# PRODUCTION OF DYES FROM KOLA NUT


BY

SALAMI SIMPA EZEKIEL

2003/15089EH

DEPARTMENT OF CHEMICAL

ENGINEERING SCHOOL OF ENGINEERING

AND ENGINEERING TECHNOLOGY

FEDERAL UNIVERSITY OF TECHNOLOGY,

MINNA

NIGER STATE, NIGERIA


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A project submitted to the chemical engineering, F.U.T minna, in partial fulfillment of the requirement for the award of bachelor of engineering (B.Eng) degree in chemical engineering


Department of chemical engineering school of engineering and engineering technology

FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA

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# DECLARATION

I, salami simpa Ezekiel, (2003/15089EH) here by declare that this research project titled "production of dye from kola nut" is May original work and was presented under the supervisor of eng'r M.U Garba. To the best of my knowledge, it has not been presented elsewhere

Salami Simpa Ezekiel

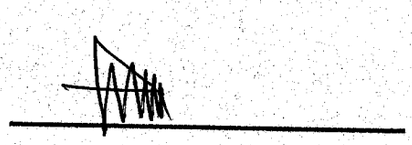
**Salami Simpa Ezekiel**

07. 11. 2008

**Date**

# CERTIFICATION

This research project "production of dye from kola nut" by Salami simpa Ezekiel (2003/15089EH) has been examined and certified under the supervision of egn'r .M.U. Garba to be adequate in scope and quality for the partial fulfillment of the requirement for the award of Bachelor of engineering (B.eng) degree in the department of chemical engineering, federal university of technology, mina Niger state.



01/11/2018

**Engr. M.U. Garba**

**(Project supervisor)**

**Date**

**Dr. M.O. Edoga**

**(Head of Department)**

**Date**

**External supervisor**

**Date**

# DEDICATION

I dedicate this research project to the Almighty God for guiding and protecting me, for all his goodness and faithfulness. I also dedicate it to my mummy, Mrs. Grace Salami for her prayers, struggle to see me through out my education.

# ACKNOWLEDGEMENT

My gratitude to the Almighty God for being my strength, and keeper throughout all these years. A profound gratitude to my parents Mr. and Mrs. A.O Salami and my ~~by~~ brothers and sisters (Peter, Paul, Abraham, Emmanuel and Dorcas) the entire Salami family for all their support financially, spiritually, love, encouragement and believing in me till this stage of my life.

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My deepest appreciation goes to Abraham Serah my fiancée for being there for me spiritually, love and caring may God bless you. To my friends; Ekeocha Chukwuemeka Donaldson (P.K). Umoh S. Kingsley (Da Crook), Emmanuel Momoh (momoney) Eneche John (Oya kanaba) Emeka Ugwumba (Biano) and others, to my able friend room mate, Abdullahi Jabar (Ustaz Ustaz), mallam mallam (Omadivi) for their care, help, love, concern and encouragement. I appreciate you all, u are a friend in deed.

Also to all my lecturers for all their good work. God bless you all. Finally to all the Chelsea Football club fan (the blues). I love you all. May God bless you all.

# ABSTRACT

The project research eyes all about production of dyes from kola nut using alcohol (ethanol) as the extraction solvent. The kola nut was washed, pounded using a mortal and a pestle. The sample was weighed and then extracted with ethanol over a hot plate of a known temperature for a period of about 30 minutes, until the colour pigment was completely extracted from the kola nut sample. The percentage extraction of dyes stuff from the kola nut was determined to be 45.18 as well as the moisture content of the kola nut sample. The moisture graph shows that the moisture content decrease with increase in drying time as heat was applied till the sample was completely dry. Also the dyestuff was tested to be acidity with a pH meter 6.94, the colour obtained from the kola dye was deep orange and when applied on a Fabric it gives a brighter colour (cola pink) and is one of the shades of colour extracted from kola nut. Finally test for dyeing, light, washing was conducted on the fabric dyed.

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# CHAPTER ONE

## 1.0 INTRODUCTION

## 1.1 GENERAL INTRODUCTION

Dye is any organic chemical which is able to impact colour evenly and on a fairy permanent basis to the material unto which it is applied or administered by selectively retaining some of the wavelength of the light falling upon the surface without causing unbearable damages.

