DEODORIZATION AND DECOLOURIZATION OF GROUND NUT OIL USING ACTIVATED CHARCOAL

BY

BABALOLA MAYOWA AYODEJI

2003/14786EA

DEPARTMENT OF AGRICULTURAL AND BIORESOURCES ENGINEERING, SCHOOL OF ENGINEERING AND ENGINEERING TECHNOLOGY

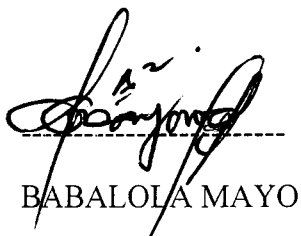
FEDRAL UNIVERSITY OF TECHNOLOGY,

MINNA, NIGER STATE.

NOVEMBER, 2008

DECLARATION

I hereby declare that this project is a record of a research work that was undertaken and written by me. It has not been presented before for any degree, diploma or certificate at any University or institution. Information derived from personal communication, published and unpublished works of others were duly referenced in the text.



24-11-2008.

BABALOLA MAYOWA AYODEJI — DATE

2003/14786EA

CERTIFICATION

This project entitled "Deodorization and decolourization of ground nut oil using activated charcoal"by Babalola Mayowa Ayodeji meets the regulations governing the award of Bachelor of engineering (B. ENG) of The Federal University of Technology, Minna, and it is approved for its contribution to scientific knowledge and literary presentation.

Prof.E.S. A Ajisegiri — DATE

Supervisor

Engr .Dr. Mrs. Z. D. Osunde — 25/11/2008 — DATE

Head of Department of Agricultural and Bio Resources Engineering.

External Examiner — 19-11-08 — DATE

DEDICATION

This project work is dedicated to my God Jehovah Almighty for his protection, guidance and divine provision. Also to my "late grand mother MADAM R.A. OLAORE". May her gentle soul rest in perfect peace. And also to my ever charming loving mum MRS. O.T BABALOLA for her great effort towards the successful completion of my course. Lastly, to my dear loving one and only sister "*Babalola Odunayo Ayobami*".

ACKNOLEDGEMENTS

My sincere appreciation to my father in heaven al-mighty God which is name is Jehovah for seen me through and having provided for all my needs to make my course of study a great success.

My gratitude also goes to my project supervisor, Professor E .A. Ajisegiri for his concern and for his full support in every area to make my work to be a successful one.

Also my gratitude goes to my great ever-charming loving mum (the best mother in the world)Mrs. Olufunke T. Babalola Ibrahim for her financial and motherly support and also for her prayer to make sure I graduate out of university and to become a great person on the surface of the earths. (Mum, I will love you for the rest of my life.) This acknowledgement will not be completed without recognizing the effort of my school daddy chief G.F Ibikunle of WAFT department and also Mr. Bulus for the assistance throughout the experiment period in the laboratory.

Also, kudos to my dearest loving sisters Babalola Odunayo Ayobami and Orisagunna Ronke Odunola. Also to my great friends Musa Abdulwasiu Abiola, Joseph Elijah, Irewole I. Sunday,Ogunyoyin Ebenezer, Omoniyi Babawale, Ajani Olugbenga, Yusuf Humar, Sheu Hamid Dauda, Muhamed Femi Abdulfatai, Mustapa O. Ismail, and the rest of my friends that their named are not mentioned.I Can not in any way forget the tireless effort of my lecturers especialy, my course adviser Engr. Peter Adeoye, Engr. Solomon Dauda, Engr. Dr. Chukwu, Prof. M.G Yisa, Engr. Dr. Mrs.Zenach Osunde, Engr.Dr. Alabadan, Engr. Dr. Balami, Engr.Dr. Donald Adgizi, Engr. Adebayo Segun, Mrs Bosede Erevba, Engr. John Jiya, Mrs. Mustapha, Engr. Olorunsogo, Dr. Egarehvba. Engr. Sadeeq. I thank you all for the knowledge impacted on me.

My sincere thanks goes to Dr Egwin Evans of Bio-chemistry department for his moral supports.

To cap this acknowledgement up, I'm using this medium to appreciate my sweet heart (my one and only). Amoo Taiwo Oyebanke for her love and her prayer and for always been there for me I love you.

ABSTRACT

Animal bones were carbonized and chemically activated using orthophosphoric acid according to standard procedures. The activated charcoal was employed in the purification of groundnut oil . Physicsicochemical properties fatty acid profiles is monitored hourly melting point, odour and colour was determined for crude and purified samples. The result showed that unsaponfiable and saponficable value increased from 5.20 to 7.20%. Unsaponifiable matter increased from 6.30 to 11.30%). The data showed that adsorption tends to equilibrum witin 3-4 hrs.melting point reduced from 29 to 24.5C. Odor and colour improved after 4 hrs.

