while hot dye bath of caustic soda and ash gave the best result rating 5 point.

4.3(b).Wash fastness result on mordanted dyed samples of cotton and synthetic fabrics using B 29 soap.

Table 4.3.1 Fresh extract result in cold and hot dye bath

	Key:	**Alum**		**AshToka**		**Caustic soda**	
	Cold - 10^0C, Hot - 100^oc	Cold	Hot	Cold	Hot	Cold	Hot
1.	Traditional woven cotton fabric	3	4	2	4	3	4
2.	Calico cotton fabric	4	4	2	4	4	4
3.	Cotton blend fabric	4	5	3	4	3	4
4.	Nylon fabric	4	-	4	-	4	5

Source: Field study 2013 by the Researcher
Key. 1 – Minimum fastness, 5 -maximum fastness

Table 4.3.2: Fermented extract result in cold and hot dye bath

	Fabric types	Alum		Ash/Toka		Caustic soda	
		Cold	Hot	Cold	Hot	Cold	Hot
1.	Traditional woven cotton fabric	4	4	3	4	3	4
2.	Calico cotton fabric	4	4	4	4	4	4
3.	Cotton blend fabric	4	5	4	5	4	5
4.	Nylon fabric	-	5	4	5	-	5

Source: Field study 2013 by the Researcher

Key. 1 – Minimum fastness, 5 maximum fastness

Colours developed on the dyed samples of cotton and synthetic fabrics proved to be fast in the test of washing using B29 soap with minimum rating of 2 and maximum rating of 5 rating order in hot dye baths with alum and caustic soda using fresh extract in both cold and hot dye baths. The best result of fastness developed in hot dye baths using all the three mordant alum, ash and caustic soda were oncotton blend and nylon which gave a rating of 5. The minimum result for fermented extract in both dye baths using mordantswas rated 3 in cold dye bath with ash and caustic soda.

4.4 Results of dye control on cotton and synthetic fabric samples

Table 4.4.1– Bleeding control results

	Fabric types	Alum		Ash/ Toka		Caustic soda	
		Cold	Hot	Cold	Hot	Cold	Hot
1.	Traditional woven cotton fabric	1	4	1	3	2	5
2.	Calico cotton fabric	3	4	2	4	2	5
3.	Cotton blend fabric	4	5	4	5	4	5
4.	Nylon fabric	-	5	4	5	-	5

Source: Field study 2013 by the Researcher

Key. 1 – Minimum bleeding control of dye, 5 maximum bleeding control of dye

Hot dye bath with caustic soda with ‘cicha’ extract came out to give the best result with all the fabric samples of cotton and synthetic fabrics followed by Alum hot dye bath and ash hot dye baths on all the fabrics with lowest rating of 3. Cold dye bath with alum, ash and caustic soda have minimum result rating 1 and 2 on cotton

fabrics.With nylon in cold dye bath mixed with alum and casuistic soda there was no dye absorption observed.

4.4b Dye Migrating control Result

Table4.4.2: Migrating control of dye

	Fabric types	Alum		Ash/ Toka		Caustic soda	
		Cold	Hot	Cold	Hot	Cold	Hot
1.	Traditional woven cotton fabric	4	5	2	4	3	5
2.	Calico cotton fabric	4	5	2	4	3	5
3.	Cotton blend fabric	4	5	5	5	5	5
4.	Nylon fabric	-	5	5	5	-	5

Source: Field study 2013 by the Researcher
Key 1- Minimummigrating control of dye while 5 – maximum migrating control of dye.

Dye control results on cotton and synthetic fabric samples dyed in cicha extract. Results showed that only cotton in cold dye bath with ash had minimum migrating control in the test and nylon had not absorbed dye which showed little change on the fabric. Caustic soda and alum gave the best migrating control on all the fabrics when hot dye bath was used with ‘cicha’ extract and moderate result with caustic soda and ash in cold dye baths.

4.5 Testing of Null Hypotheses

Null Hypothesis 1 There is no significant difference between the fastness properties of fresh and fermented extract on cotton and synthetic fabric.

Table 4.5.1: Chi-Square test to determine difference between the fastness properties of fresh and fermented extract on cotton and synthetic fabric.