Dyestuffs are compounds applied to textile substances of substrates to produce a visual stimulate on interpreted as colour by the viewer. The history of the dye industry has been linked with the development of synthetic organic chemistry (Tedder 1972).

While natural dyes are dyes stuff made from plant, mineral matter or vegetable and in some few cases like the case of cochineal an insect. They are also colour=extracted plants and are fixed by means of minerals or metal salts such as alum (aluminum salt or iron or tin called mordant). Most of the existing natural dyes are medicinal and have a long and rich history: all the beauty and finery of ages past were dyed naturally because before 1856 all colours were naturally dyed. Natural dyes are the most ecologically sound for the planet, this is due to the fact that they are very safe and naturally do not cause any harm or pollution to the environment and are cheap (Ethiel M. Mairet).

In the 20$^{th}$ century the importance of colour in our lives seen to be realized less and less. It had been forgotten that strong and beautify colour such used to abound in all everyday things is an essential to the full Joy of life. A sort of fear or nervousness' of bright colour is

one of the features of our age: it is especially evident in the things we wear. (Biodun Noah, 1994).

Some setbacks over the years about the natural dyes has lead to the shifting of emphasis from natural dyes to synthetic dyes, they are as follows:

1. Poor fastness to light and washing
2. Inability of the dye to be obtained in powder form
3. Dependent n natural fermentation and atmospheric condition for vat solution.

## 1.2 OBJECTIVE OF STUDY

1. To create awareness of the availability of raw material for dyeing purpose in Nigeria.
2. It can be process to one test and at a cheaper rate.
3. To give room for improvement on the usual local method.
4. Eliminate the problem of uneven oxidation and the amount of extraction product available in a given quantity of the sample.
5. It also enables the determination of the pH of the dye.

## 1.3 SCOPE OF STUDY/LIMITATION

The project work is limited to the extraction and concentration of natural dye from kola nut (Kolanitida are Kola cuminata) using alcohol (ethanol) as the extraction solvent.

# CHAPTER TWO

## 2.0 LITERATURE REVIEW

### 2.1 KOLA NUT HISTORY AND OCCURRENCE

History of kola nut can be traced via economic crop that is indigenous to the rain forest of west African Kola accuminata, is a minor crop industry rain forest and derived from savannas of the eastern part of West Africa. The remaining edible com pieces rarely cultivated, but are retained when vegetation is cleared for forming purposes (5).

Kola nitida is native to Sierra Leone and introduced to Nigeria. Kola Accumulata is native from Togo east wards and southwards, introduced the flowers are unisexual and lack petals, but the calyx is often showy. The fruits are all composed of several carpels that open along the top and contain bulky seeds. The nuts of some varieties are more viscid than those of the Kola nitida.

In Nigeria, kola nut occupies a central position in the culture and tradition of Igbos. It represents a symbol of peace and no ceremony is cultivated for its seeds. After the removal of the fleshy seed coat from the seed, the embryos are left, commonly called kola nuts' the nut is consumed for its stimulating effect, as it dispels sleep, thirst, and hunger. The principal stimulated alkaloid component id caffeine. The use of kola nut is however closely interwoven with local customs its pharmacological action and uses derived from its content of the alkaloidal derivatives of purmise especially Caffeine (10).

When all leaves are lost the tree usually dies back. This behavior restricts the Kola to the rain forest areas or areas where what is continuously available.

Pollination of Kola nitida by Kola accuminata or vice versa leads to seed set, but the resulting plants are invariably sterile. This abnormal meiotic pairing of chromosomes has been observed and it is a possible explanation of the high frequency of infertile Kola trees in the southern part of Nigeria where the two species meet.

Within Kola nitida nut colour varies from a creamy white through pink to very dark purple. There is strong social preference for white Kola nuts. The nuts have a bitter taste but the after-taste is not unpleasant. To chew a kola nut before drinking bad-tasting what helps to render the water comparatively sweet. The nut containing 50% nutritive matter. The Kernel contains about 1.6% tannin.