TABLE OF CONTENT.

CHAPTER THREE

CHAPTER ONE

INTRODUCTION

1.1 Background of Study

The invention relates generally to the use of a particular amount of local adsorbent as a stripping medium in deodorizing edible oils. Deodorization is usually the final processing step in the production of edible oil and fat products. Commonly, edible oils or fats are subject to chemical refining involving degumming, neutralizing, dewaxing, washing and filtrating steps or physical refining involving degumming, decoloring and filtering steps, prior to deodorization. The type of refining involved, i.e. chemical or physical refining, could dictate the operating conditions of deodorization. Severe deodorization operating conditions, for example, may be necessary to obtain edible oil and fat products having the desired characteristics when physical refining, as opposed to chemical refining, is employed prior to deodorization. The physical refining is likely to produce edible oils or fats having a greater amount of impurities than those produced by chemical refining due to the limited refining steps involved. Deodorization basically involves stripping edible oils and/or fats to remove, among other things, substances that impart disagreeable odor and taste. The substances removed usually include free fatty acids; various disagreeable odor and taste causing compounds, such as aldehydes, ketones, alcohols and hydrocarbons; and various compounds formed by the heat decomposition of peroxides and pigments. These substances should be sufficiently removed to impart the desired property to the edible oil and/or fat. The fatty acids in the edible oils and/or fats, for example, should be substantially reduced, to about 0.1 to 0.2% to obtain the edible oil and/or fat having the desired properties.

Groundnut oil and fat resources are indispensable to mankind as a source of nutrient and industrial raw materials. Crude groundnut oil obtained from various oil milling units is further refined before use for edible purposes. Refined edible oil is a process where free fatty acids are volatized, condensed and recovered simultaneously with vacuum de-colouring operation. Sometimes, refining process is limited to simple physical treatment such as heating and filtering in regard to refining of superior quality of crude oil. Generally the cake in the oil is separated by centrifuge, decolouring by activated charcoal deodorization at high temperature in vacuum up to 5 mm. Hg. This is not a location specific project and can be set up at a place where crude oil is easily available.

1.2 Objective of the Study

The main aim of this study is to produce oil and fat which has no smell and free from impurities. Domestically, the use of groundnut oil essentially limited to frying and cooking because of the in.purities contained in it.

The objective of this study therefore is to improve groundnut oil properties and quality in order for it to have wider range of uses for both domestic and industrial sector, such as, for the manufacture of blend or flavored margarine, for the use in mayonnaise, and salad oil, for the use as substitutes for other tingly cerid.

These is to be achieved through assessing the potential of some local adsorbent to refine, decolourise and de-ordourise locally produced groundnut oil through adsorption bleaching.

1.3 Justification

This study work is to try as much as possible to produced de-odourised groundnut which the odour has been complepely removed, making it have good smell and the colour to be that is

attractive to the use of groundnut oil. The impact to be made if the de-odourisation has been carried out successfully includes making it useful in the production of other edible oil products.

1.4 Statement of Problem

Undeodourised groundnut oil contain dis-agreeable and taste, which restricted many people through out the country for the use of groundnut oil for their cooking's. At the end of this study the use of groundnut oil will increase immensely and make it useful for other purposes.

1.5 Scope of the Study

This work study is limited to the deodorization and decolourisation of groundnut oil with the use of activated charcoal. This is carried out in the laboratory. After the groundnut oil has been extracted from the groundnut paste.

CHAPTER TWO

LITERATURE REVIEW

2.1 General Oil

Oil and fat is substance plant or animal organ; they are non-volatile, insoluble in water, and greasy to touch. Fats and oils are certain member of group of compound called fatty acid.

One fat or oil can differ from another in several ways, but the most fundamental is in fatty acid composition oils and fat are obtained from even those from nominally the same king of sources, and it is to be noted that even those from nominally the same kind of source can vary considerably. In the case of the animal fats, this can relate to the part of the animal from which the part came, the food which the beast ate and the particular breading animal e.g. sheep or cattle similarly vegetable oils vary with factor such as plant variety and climate. A striking example is groundnut oil, which obtains from groundnut; this is an example of plant fats. The term oil in used in genetic sense to describe all substances greasing or oily fluid at ordinary temperature (room temperature). Fat and oils are ester of fatty acids and glycerol; the distinction between fats and oil is purely an arbitrary one base on their physical state at ordinary temperature. The oil being liquid at ordinary temperature such as 25c the fat is solid at the same temperature. Fates and oils, However fixed oils form the main raw materials heated, and are easily saponified by Alkali Fixed oils and fats, which include both animal and vegetable fat and oils, are further classified according to their physical proportion as follow. (a) Groundnut oil (b) Hard fats (c) Soft oils in this project the attention will be made new.