Variable	$\chi^{2\ calculated}$	$\chi^{2\ critical}$	***df***	***p***	***decision***
difference between the fastness properties of fresh and fermented extract on cotton and synthetic fabric	96.865	43.773	30	0.000	Significant

χ^2 calculated >χ^2 critical, calculated p < 0.05 at df = 30 (2tailed)

Table 1 shows that the calculated probability value of 0.000 is less than the 0.05 alpha level of significance, while the calculated chi square value of 96.865is greater than the critical chi-square value of 43.773at df = 30. This implies that there is a significant difference between the fastness properties of fresh and fermented extract on cotton and synthetic fabric.Therefore, the null hypothesis which states that there is no significant difference between the fastness properties of fresh and fermented extract on cotton and synthetic fabric, is hereby rejected.

Null Hypothesis 2: There is no significant difference between the colours produced on the cotton using alum, ash/toka and caustic soda in the fresh and fermented extracts.

Table 4.5.2: Chi-Square test to determine difference between the colours produced on the cotton using alum, ash/toka and caustic soda in the fresh and fermented extracts.

Variable	$\chi^{2\ calculated}$	$\chi^{2\ critical}$	***df***	***p***	***decision***
Colours produced on the cotton using alum, ash/toka and caustic soda in the fresh and fermented extracts.	154.876	43.773	30	0.000	Significant

χ^2 calculated >χ^2 critical, calculated p <0.05 at df = 30 (2tailed)

Table 2 indicated that the calculated probability value of 0.000 is less than the .05 alpha level of significance, while the calculated chi square value of 154.876 is greater than the critical chi-square value of 43.773at df = 30. This means that there is a significant difference in the colour produced using different mordants in the fresh and fermented extract. Therefore, the null hypothesis which stated that there is no significant difference between the colours produced on the cotton using alum, ash/toka and caustic soda in the fresh and fermented extracts, is hereby rejected.

Null Hypothesis 3: There is no significant difference between the colours produced on synthetic fabric using alum, ash/toka and caustic soda in the fresh and fermented extracts.

Table 4.5.3: Chi-Square test to determine difference between the colours produced on synthetic fabric using alum, ash/toka and caustic soda in the fresh and fermented extracts.

Variable	$\chi^{2\ calculated}$	$\chi^{2\ critical}$	***df***	***p***	***decision***
Colours produced on the synthetic fabric using alum, ash/toka and caustic soda in the fresh and fermented extracts	105.026	43.773	30	0.000	Significant

χ^2 calculated >χ^2 critical, calculated p < 0.05 at df = 30 (2tailed)

The calculated probability value of 0.000 is less than the .05 alpha level of significance while the calculated chi square value of 105.026 is greater than the critical chi-square value of 43.773 at df = 30. This implies that there is a significant difference in the colours produced on synthetic fabric using different mordants in the fresh and fermented extracts. Hence the null hypothesis which stated that there is no significant difference between the colours produced on synthetic fabric using alum, ash/toka and caustic soda in the fresh and fermented extracts, is hereby rejected.

Null Hypothesis 4: There is no significant difference among the effect of alum, ash/toka and caustic soda on colour fastness in the fresh and fermented extracts on cotton.

Table 4.5.4: Chi-Square test to determine difference among the effect of alum, ash/toka and caustic soda on colour fastness in the fresh and fermented extracts on cotton.

Variable	χ^{2} *calculated*	χ^{2} *critical*	***df***	***P***	***Decision***
Effect of alum, ash/toka and caustic soda on colour fastness in the fresh and fermented extracts on cotton	161.580	43.773	30	0.000	Significant

χ^{2} calculated >χ^{2} critical, calculated p < 0.05 at df = 30 (2tailed)

Table 4 shows that the calculated probability value of 0.000 is less than the 0.05 alpha level of significance while the calculated chi square value of 161.580 is greater than the critical chi-square value of 43.773 at df = 30. This means that there is significant difference among the effect of alum, ash/toka and caustic soda on colour fastness in the fresh and fermented extracts on cotton.Therefore the null hypothesis which states that there is no significant difference among the effect of alum, ash/toka and caustic soda on colour fastness in the fresh and fermented extracts on cotton tested is hereby rejected.

Null Hypothesis 5: There is no significant difference among the effect of alum, ash/toka and caustic soda on colour fastness in the fresh and fermented extracts on synthetic fabrics tested.

Table 4.5.5: Chi-Square test to determine differenceamong the effect of alum, ash/toka and caustic soda on colour fastness in the fresh and fermented extracts on synthetic fabrics tested.