### 2.1.1 KOLA NUT PLANT

The Kola tree is a dome-shaped evergreen tree, usually 35 to 50feet in height. Trees are usually planted from seeds, about 20 to 27 feet apart, although vegetative production can be accomplished. Growth of this tropical tree is in flushes. Flowering begins at 6 to 10 years, the fruits mature about 41months after flowerings fill fruit production is reached by the twentieth year, and the tree may continue bearing until it is 70 to 100 years old. The main harvest period of nuts extends from October to December, but some nuts may be available throughout the year. The pod is harvested before the nuts are ripe. The follicle is split and the tree to six nuts are removed, fermented in heaps for 5 days, washed clean, and stored. They can be kept for several months average yield is 210 to 250 saleable nuts per tree or 12,000 nuts (about 500 pounds) per acre.

### 2.1.2 CHEMICAL CONSTITUENTS AND COMPOSITION OF KOLA NUT

Kola seeds contain caffeine (1-2.5%) and a little of the bromine, less than 1%. The alkaloids appear to be partly in the Free State and partly combined, Kola seeds contains 5-10% of tannins, particularly catechol and epicatehol. In the fresh nuts the purine derivatives are bound to the tannin. During drying this tannin complex is split yielding free caffeine and the bromine. Another principle obtainable from fresh nuts only and formerly known as "Kola Red" has been isolated under the name of Kolatine. Kolanin is an oxidation product found only in dry nuts. The exact composition of fresh nuts is less certain, but the active principle content is stated in term of caffeine, and the amount of Kolatine is presumed to be proportional to it. However, the composition is widely known in select circles, but little published. Some early data published in 1884 by Heckel give the analysis as follows:

| chloroform soluble | % |
|---|---|
| Caffeine | 2.35 |
| Theobromin | 0.03 |
| tannin | 0.03 |
| Fata | 0.59 |
| Total | 2.99 |
| alchohol soluble | % |
| Tannins | 1.59 |
| Kola red (Kobtine) | 1.29 |
| glucose | 2.88 |
| Others | 0.07 |
| Others | % |
| Starch | 33.75 |
| Colours | 2356 |
| Proteids | 6376 |
| Ash | 3.33 |
| Cellulose | 29.83 |
| Water | 14.99 |
| Total | 91.38 |

### 2.1.3 USES OF KOLA NUT

Kola nuts are used medicinally to enable a patient to do without food and so rest the digestive organs. They are used as a colouring (red)matter and flavoring extract in wines,

cream e.t.c. where Kola trees are indigenous the natives chew the seeds to enable them to do heavy work over a long period of time.

The bark of Kola tree, mixed with that of Khaya is said to make a brown dye (moor), and is also used medically in equatorial Arica, bark chip are eaten for colic, and an infusion of them drunk to get rid of bite, while a pinch of them with a little salt and seeds of xylopia aethiopia, is used for coughs (Abbe walker). An infusion of the pulped bark is used in Burkina faso as a beverage. The seeds of Kola nitida are in Garbon as aphrodisiac. The powdered nuts help to stop diarrhea.

### 2.1.4 EFFECT OF KOLA NUT.

Kola nut is a strong stimulant like coffee, kola nut works stimulating and non-soponfic (it keeps you awake). The psychoactive effect however is stronger and different. The power of endurance, increase, while it dispels hunger. It also increase concentration, clears the brain, work as alight aphrodisiac and it can raise a "light" it boosts your normal capabilities as for instance work, spots and sex. Because kola nut with draws energy from the body in many ways. Its also used as a waste to lose weight. The properties of Kola are the same as caffeine, modified only by the astringent present.

Kola nut was the main ingredient in coca kola after cocaine became illegal. If as is still cocal kola it's a secret for sure it's in Pepsi, kola nut are chewed or can be used in making natural dyes, for marriage ceremonies, also for some traditional rites, as a stimulant used to improve moods. It devalues body temperature, increases blood pressure and respiratory rate thereby medicinal. The dyes extractions of their nut are also used for energy drinks.

## 2.2 DEFINITION OF DYE

Dye are intensely coloured chemical compounds, which when applied to a substrate impart colour to such substrate or can be defined as compounds which are applied to textile substrate to produce a visual stimulation interpreted as colour by the viewer. A dye differs from a pigment in that it is absorbed by the material to be coloured while a pigment is applied with a binding material to the surface, a dye is water soluble and pigment are water insoluble.