(d) Groundnut oil, those oils are characterized by a large proportion win and fatly acid with low molecular weight.(Inter science publisher New York-London 1986)

2.1.1 Occurrence of the Oil.

(Groundnut oil) the groundnut oil occurs in groundnut, of seed provided by groundnut plant, the seed it self barked within fiber and the outer most layer, this oil has some vessel balance to the characteristic in the shear though it is usually brown and has unpleasant odour.

2.1.2 Physical and Chemical Properties.

Fats and oils may be divided into animals and vegetable fats according to source. Further they may be classified according to their degree and unsaturation determines to a large extent the ultimate use of fat or oils.

Oils having iodine value higher than 150(and therefore a high degree of illustration) are generally called DRYING OILS and are used primarily in protective coatings. Those having iodine value of 100-150 are considered a semi-drying are be used either for food or in protective coating. The non drying oils with the lowest amount and unsaturation have iodine value generally bellow 100 and used mainly in foods, soaps and chemical industries example of the non- drying and oils is full groundnut oil which attention will be made on this project. (The new Encyclopedia britannical macropeadia vol 13)

2.1.3 General Properties of Fat and Oil.

The properties of the oil are generally the properties of the component glycerides. These is turn are greatly influence by the fatty acid courponents. The properties to be considered are;The solubility melting, solidification, oxidation polymerization and hydrolysis.

2.1.4 **Solubility**

Fat have lower density than water and are almost completely insoluble in it through small quantity of fats can dissolve in water. About 0.1% water dissolve in fat at room temperature and the solubility increases with temperature and pressure of free fatty acids solubility of fats in aqeous colvent is influenced by the chain length of the fatty acid and the degree of unsaturation saturated chain length of decreases solubility which it is increase by member of unsaturation. These factors can be taken in separations of glycerides by fractionation at different temperatures.

As a solution of a fat in acetone is cooled the saturated trigly cerides crystallize out and the solution becomes of glycerides of fats. However, the process is completed as the none soluble glycerides of diethyl either petroleum spirit, carbon tetrachloride and chloroform will readily dissolve fat in its very slowly in solid form.

2.1.5 Melting and Solidification.

The method of solidification of fat effect their melting characteristic the greater the temperature shock during cooling the lower the melting point becomes therefore it is important to specify the solidification method when considering melting of fats. Slow cooling can lead to fractional crystallization producing large crystals of fats. Higher melting point glycerides leaving the lower melting ones in solution rapid cooling producing crystallization that hold a plastic solid. This is usually employed in the shawtering solidification of margarine. (H.dupoint durst-experiment organic chemistry and geoge.w. nok)

2.1.6 Oxidation

On exposure of air fats, absorb oxygen at a rate, which depends on the degree of unsaturation. The absorption increases rates of oxidation and the fats soon reaches a state of rancidity. Is also influence by temperature and light gud due in proceeds,peroxides are form break down forming aldehydes and kefone which combine to give the unpleasant snile and taste of remered fats.common metals such as iron and copper, mostling copper increase oxidation and it is advisable and usually added to fats at few parts permillon (ppm)to postpone the development of raneidily for a long time.(Animal bark ASTM standards)

2 1.7 Polymerization

This usually occur in the unsaturated fats and is attached by heat, air, presence and the degree of unsaturature, it is as a result of cross links that ake place between adjacent molecules (Animal Book ASTM Hardamids)

2.1.8 Hydrolysis

as oils contain glycerol and patty acid which made them a class of esters they are susceptible to hydrolysis like all esters the alcohole and acid linkage can be brokenly hydrolysis given the free alcohole and free fatty acid, therefore it is possible to separate the acid from alcohole and reducing the fat form inglycerides to diglyce rides and monoglycor ide glycerol. The hyrolysis mainly if dup to enzymes su c/u as lipase prosent in the digestive juice of animals but are screted in lactaria andmoulds in lactaria and moulds and are present in many plant tissues chemical hydrolysis is carried but by water at high pressure hydrolysis clou with allcali yield glycerol and the altalise salt of the fatty acid.this is otherwise known as saponification, the amount of allcal required to perform the reduct is directly propertual to the equivalent weight of the fatty acid

involved thus the mean molecular weigh of the fatty acid can be determined (Befteth ein &march gennel organic and biochemistry 1988.)