Variable	χ^{2} ***calculated***	χ^{2} ***critical***	***df***	***P***	***Decision***
effect of alum, ash/toka and caustic soda on colour fastness in the fresh and fermented extracts on synthetic fabrics tested	149.803	43.773	30	0.000	Significant

χ^{2} calculated >χ^{2} critical, calculated p < 0.05 at df 30 (2tailed)

Table 5 revealed that the calculated p value of 0.000 is less than the 0.05 alpha level of significance while the calculated chi square value of 149.803 is greater than the critical chi square value of 43.773 at df = 30. This implies that there is significant difference in effects of alum, ash/toka and caustic soda on colour fastness in the fresh and fermented extracts on synthetic fabrics tested. Therefore the null hypothesis which stated that there is no significant difference in effects of alum, ash/toka and caustic soda on colour fastness in the fresh and fermented extracts on synthetic fabrics tested is hereby rejected.

Null Hypothesis 6: There is no significant difference among the effects of alum, ash/toka and caustic soda on dye bleeding control on cotton.

Table 4.5.6: Chi-Square test to determine difference among the effects of alum, ash/toka and caustic soda on dye bleeding control on cotton.

Variable	$\chi^{2\ calculated}$	$\chi^{2\ critical}$	*df*	*p*	*decision*
Effects of alum, ash/toka and caustic soda on dye bleeding control on cotton.	159.703	43.773	30	0.000	Significant

χ^2 calculated >χ^2 critical, calculated p < 0.05 at df 30 (2tailed)

Table 6 revealed that the calculated p value of 0.000 is less than the 0.05 alpha level of significance while the calculated chi square value of 159.703 is greater than the critical chi square value of 43.773 at df = 30. This shows that there is significant difference in the effects of alum, ash/toka and caustic soda on dye bleeding control on cotton. Hence, the null hypothesis which stated that there is no significant difference among the effects of alum, ash/toka and caustic soda on dye bleeding control on cotton tested is hereby rejected.

Null Hypothesis 7: There is no significant difference among the effects of alum, ash/toka and caustic soda on dye bleeding control on synthetic fabric.

Table 4.5.7: Chi-Square test to determine difference among the effects of alum, ash/toka and caustic soda on dye bleeding control on synthetic fabric.

Variable	$\chi^{2\ calculated}$	$\chi^{2\ critical}$	*df*	*p*	*decision*
Effects of alum, ash/toka and caustic soda on dye bleeding control on synthetic fabric.	159.739	43.773	30	0.000	Significant

χ^2 calculated >χ^2 critical, calculated p < 0.05 at df 30 (2tailed)

Table 7 revealed that the calculated p value of 0.000 is less than the 0.05 alpha level of significance while the calculated chi square value of 159.739 is greater than the critical chi square value of 43.773at df = 30. This shows that there is significant difference in the

effects of alum, ash/toka and caustic soda on the migrating control of dye on synthetic fabric tested. Therefore the null hypothesis which stated that there is no significant difference among the effect of alum, ash/toka and caustic soda on the migrating control of dye on synthetic fabric tested is hereby rejected.

Null Hypothesis 8: There is no significant difference among the effect of alum, ash/toka and caustic soda on the migrating control of dye on cotton tested.

Table 4.5.8: Chi-Square test to determine difference among the effect of alum, ash/toka and caustic soda on the migrating control of dye on cotton tested.

Variable	χ^2 ***calculated***	χ^2 ***critical***	***df***	***p***	***decision***
Effect of alum, ash/toka and caustic soda on the migrating control of dye on cotton tested.	167.522	43.773	30	0.000	Significant

χ^2 calculated >χ^2 critical, calculated p < 0.05 at df 30 (2tailed)

Table 8 revealed that the calculated p value of 0.000 is less than the 0.05 alpha level of significance while the calculated chi square value of 167.522 is greater than the critical chi square value of 43.773 at df = 30. This shows that there is significant difference in the effects of alum, ash/toka and caustic soda on the migrating control of dye on cotton tested. Therefore the null hypothesis which stated that there is no significant difference among the effect of alum, ash/toka and caustic soda on the migrating control of dye on cotton tested is hereby rejected.

Null Hypothesis 9: There is no significant difference among the effect of alum, ash/toka and caustic soda on the migrating control of dye on synthetic fabric tested.

Table 4.5.9: Chi-Square test to determine difference among the effect of alum, ash/toka and caustic soda on the migrating control of dye on synthetic fabric tested.