### 2.2.1 DYE MAKING (HISTORY)

Man discovered ways of extracting dye from natural stuff for application to his own articles, the colouring matters of nature have always attracted mans interest and in very early times lead to his discovery of naturally dyes. He uses extract from rooms, leaves flowers, bark, insect (in very few cases) e.t.c. for the coloration of textile materials, these colouring matter were not obtained in their direct useable coloured form, frequently the colouring matter had to be released from their glycosides either by extraction or fermentation. Mineral pigment have been used in various form of art for thousands of years and since most natural dyes have no direct affinity for textile, material, they were applied by means of a metal salt mordant the extraction of natural dyes became a substantial industry which flourished until the later part of the $19^{th}$ century when it was superseded by the new synthetic thereby industry.

### 2.2.2 CLASSIFICATION OF DYE

Dyestuffs can be classified basically as natural and synthetic dyes.

### 2.2.3 NATURAL

They are dyestuffs extracted from naturally occurring substance like animal or vegetative matter. These can be classified into substantive, vat and mordant dyes.

### 2.2.4 SUBSTANTIVE DYES:

These are dyestuffs which are soluble in water and direct in dyeing sample of these are curcumin, rucou (anotta), safflower (cathanus tintorious).

### 2.2.5 VAT DYES:

These are soluble in alkaline medium and are transformed into leuco compounds which fix unto the fibre by oxidation in the air without the use of the mordant. Dye fabrics resulting from the use of vat dyes are exceedingly fast to light and washing. Examples are Indigo dye Gambier (Uncovia Gambin).

### 2.2.6 MORDANT DYE

They form the majority of natural dyes and require some auxiliary chemicals to precipitate them onto the fabric. Some dyes combine with metallic salt to form highly insoluble coloured material called lakes. The amts are usually used s pigments if a cloth made of cotton wool or other protein fiber is impregnated wit an aluminum, chromium or iron salt, and then contacted with a lake forming dye the metallic precipitated form in the fiber and the colours become far more resistant to light and washing.

### 2.2.7 SYNTHETIC DYE

They are dyestuffs obtained from the chemical combination of the primary compound of a dye. The society of dyers and colorist classify dyes by using one ingenious system called the colour index (CI). The colour index classifies dyes according to a dual system.

1. An arranged number define the chemical chains and
2. A generic name identifies the usage of application.

### 2.2.8 CLASSIFICATION ACCORDING TO CHEMICAL COMPOSITION AND STRUCTURE

Dyes which fall under these classes are:

1. Axodyes
2. Nitroso dyes
3. Nitro dyes
4. Stil bene dyes
5. Hydrazone dyes
6. Diphenl methane dyes
7. Triphenymethane dyes
8. Xanthen dyes
9. Acridrine dye
10. Anthracene dye
11. Indigo dye
12. Aui-inide dye
13. Thiasol dye
14. Sulphur dye
15. Leactive dye

## 2.9 CLASSIFICATION ACCORDING TO METHOD OF USES

Dyestuffs that fall under this category are

1. Direct dyes
2. Acid dyes
3. Mordant dyes
4. Vat dyes
5. Sulphur dyes
6. Basic dyes
7. Soluble vat dyes
8. Pispersed dyes
9. Azoic dyes
10. Odixdation dyes
11. Prematallized dye
12. Mineral and pigment colour

## 2.3.0 PROPERTIES OF DYE

The properties of dye can be based on

i. application properties

ii. end-use properties

### 2.3.1 APPLICATION PROPERTIES

These include solubility, diffusivity and affinity

### 2.3.2 SOLUBILITY:

Dye must be readily soluble in water as water is almost always the application medium of capable of being made soluble in the medium in which there are applied. The presence of auxochrome in dye increases the solubility of dyestuffs. Two types of substituent groups that confer solubility group in dyes (include sodium sulfonate group) and temporary solubilizing groups (includes sodium phenate and sodium thio-phenate).

### 2.3.3 DIFFUSIVITY

Dye must be able to diffuse into fibre substrate under the condition of dyeing. Diffusion of the dye into the centre of fibre substrate depends on relative size of the dye molecule and the preopening of the substrate. The forces which anchor dyestuffs molecules to fibres have been identified as:

I. Migration of dyestuff from a solution to the substrate interface followed by adsorption on the surface of the fibre.

II. Diffusion of the dye from the surface to the centre of the fibre where it locates around and between the substrate molecules.