2.1.9 Impurities

This are foreign material that are present in oils duen to accident, careless or unavoidable condition some of them come from the fat bearing tissue e.g plant or animals. they include cell debur cnnetive tissues husks mucillag enous material (genus) and moistune to stands allowance should be given to the serarated fiots other impurities comes from handling and processing the oils (Ref the new enyclopeila Britannica macropeasia vol 13)

2.1.0 Oilseed Crops

Oilseed crops have been the backbone of agricultural economy of Nigeria from time immemorial. Today these crops are cultivated on about 16.5 million hectares, with total production of 10 million tonnes. This area constitutes approximately one-tenth of the total cultivated area in Nigeria. On the oilseed map of the world, Nigeria occupies a prominent position, both in regard to acreage and production. The important oilseed crops grown in this country in order of importance are groundnut, and mustard, sesame, linseed, safflower, castor, sunflower and tiger nut.

2.10.1 Groundnut

2.10.2 Geographical Origin.

Groundnut (Arachis hypogaea L.) is believed to be the native of Brazil to Peru, Argentina and Ghana, from where it was introduced into Jamaica, Cuba and other West Indies islands (Krishiworld, 2008). The plant was introduced by Portuguese into Africa from where it was introduced into North America. It was introduced into India during the first half of the sixteenth

introduced into North America. It was introduced into India during the first half of the sixteenth century from one of the Pacific islands of China, where it was introduced earlier from either central America or South America (Krishiworld, 2008).

2.10.3 Economic Importance.

The oil content of the seed varies from 44 to 50 per cent, depending on the varieties and agronomic conditions. Groundnut oil is edible oil (Kirk-othemer, 1964). It finds extensive use as a cooking medium both as refined oil and Vanaspati Ghee. It is also used in soap making, and manufactoring cosmectics and lubricants, olein stearin and their salts (Krishiworld, 2008). Kernels are also eaten raw, roasted or sweetened. They are rich in protein and vitamins A, B and some members of B_2 group. Their calorific value is 349 per 100 grammes. The H.P.S. types of groundnut kernels are exported to foreign contries. The residual oilcake contains 7 to 8 per cent of N, 1.5 per cent of P_2O_5 and 1.2 per cent of K_2O and is used as a fertilizer. It is an important protein suppliment in cattle and poultry rations (Krishiworld, 2008). It is also consumed as confectionary product. The cake can be used for manufacturing artificial fibre. The haulms (plant stalks) are fed (green, dried or silaged) to livestock. Groundnut shell is used as fuel for manufacturing coarse boards; cork substitutes etc. groundnut is also of value as rotation crop. Being a legume with root nodules, it can synthesis atmospheric nitrogen and therefore improve soil fertility (Ajose E,B, 1988).

2.10.4 Botanical Description.

Groundnut (Archis hypogaea L.) is a member of sub-family, Papilionaceae of the family Leguminosae. Archis hypogaea L. consists of two subspecies each containing two botanical

varieties. Subspecies hypogaea variety hypogaea (The Virginia Group) variety hirsuta Kohlar Subspecies fastigiata Waldron variety fastigiata (the Valencia Group) variety vulgaris (the Spanish Group) Plants of the botanical variety hypogaea are spreading (runner) to upright (erect bunch) in growth habit, have alternate branching, lack inflorescences on the main stem, possess appreciable fresh seed dormancy, flowers are longer and mature later than those of subspecies fasligiata. Variety hirsuta has been used only to a little extent(Krishiworld, 2008).

Plants of this subspecies fasligiata are upright, have sequential branching and inflorescences in the main-stem leaf axils, possess little fresh seed dormancy, and are of shorter duration than those of the subspecies hypogaea. Subspecies fasligiata includes both the Spanish and Valencia types (Krishiworld, 2008).

Groundnut, in general, has a short-statured plant, with the main axis being upright (15 to 40 cm long) but the major part of the plant consists of the primary branches. Secondary and tertiary branches are found in the semi-spreading and spreading (Virginia) types, giving them a prostrate stature. The leaves are alternate, stipulate and quadri-foliate. The flowers are orange yellow, typically papilionaceous, with a long calyx tube within which is held the style borne on a superior ovary. The calyx and corolla lobes are borne in the axils of the leaves on the fruiting branches. They are bisexual, Zygomorphic, complete and sessile. Petals are five, with one large standard, two wings and two fused keel petals. There are two steering and eight fertile anthers, four of which are globose and four oblonge(dimorphic).

Groundnut is predominantly a self-pollinated crop and pollination takes place early in the morning. As soon as the fertilization is complete, the flowers fade. After fertilization, an

hypanthium, producing new tissue below itself and resulting in an elongated stalk in the peg. The pegs are positively geotropic, enter the soil and bend in a horizontal plane. Generally two, and occassionally one, three or four, fertilized ovules are borne at the tip of the peg which later swells to become the pod. The testa is generally pink, but varieties with red, white, purple and blotched testa, with various gradations of colours are available.