Variable	χ^{2} *calculated*	χ^{2} *critical*	***df***	***p***	***decision***
Effect of alum, ash/toka and caustic soda on the migrating control of dye on synthetic fabric tested.	145.521	43.773	30	0.000	Significant

χ^{2} calculated >χ^{2} critical, calculated p < 0.05 at df 30 (2tailed)

Table 9 revealed that the calculated probability value of 0.000 is less than the 0.05 alpha level of significance while the calculated chi square value of 145.521 is greater than the critical chi square value of 43.773 at df = 30. This shows that there is significant difference in the effects of alum, ash/toka and caustic soda on the migrating control of dye on synthetic fabric tested. Therefore the null hypothesis which stated that there is no significant difference among the effect of alum, ash/toka and caustic soda on the migrating control of dye on synthetic fabric tested is hereby rejected.

4.6 Summary and Discussion of Major Findings

Based on the analysis of data for 'cicha' study the following were raised as the major findings:-

1. cicha dye extracts using mordants (alum, ash/toka, and caustic soda) was regarded good for fastening properties on cotton and synthetic fabrics
2. Methods adopted gave variety of colours on both synthetic and cotton fabrics developed in all the dye bath.

3. Cicha dye extract proved to be a good dye source for direct dyeing on all cotton and synthetic fabric selected in hot dye bath but have no affinity on nylon in cold dye bath using fresh extracts.
4. All the three selected mordantsprove to be good dyeing additive for cicha extract by providing variety of colours on both cotton and synthetic fabrics used in fresh extract, but have no dyeing effect on nylon in hot dye baths with ash/toka and alum.
5. Fermented dye extract developed variety of colours in all the mordanted dye baths of cold and hot bath had no effect of dye on nylon in cold dye baths with alum and caustic soda.
6. Fermented dye extract in hot dye baths with ash/toka and caustic soda gave purple colour on synthetic fabrics with mordants and without mordants.
7. Both fresh and fermented extracts developed variety of good colour on both fabric types in both cold and hot dye baths mordanted with alum, and caustic soda,
8. All the mordants used prove to be good for colour fastness on both cotton and synthetic fabrics in cold and hot dye baths using sunlight detergent powder and B29 soap, using fresh and fermented extracts tested. See tables 4.5, 4.6, 4.7 and 4.8 observation results.
9. The mordants used; alum, ash and caustic soda proved to be good dye bleeding control agent of ‘cicha’ dye extracted in hot dye baths than cold dye baths on all the fabric tested.
10. All mordanted cold dye baths have weak effect on dye bleeding control on traditional woven fabric.

11. Hot dye bath mixture with all the mordanthas good migrating control of cicha extract than cold dye baths.

From the enumerated major finding cicha is therefore a good source for dyeing synthetic fabrics. As for the tested null hypotheses the results showed that all were rejected for there was difference in the colours produced and the effects of the mordants showed different reaction which showed there were good for colour fastness, bleeding and migrating.Finally see appendices II, III, IV and V on the finished products.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary

This research work was designed on Analysis of Dye extracted from "cicha" plants in Borno state: Quantity and fastness properties on cotton and synthetic fabrics. The research worked on extracting dye from "cicha" leaves using water, fresh and fermented dye extracting method used 500 grams of the fresh leaves of 'cicha' plant for each method of dye extraction. Experimental research designed was used for the dye extraction. Questionnaire with 40 items as a guide for the researcher was developed by the researcher to direct the observation during the experiment. The items were divided into five sections based on the research questions vetted by the researcher supervisors in Vocational and Technical Education Home Economics Section and a statistician. Collected data based on the colours developed on the selected cotton and synthetic fabrics as a result of mordant's alum, ash/toka and caustic soda on colour shades colour fastness and dye control were used for the statistical analysis. Two cleaning agents namely sunlight detergent powder and B29 soap were used for the wash test and analyzed.

Extracts from both extracting method of fresh and fermented were used in cold and hot (boiling) dye baths. Sixteen tests were carried out in the experiment for relevant results of the test on the fabrics of cotton and synthetic. The finding proved that both extracting methods can be used for dyeing both cotton and synthetic fabrics, but hot (boiling) solution proved to produce the best and bright varieties of colours than cold dye baths used.