III. The attaching of the dye molecules to the fibre molecules by physical force hydrogen bond or actual covalent bonding with the fibre molecules.

### 2.3.4 AFFINITY

This is used in describing the various types of attraction between fibre substrate and dyestuffs. Affinity can be aided by increased temperature which tends to break dye miceler into small units and thus, enables the dye to attach itself to the fibre substrate. It can be caused by the formation of solid solution of dye in the material or by attraction between changed dye particles and oppositely charged dye site on the fibre.

### 2.3.5 END USE PROPERTIES

This include colour and is determined by the energy difference between the molecular orbitals. Molar absorptivity is the quantitative measurement of the colour strength of a dye. Dyes must be highly coloured and yield coloured products with fastness to light and washing. (8)

### 2.4.0 THEORY OF DYEING WITH KOLA NUT

Fabric like cotton absorbs dyestuffs in relation to the surface area created in the fabric yams or thread, the woven fabric contains some natural impurities such as waxes, oils and esters, there impurities prevent cotton fabric from maximum absorption of dyestuff, hence it is necessary to treat the fabrics with strong alkali such as sodium hydroxide (NaOH) for potassium hydroxide (KOH) to remove these enters before printing.

After these impurities are removed, the fabric is further treated with bleaching agent to ensure that it is completely white and free n any natural colouring matter, then it is introduced into dyestuff solution and the absorption compare with the concentration of alkali present in the fabric. The colouring matter is removed by bleaching agents such as chlorine or hydrogen peroxide ($H_2O_2$). The use of chlorine as a bleaching agent in cotton

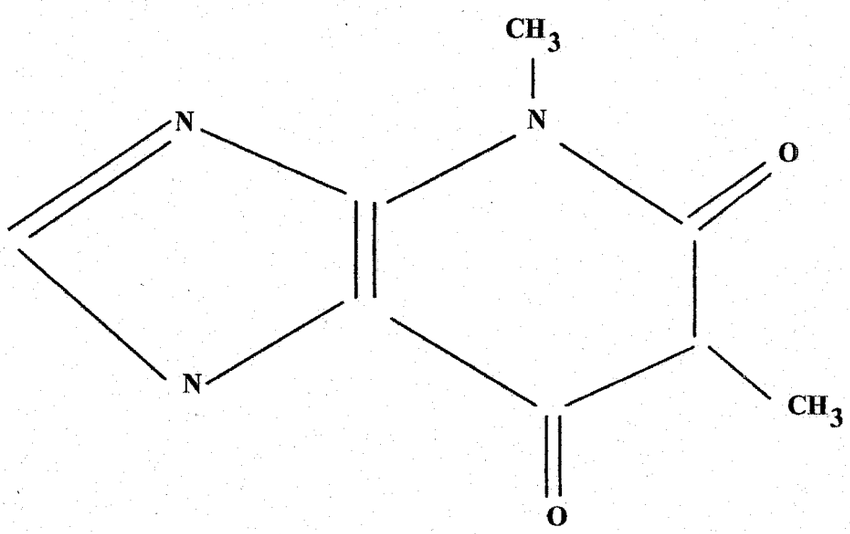
fabric processing is always not welcome because of the ability of chlorine to undergo oxidation reduction w atmospheric condition. [Margaret and brain vickery, (1979) plant products of tropical Africa. Macnukani tropical agricultural, horticulture and applied series pg 521-523].

### 2.4.1 EXTRACTION OF KOLA NUT

Kola nut is a natural dye and require no mordant. The dye is extracted from the nut of kola by crushing of pounding the nut in a wooden mortar. The crushed material/sample is then treat with ethanol in a round bottom flask and heated over a corning hot plate at a temperature below $12^0$C of the weight of dried powdered Kola nut.