2.10.5 Distribution Area and Production

The major groundnut -producing countries of the world are India, China, Nigeria, Senegal, Sudan, Burma and the USA. Out of the total area of 18.9 million hectares and the total production of 17.8 million tonnes in the world, these countries account for 69% of the area and 70% of the production. India occupies the position, both in regard to the area and the production, in the world. About 7.5 million hectares is put under it annually and the production is about 6 million tonnes. 70% of the area and 75% of the 67production are concentrated in the four states of Gujarat, Andhra Pradesh, Tamil Nadu and Karnataka. Andhra Pradesh, Tamil Nadu, Karnataka and Orissa have irrigated area forms about 6% of the total groundnut area in India.

2.10.6 Climate and Soil.

Groundnut is grown throughout the tropics and its cultivation is extended to the subtropical contries lying between 45 degrees N and 35 degrees S and upto an altitude of 1000 metres. The crop can be grown successfully in places receiving a minimum rainfall of 1,250 mm. The rainfall should be well distributed well during the flowering and pegging of the crop. The total amount required for presowing operations (preparatory cultivation) is 100 mm; for sowing, it is 150 mm

and for flowering and pod development an evenly distributed rainfall of 400-500 mm is required. The groundnut crop, however, cannot stand frost, long and severe draught or water stagnation.

Groundnut is grown on wide variety of soil types. However, the crop does best on sandy loam and loamy soils and in the black soils with good drainage. Heavy and stiff clays are unsuitable for groundnut cultivation as the pod development is hampered in these soils.

2.10.7 Rotation and Mixed Cropping.

Generally, as a kharif crop, groundnut is grown year after year. In certain places, it is rotated with wheat, jowar, bajra, garden crops, such as potatoes, onions, chillies, garlic, ginger and turmeric. The yields of the cereal crops following groundnut are usually increased by about 25%.

Pulses, e.g. red gram (arhar), mash and moong are grown mixed with groundnut. In certain places, millets e.g. jowar and bajra, and castor are grown mixed with groundnut.

2.10.8 Season.

Groundnut is raised mostly as a rainfed kharif crop, being sown from May to June, Depending on the monsoon rains. In some areas or where the mansoon is delayed, it is sown as late as August or early September. As an irrigated crop it is grown to limited between January and March and between May and July.

2.10.9 Cultivation.

For a kharif crop, with one set of rains in May-June, the field is given two ploughings and the soil is pulvarised well to obtain a good tilth. The third ploughing may be given just before

sowing. Harrows or tillers can be used for cultivation. When the soils are heavily infested with perennial weeds, e.g. Cynodon or Cyperus, very deep ploughing is needed. If a field is infested with white grubs, chemicals, such as Heptachl or chlordane, are drilled at the rate of 25 kg per ha before final horrowing. For the irrigated crop, beds of convenient size may be made, depending on the tropography of the land, the nature of the irrigation source and the mode of liftinfg water. Since groundnut is a deep rooted plant it uses up both moisture and nutrients in the deeper layers of the soil. Generally, the following fertilizer schedules are recommended, depending upon the soil .

2.10.10 Harvesting and Stripping.

The groundnut plants are annually harvested by being pulled or dug up. This usually called lifting. There are various designs of equipment available to assist in lifting groundnuts. The industries development center (ICD) originally developed a groundnut lifter at Maiduguri for the savannah area of northern Nigeria and later adapted for local manufacture for the practical action project in magoye in Zambia. The IDC lifter is an attachment for an EMCOT plow. Its is pulled by a draft animal, with two depth wheels and a plow-like bar for lifting up the groundnut. The practical action groundnut lifter suitable for groundnuts grown on 75 cm spaced ridges in sandy soils. Suitable for manufacture by village blacksmiths. The minimum equipment required would be a forge, anvil, hammer tongs chisel, and punch,

2.10.11 Striping

Striping is the process of removing groundnut in shell from the haulm after lifting and, usually drying. This is normally done by hand and is a tedious and time-consuming operation. Picking or flailing removes the pods. (Practical Action, 2006).

2.12 Extraction Process

Generally extraction is the process of separating the constituent of a mixture by using the preferential solubility phase. Commonly, this added second phase is a liquid, while the mixture to be extracted may either be solid or liquid (Parker, 1989).

Extraction is divided into two types of separation processes which are liquid – solid and liquid – liquid extraction processes.