5.2 Conclusion

The research result based on the experiment conducted on cicha dye extraction using fresh and fermented method proved to develop different colour shades on bath cotton and synthetic fabrics in direct dyeing application in different dye both temperatures of cold and hot (boiling) ranging from yellow, cream, bluish green, brown, blue, carton, army grey coffee and purple from light and golden shade. Mordanted dyed samples gave the best colour shades in hot dye bath with the exception of nylon in some dye bath using direct dye application and a hot dye bath with alum, and ash using fresh extracts. Reverse is the case with fermented extracts affinity was absent in cold baths in direct dyeing on nylon with alum, and caustic soda.

Wash test with both cleaning agents gavegood results on all the dye samples with fastness rating 4 and 5 in almost all the dye baths using both extracts. Finally then it can be concluded that 'cicha' leaves dye is recommended to be used for synthetic fabric for producing different colour shades using mordants and have the best bleeding and migrating dye control in both dye baths of cold and hot (boiling). 'Cicha' leaves dye also prove to be a substantive dye (direct) as observed in the direct dye application on both cotton and synthetic fabrics tested. Based on the observation and recorded results hot (boiling) dye bath using water for dyeing is faster compared with cold dye baths used.

5.3 Recommendations

With regard to the major findings the researcher recommended the following:-

1. 'Cicha' plant leaves should be used for dye extraction and used in schools and college during practical even textile industries.

2. Cicha plan should be produced by farmers or all interest individuals as cash material for dye sourcing in the small scale dye workshops.
3. The seeds and roots should be used for further studies to find out its colorant development on synthetic and other man made fabrics.
4. Dyeing process should be carried out using different method for example mordanting before dyeing and mordanting after dyeing.
5. Other extracting methods should be used for ‘cicha’ dye extraction for example in powdered form using other mordants.
6. ‘Cicha’ dye extract should be used to dye others materials like silk, rayon and wool.
7. Schools and colleges more especially in Borno State should cultivate ‘cicha’ plant farmfor easy utility during practical lessons.

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APPENDICES

Appendix I

‘Cicha’ plant in Biu Local Government Area



‘Cicha’ plant dye sourcing materials for this study

Appendix II

Traditional Woven Fabric (cotton)







These are samples of 'cicha' extracts products on traditional woven fabrics after testing the colour fastness properties which proved to begood extract for both direct and mordanted dyeing showing light brown, coffee army, bluish green army and yellow.

Appendix III

Calico Cotton Fabric



Finished product of ‘cicha’ extract after treatment given on colour fastness showed the different colours of brown,coffee,army and yellow on calico fabrics.

Appendix IV:

Cotton Blend Fabric (synthetic)



Result of cotton blend fabrics dyed in ‘cicha’dye extracts showing variety of colours produced on cotton blend fabrics ranging from blue, brown sky blue grey and purple.

Appendix V:

Nylon Fabric (synthetic)



Nylon fabric dyed in ‘cicha’ extracts showing different colours of blue, purple, sky blue and grey after colour fastness tests.

Appendix VI

Observation Checklist

Section A: Instruction:please tick against the option you consider appropriate after observation.

s/n		SA	A	D	SD
1	There is differences in colours produced on the cotton fabrics in fresh cold and hot dye bath using fresh and fermented extract in direct application				
2	There is no difference in colours developed on cotton fabrics in fermented cold and hot dye bath using direct application				
3	Synthetic fabrics absorbed no dye in fresh cold and hot dye bath using direct dyeing				
4	Synthetic fabrics have no colour change in fermented cold and hot dye bath using direct dyeing				
5	Fresh cold and hot dye bath with alum developed colours on cotton fabrics well				
6	Fermented cold and hot dye bath with alum developed no colour on cotton fabrics				
7	Synthetic fabric in fresh cold and hot dye bath with alum showed the same colour hue				
8	Synthetic fabrics dye in fermented cold and hot dye bath with alum developed varieties of colour				
9	Cotton fabric in fresh cold and hot dye bath with ash developed different colours in each bath				
10	Fermented cold and hot dye bath with ash result in different colours on cotton fabrics				
11	Fresh cold and hot dye bath with ash developed no colour on synthetic fabrics				
12	Fermented cold and hot dye bath with ash developed colours on synthetic fabrics				
13	Fresh cold and hot dye bath with caustic soda on cotton gave no colour				
14	Fresh cold and hot dye bath with caustic soda on synthetic fabrics developed colours				
15	Fermented cold and hot dye bath with caustic soda on cotton fabrics gave colours				
16	Synthetic fabrics dyed in fermented cold and hot dye bath with caustic soda had no colour effect				
17	Fresh extract of cold dye bath with all the mordants have poor dyeing effects on cotton fabrics				
18	Fresh extract of cold dye bath with all the mordants have good dyeing effects on synthetic fabrics				
19	Fermented extract of cold dye bath with all the mordants				

	have good dyeing effects on cotton fabrics				
20	Fermented extract of hot dye bath with all the mordants gave the best dyeing effects on synthetic fabrics				

Section B: Effects of mordant's on colour fastness on the cotton and synthetic fabrics fresh and fermented extracts when washed B29 soap.