### 2.4.2 PROPERTIES OF KOLA NUT

Kola nut is orange colour when pound. One of the plant dyes. Kola nut contain affect and has a molecular structure as shown below;




**Caffeine molecular structure.**

Caffeine which is an alkaloid of the methylxan time family, which also includes the similar compound the phyllime and theobromine which are also present in kola nut. Its chemical

formula is $C_8H_{10}N_4O_2$ its systematic name is 1,3,7-trimethly-1H-purine-2,6-dione, and its structure is shown above phenolic compounds and total phenol are found in kola nut. This was analyzed by paper chromatography, using five solvent systems: N-butylacohol, acetic acid, water in the proportion of (4:1:5) yield the highest number of phenolic compounds: catechon, guinic acid, tanic acid and chlorogenic acid were determined to be the major components of the kola nut. There were marked differences in the amount of total phenol; in each species and colour characteristic related difference within species. Percent total phenol in Kola nitida was higher than in Kola accuminata. The total phenol varies across different species of kola nut being higher in red kola nut than the white and pink varieties.

Other compositions of kola nuts are: Ash, protein, carbohydrates and fats [7]

### 2.4.3 FASTNESS TEST FOR DYES

Fastness refers to colour retention ability. Fastness is the ability of the dyed material to retain its colour in the presence of light, heat, acid washing and other external chemical. The natural dyes have to be tested for fastness in order to evaluate their qualitative properties.

One of the most important things one will want to consider in using this experimental plant is whether or not they yield a dye that is fast to either light or washing.

### 2.4.4 FASTNESS TO WASHING

This is the ability of the dyed material to retain its colour after subsequent washing. Some natural dyes undergo marked colour changes in time on washing, shown to be attributable to even small amount of alkali in washing mixture. Highlighting the necessity of knowing

the pH of alkali solution used for cleaning of textiles dyed with natural dyes, clearly the small increase in cleaning efficiency, attributable to the alkali must be balanced against possible colour changer industry dye apart from the possible damage to old protein fibres under alkali contributions.

Commercial washing powders are generally in appropriate for cleaning naturally dyed textiles.

### 2.4.5 FASTNESS TO LIGHT

This is the ability of the dyed material to retain its colour in the present of ultra-violet light. In the dyeing of cotton, fastness to light is achieved by utilizing feature of chromospheres. Hydrogen bonding holds soluble dyes or aggregate of soluble dye molecules onto the fiber, alternatively, formation of an insoluble dye in the fibre and aggregation of the particles is used in some cases of dyes.

Test of light fastness is carried out by putting a small piece of the naturally dyed on yarn or fabric on a sunny window and after about a week, compare it to the rest of the material, which has been kept away from light completely. [4]

# CHAPTER THREE

## 3.0 METHODOLOGY

## 3.1 EQUIPMENTS AND INSTRUMENTATION

| reagents | manufacture |
|---|---|
| ethanol | BDH chemical ltd England. |
| water | chemical engineering lab FUT minna |
| | |
| equipment and apparatus | manufacture |
| digital weighing balance | chaus USA co-operation |
| coning hot plate | coning ltg England |
| electric oven | coning ltg England |
| sieve | endocotts ltd England |
| measuring cylinder | SEDIM Nigeria |
| reflux condenser | SEDIM Nigeria |
| round bottom flask | SEDIM |
| mortal and pestle | local manufactures of wooden wares minna, Nigeria |

## 3.2 PREPARATION F THE RAW MATERIAL FOR EXTRACTION

The kola nuts can be obtained and prepared in the following ways:

The seeds are collected and sun-dried. During the sun dry the Kola nuts lose part of their free are acquired moisture to the surroundings. This stage of preparation is purely a manual process and mechanized methods are so far non-extent.

The term size reduction is used to describe the different methods in which particles of solids are cut or broken into smaller pieces. Depending on the size(s) of the particles size reduction can be carried out using any or all of the following equipments: Jaw crusher, ball mill, rod mill, grew null, impact hammer e.t.c.

## 3.3 EXTRACTION

100g of kola nut powdered was leached with 300ml of ethanol and then connect to a reflux condenser with two hoses connected, one to the tap and the other an out let to the drain. Then the sample heated over a hot plate at a temperature of about $100^0$C, to get the percentage yield of extract. The mixture was heated for 30mins and the mixture deepened in colour as heat was being applied indicating that ethanol is the perfect extraction solvent. The mixture was filtered with a filter paper after cooling to separate the residue from the filtrate. The boiling increased till it was 30mins. The residue collected was dried in the electric oven and reweighed after which the empty pan was washed and weighed, and the weight deducted from that of the pan plus the residue and the weight recorded. The recorded weight was then deducted from the initial weight before the experiment and the percentage yield was recorded. The extract was poured into a clean container and stored in the refrigerator.