2.12.1 Liquid – Liquid Extraction

This is basically the separation of the constituent of a solution by contact with another insoluble liquid. In this operation, the solution which is to be extracted is called the feed and the liquid with which the feed is contacted is the solvent (Agan et al, 1978).

The purpose of liquid – liquid extraction may be to purify one or more compound or to effect a more economical recovery of a component than is possible by other means. This process is useful in pharmaceutical and petroleum industries etc. (Agan *et al*, 1981)

2.12.2 Solid – Liquid Extraction

This is the removal of one or more components of a solid phase or mixture of phases by using liquid to selectively dissolve the required fraction. It is considered that the fraction required become the solute in the extraction solution, however this need not always be the case as the required material could be the residual solid. Solid extraction may be used either when the extracted component is required, or to recover the solid residue often more associate d with purification such as washing of filter cake. (Parker, 1989)

2.13 Fats and Oil Extraction

2.13.1 Mechanical Pressing

Pressing involves the application of pressure to oil bearing tissue to squeeze out the fat. This is accomplished either by hydraulic press, the flaky material is usually scrapped in a cloth or filter cloth which holds back the residual mass as the oil strains through. Hot expression is more common where the preheating of grounded sample with steam to allow the lipids or fat to escape from the cells. In cold expression the grounded samples are pressed out without resulting to steaming. As a result of pre-cooking, the oil gives a higher yield but the quality is relatively inferior when compared to the solvent extraction.

2.13.2 Solvent Extraction

This process employs a solvent to lead out the oil and it is only practical method of removing oil from tissue with relatively low proportion of oil. Sometimes even the pres cake left during mechanical pressing still contains some quantity of oil and solvent extraction process can be used to retrieve the remaining oil. This method is quite effective but expensive and time consuming. The most widely used apparatus from the solvent extraction is the Soxhlet apparatus; also Distillation Column is used in steam distillation method of extraction.

2.13.3 Purification of Extracted Oil

Crude fats and oil are obtained directly from the extraction of the oil seed. Crude fats and oil contain varying substances that may influence undesirable flavor, colour and keeping quality. This oil extracted must be processed further before it substance for food or industrial uses. These substance are removed through a series of processing steps, which is basically the ame for the

most crude oil, groundnut oil inclusive. The purification can be divided into four (4) types namely:

i Degumming

ii Nutralization/ Alkali treatment

iii Bleaching

iv De-odourizatiion

2.13.4 Degumming

Most crude and oil obtained by pressing or solvent extraction always contain fats like substances, such as phospholids or fat protein complexes, which are gumming.

Degumming is the removal of this gum from the oil. It is partial refining sink free fatty acid are not reduced and even the gums are not completely removed. The processing of mixing oil at 130° - 160°F with water or steam for thirty (30) minutes. Degumming residue is dehydrated and the oil is passed through centrifugal separators larger amount of water are used to prepare an oil which is more degumming (Kirchenbauer, 1960).

2.13.5 Neutralization

The process of neutralization reduces the free fatty acid, phospholipids, carbohydrates, or proteins. The most widely practiced form of neutralization method is an alkali treatment. By treatment of the fats and oils with an alkali solution, the free fatty acid converts into water soluble soaps. Phospholipids carbohydrates and proteins also can be changed to water soluble

substances with hydration. After the alkali treatment, the fats and oils are washed with water to remove residual water soluble soaps (Nawar, 1996).

Neutralization has the most impact on quality and economic performance on the oil. If oils are not adequately neutralized, subsequent process such as bleaching and hydrogenation will be difficult and finished products will ail quality standards.

2.13.6 Bleaching

The bleaching process is removing colouring materials, such as chlorophyll and carotene and purifying the fats and oils so as to be acceptable to the consumers. The method is by adsorption of the colour producing substances on an adsorbent material. Charcoal, adsorbent clay, activated carbon are used as bleaching adsorbents (Ziller et al., 1994).Other impurities more or less completely removed by bleaching are residual soaps from neutralization, sulphur compounds, peroxides and trace of aldehydes and ketones arising from decomposition of peroxide.

2.13.7 Deodorization

Deodourization is a vacuum steam distillation process for the purpose of removing undesirable flavours and odours, mostly arising from oxidation, in fats and oils. Using steam under reduced pressure the volatile compounds are removed from fats and oils. The deodourization utilizes the differences in volatility between off-flavour and off-odour substances and the triglycerides. (Potter, 1986). Deodourization gives a product of bland flavour, odour and good shelf life stability. So this process must remove as far as possible free fatty acids, aldehydes and ketones principally responsible for the unacceptable taste and odour of oil after bleaching. (Potter, 1986)

2.14 Characterization of Fats and Oils

Generally, fats and oil are tested to gain information related to performance in specific food application, this is to assess or measure the degree of deterioration as well as stability of the oils against such change to check fat properties against purchase specification and to identify fats and oil against possible misinterpretation or adulteration. The important physical and chemical characteristics have been measured in various was that have created a number of terms associated with the properties of fats and oils.