Instruction: 1 Stand for minimum colour fastness 5 for maximum colour fastness.

	Minimum fastness 1		Maximum fastness 5	
1. Cotton fabrics dyed in fresh extract with alum.				
2. Cotton fabrics dyed in fermented extract with alum				
3. Synthetic fabrics dyed in fresh extract with alum.				
4. Synthetic fabrics dyed in fermented extract with alum.				
5. Cotton fabrics dyed in fresh extract with ash/toka.				
6. Cotton fabrics dyed in fermented extract with ash/toka.				
7. Synthetic fabrics dyed in fresh extract with ash/toka.				
8. Synthetic fabrics dyed in fermented extract ash/toka				
9. Cotton fabrics dyed in fresh extract with caustic soda.				
10. Cotton fabrics dyed in fermented extract with caustic soda.				
11. Synthetic fabric dyed in fermented extract with caustic soda.				

Section C: Effects of mordant's in controlling bleeding and migrating of dye on the cotton and synthetic fabrics.

Instruction: 1 for minimum control and 5 for minimum control of dye

	Minimum control		**Maximum control**	
	Bleeding	Migrating	Bleeding	Migrating
1. Cotton dyed in dye bath with alum.				
2. Synthetic fabrics dyed in dye bath with alum.				
3. Cotton fabrics dyed in dye bath with alum.				
4. Synthetic fabrics dyed in dye baths with ash/toka.				
5. Cotton fabrics dyed in dye bath with caustic soda.				
6. Synthetic fabrics dyed in the bath with caustic soda.				

Appendix VII

Record of observation of 16 observers during the experiment.

s/n	Opinions	SD	A	D	SD
1	There is differences in colours produced on the cotton fabrics in fresh cold and hot dye bath using fresh and fermented extract in direct application	5	11	0	0
2	There is no difference in colours developed on cotton fabrics in fermented cold and hot dye bath using direct application	0	11	5	0
3	Synthetic fabrics absorbed no dye in fresh cold and hot dye bath using direct dyeing	0	0	11	5
4	Synthetic fabrics have no colour change in fermented cold and hot dye bath using direct dyeing	0	0	7	9
5	Fresh cold and hot dye bath with alum developed colours on cotton fabrics well	5	11	0	0
6	Fermented cold and hot dye bath with alum developed no colour on cotton fabrics	0	0	0	16
7	Synthetic fabric in fresh cold and hot dye bath with alum showed the same colour hue	2	10	4	0
8	Synthetic fabrics dye in fermented cold and hot dye bath with alum developed varieties of colour	0	4	8	4
9	Cotton fabric in fresh cold and hot dye bath with ash developed different colours in each bath	6	10	0	0
10	Fermented cold and hot dye bath with ash result in different colours on cotton fabrics	0	4	11	1
11	Fresh cold and hot dye bath with ash developed no colour on synthetic fabrics	0	0	5	11
12	Fermented cold and hot dye bath with ash developed colours on synthetic fabrics	1	15	0	0
13	Fresh cold and hot dye bath with caustic soda on cotton gave no colour	0	0	0	16
14	Fresh cold and hot dye bath with caustic soda on synthetic fabrics developed colours	16	0	0	0
15	Fermented cold and hot dye bath with caustic soda on cotton fabrics gave colours	2	9	5	0
16	Synthetic fabrics dyed in fermented cold and hot dye bath with caustic soda had no colour effect	0	0	14	2
17	Fresh extract of cold dye bath with all the mordants have poor dyeing effects on cotton fabrics	0	0	0	16
18	Fresh extract of cold dye bath with all the mordants have good dyeing effects on synthetic fabrics	0	0	10	6
19	Fermented extract of cold dye bath with all the mordants have good dyeing effects on cotton fabrics	2	14	0	0
20	Fermented extract of hot dye bath with all the mordants gave the best dyeing effects on synthetic fabrics	9	6	1	0