## 3.4 DYEING

A solution of the dye concentrate and water was prepared in a beaker in the ratio 1:3 in their case 20$cm^3$ of water. The resultant solution in a beaker was placed on a water bath and a piece of white fabric was soaked into it. The beaker was covered and kept at a temperature of $60^0$C for about half an hour which the dyes fabric was removed.

## 3.5 TESTING OF SAMPLE

(i) Test For Light Fastness

This was carried out placing a portion of the dyed fabric in the sun while keeping the other portion shielded from the sun for hours and comparing the shade of the two portions.

(ii) Test For Solubility of Kola Nut In Water And Ethanol.

A known quantity (10g) of kola nut was dissolved in 20ml of water and 20ml of ethanol (in separate beakers and the degree of solubility kola nut in the two beaker were compared.

# CHAPTER FOUR

## 4.0 RESULTS AND DISCUSSION

### 4.1 EXPERIMENTAL ANALYSIS

The results of the experiment analysis of raw material/sample of kola nut are shown below in table 4.1

Tale 4.1

| sample | weight of empty pan | weight of sample before drying | weight of sample after drying | drying time (min) |
|---|---|---|---|---|
| 1 | 46.41 | 20 | 13.40 | 10 |
| 2 | 46.41 | 20 | 11.80 | 20 |
| 3 | 46.41 | 20 | 10.22 | 30 |
| 4 | 46.41 | 20 | 9.90 | 40 |
| 5 | 46.41 | 20 | 9.50 | 50 |

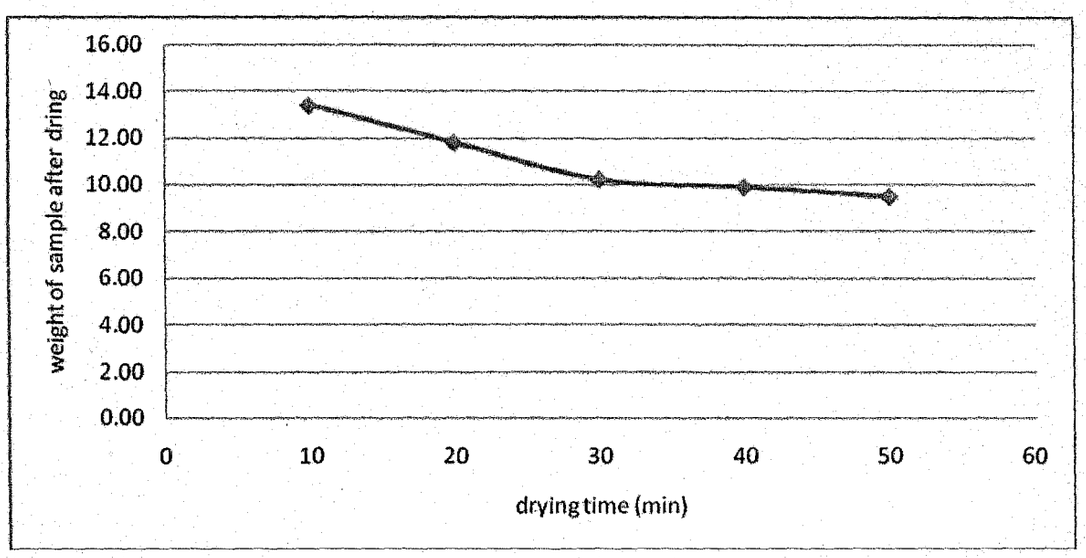
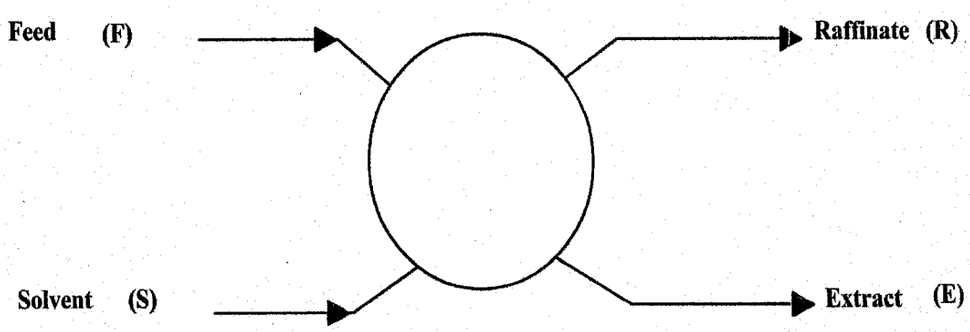