2.14.1 Physical Analysis

2.14.2 Boiling Point

Boiling point of oil is determined by heating with a thermometer inserted in it until bubbles form from the liquid. The temperature at which this occurs is the boiling point.

2.14.3 Specific Gravity

Specific gravity is the ratio of the weight of a substance to the weight of water of the same volume at specific temperature. Generally the specific gravity oil is always less than 1.0

2.14.4 PH value

This is a measure of the acidity or basicity of a given sample substance. The electrode of the PH meter is initially standardized with distilled water and the electrode is then rinsed in the oil, and then immersed in the oil and as such the PH value can be determined.

2.14.3 Refractive Index

Refractive index is a physical attribute of triglycerides measured as the angle through which a beam of light is bent when passing through a thin film of melted fat. It is determined by dropping

Refractive index is a physical attribute of triglycerides measured as the angle through which a beam of light is bent when passing through a thin film of melted fat. It is determined by dropping few drops of the oil sample on the face of a refractometer and spread, after which it is closed and lighted and allowed for a given short time, after which the refractive index is determined.

2.15 Chemical Analysis

2.15 .1 Saponification Value

The average molecular weight of fatty acids in a fat is indicated by saponification value, which is the number of milligrams of potassium hydroxide required to convert 1g of fat to soap.

2.15.2 Iodine Value

The iodine value is also an index for assessing the ability of oil to go rancid (Eka, 1980, Amoo *et al.*, 2004). It is the degree of unsaturation of the fatty acid in a fat or oil. Iodine value is use measure the amount iodine, which can be absorbed by unsaturated acids.

2.15.3 Acid Value

The term acid value refers of a measure of free fatty acid present in a fat and oil. Acid value is defined as the number of milligrams of potassium hydroxide necessary to neutralize 1g of the oil.

2.15.4 Peroxide Value

It is a measure of the extent of oxidative adsorption and entrainment of oxygen in a fat or oil. This value together with free fatty acid values indicate the degree of rancidity which has occurred in the fat or oil. Researches have shown that physical or chemical refining could be used in removing the free fatty acid from the oil; therefore this work aims at using chemical refining in which the free fatty acids are removed by neutralization using alkali. Activated

charcoal has been used in past works as adsorbent in bleaching process, ordinary clay is to be employed in this work as it is readily available.

2.16 Qualities of Groundnut Oil

The qualities of groundnut oil and usage can be determined by the level of impurities present in the oil. These can be classified into two groups namely:

Hydrolitic

ii Oxidation product trace metals pigments

i Hydrolitic

These are moisture, insoluble impurities, free fatty acid, and enzymes. Free fatty acid is an undesirable product in groundnut oil since it causes rancidity. It is produced during hydrolysis of trigly ceride through the enzyme, lipases, present in the groundnut oil. Lipases is responsible for the hydrolytic splitting of the trigly ceride. Moisture in the oil through hydrolysis causes an increase in the free fatty acid in the oil, and also give rise to rusting of the container which results in colour fixation.

ii Oxidation product trace metals pigments

phosphatides are emulsifier and it prevent the separation of oil and water phases. An enzyme is in the mesocarp and phosphatides are broadly separated into hydra-table and non hydra- table types. Hydra-table phosphatides can be removed by treatment with water which the non hydra-table compounds which are salt are removed by phosphoric acid.

Carotenoids are the pigments the high vitamin A content of groundnut oil. These and other metals present in the oil have adverse effluent on the quality of groundnut oil because of its emulsifying properties. These impurity can be removed by refining, the refined groundnut oil are usually neutral (neither acidic non alkali) in colour, odour, of material that separate on heating less viscous and susceptible to rancidity because of possible removal of some natural anti-oxidants present in the oil during refining.

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.0.1 Sources of Material and Chemicals

Animal bones were bought from the abattoir in Minna, Niger State. While most of the chemicals used were of the analytical grade from BDH, London. Groundnut oil is purchased from the local producers.

3.1 Determination of Moisture Content of Crude Groundnut Oil.

Procedure: 10g of groundnut oil was weighed into crucible of known weight and heated in an oven maintained at a temperature of 90□c for thirty minute and then reweighed. The moisture content is as shown in appendix three.