**Fig 4.2 graph of moisture content vs drying time (min)**

Table 4.2 quantity of dye extracted

| weight of components | kola nut (g) |
|---|---|
| feed | 100 |
| solvent | 300 |
| raffinate | 54.82 |
| extract | 20.07 |

CALCULATION




Taking material balance and neglecting the mass of extract, the Raffinate is able to retain.

$F + S = E + R$

$E - S = F - R$

Dissolved solute in extract: F – Are = 100 – 54.82 = 45.18

Yield of dye per gramm of kola nut /feed can be calculated as %yield =

$$\frac{\text{Mass of dissolved solute}}{\text{Mass of dry feed}} \times 100$$

$$\%\text{yield} = \frac{45.18}{100} \times 100$$

%yield = 45.18%

## 4.3 DISCUSSION OF RESULTS

### 4.3.1 EXTRACTION

When 5 drops of the dye concentrates of the kola nut were put into 10ml of water the concentrate gave a deep pink solution.

Dyeing with the dye concentrate from the kola nut gave a better shade colour on the fabric. Which gave a cola pink colour.

The fastness of the dyed fabric to light was partially good as the colour were noticed on the portion exposed to sunlight and the unexposed to be cola pink.

Fastness of the dyed fabric to wash/laundry was as well partially good. But this could be improved by an after treatment of the dyed substrate with alum or lime powder.

The extent to which kola nut was soluble in ethanol was more as compared to its solubility in water because ethanol deepened in colour as it was applied.

The reflux condenser used for this experiment is used to extract solutes from solids, using volatile solvent extractor which can be water-miscible or water-immiscible.

While preparing the kola nut for leaching, it gave a strong odour and bitter taste. This characteristic makes it to be used intensively as a strong stimulant like coffee and beverages.

The extractable matter from kola nut at the end of the extraction was 45.18% leaving 54.82% residue.

pH of the dyestuff was found to 6.94 indicating that the dyestuff from kola nut is found to be acidic.

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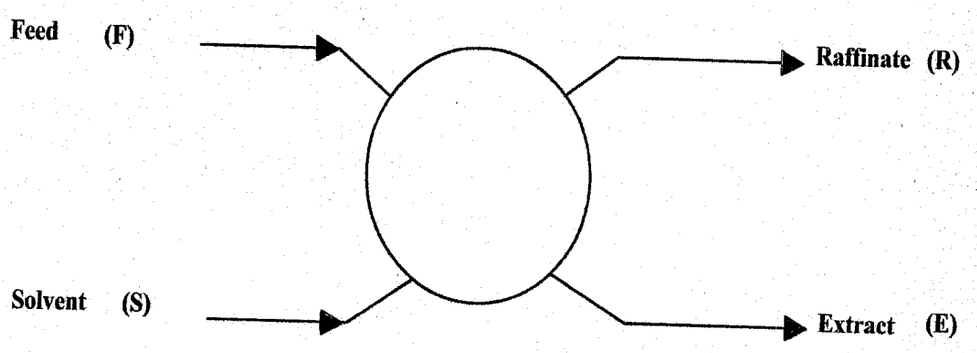
# APPENDIX

## CALCULATION




Taking material balance and neglecting the mass of extract, the Raffinate is able to retain.

$F + S = E + R$

$E - S = F - R$

Dissolved solute in extract: F – Are = 100 – 54.82 = 45.18

Yield of dye per gramm of kola nut /feed can be calculated as %yield =

$$\frac{\text{Mass of dissolved solute}}{\text{Mass of dry feed}} \times 100$$

$$\%\text{yield} = \frac{45.18}{100} \times 100$$

%yield = 45.18%