3.2 Determination of Free Fatty Acid

Procedure: 5g of oil was weighed into a chronicle flask. Approximately 50 mm of ethanol and a few, (1ml) drops of phenolphthalein were added and shaken vigorously. The solution was titrated with 0.5m of sodium hydroxide solution with constant shaken until the pink colour remain permanent. The volume of 0.5m of NaOH used was 6.7ml these shows that the free fatty acid in the oil is very small. From the quantity of 0.5m NaOH used, the percentage of acid present in the crude groundnut oil was calculated as shown in appendix 1.

3.3 Determination of Peroxide Value

Procedure: 0.5gram of oil and 0.8 gram of potassium iodide were weigh into a flask containing 10ml of solvent mixture glacial acetic acid chloroform (1:1). The mixture was

shaken and boiled for 1 minute the hot solution was pored into a flask containing 10ml of 2.5 percentage of potassium iodide. A few drop of starch solution were added to the mixture and then later filtrated with 0.02 5m sodium thiosulphate solution. The peroxide value was determined as shown in appendix 2.

3.4 Development of Adsorbent

3.4.1 Carbonization

The animal borne were cleaned, sun dry and dry and charge into and automated muffle furnace (Gallenkamp FSE -624-0100). The borne were heated for 2 to 3 hour at 800 to 900□c, the charred products were allowed to cool in a desiccator and then ground to a workable size of 75μm. 0.5m Hcl was used to purified the carbon. The product was rinsed several times with distilled water. The sample was then dried at oven at 100□c for one hour, and then stored in air tight polythene bags.

3.4.2 Chemical Activation of Animal Bones

Chemical activation of animal bones using orthophosphoric acid (H3P04) was done following the method described by Okafor and Aneke (2005). Samples of charred borne were mixed with 0.5 solution of orthophosphoric acid (1:2w/v) and heated to form a paste. The paste was transferred into crucible and heated at 500□c for 2 t0 3 hours in a furnace allowed to cool to room temperature, washed with distilled water and dried at 100□c. The final product was collected into an air tight polythene bag ready for use.

3.5 Degumming

Procedure: boiling water at 100□c was added to the crude groundnut oil and stirred properly. Two layers were formed. The gum which has a higher density than the oil was settle at the bottom of the vessel leaving an upper layer of clarified oil. The procedure was repeated to ensure complete gum removal from the oil.

3.6 Neutralization

Procedure: 100.491 gram of the Degummed groundnut oil was weighed; 2.5ml of 0.5m NaOH was added to it. The mixture was stirred, the NaOH convert free fatty acid solution into an insoluble soap. The soap was then removed by the process of filtration to obtained the neutralized oil. The oil was neither acidic nor alkaline.

3.7 Decolourization and Dedourization Processes

3.7.1 Purification of Groundnut Oil

Activated carbon was added to oil sample at ratio of 1:8 (v/w), stirred and maintained at 80 to 100□c. 20ml of sample was withdrawn at 1 hour interval, centrifuged at 1500xg. The clear supernant (oil) was collected and stored for physiochemical analysis.

3.7.2 Physiochemical Property

Melting point was determined using Gallenkamp melting point apparatus (MFB-600-0100), colour was determine using lovibond tintometer, while odour was determine by 33 member analyst. Crude samples were given the highest grade of 5 point and were compared to the purified samples and assigned number 1 to 5 as compared with the crude.

3.7.3 **Saponification Value, Unsaponifiable Matter, Iodine Value, Free Fatty Acid.**

All these values were determine in the crude and purified oil samples according by the method of ISO, (1976). Refractive was determine using Abbe refractometer while pH was determined using a standard laboratory bench pH meter (EIL model 7020).

3.7.3.1 **Free acid profile**

Fatty acid composition of crude and purified oil samples was determine using gas-liquid-chromatography method (varian Chromatography method model 3400cx).

CHAPTER FOUR

4.0 Result and Discussion

The process technology of groundnut oil as well as other less popular oil can be improved for domestic and industrial usefulness. Table 1 shows the melting point, odour and colour parameters of groundnut oil before and after purification with activated carbon.

4.1 TABLE 1: Properties of Groundnut oil before and After Purification with Activated Carbon.

	Groundnut Oil	
Parameters	**Crude**	**Purified**
Melting point (□C)	29.0	24.4
Odour	5.0 ± 0.01	2.3 ± 0.7
Colour	Brown Pale Yellow	Golden Yellow

4.2 Discussion

The reduction in melting point and the odour, and the improvement on the colour of the oil indicate that impurities have been removed from the oil samples. It is known that impurities usually increased the melting point of substances, thus the reduction of melting point is an indication of removal of impurities from the oil samples after treatment with animal bone-based activated carbon. One of the major problems of popularizing groundnut oil as cooking oil or industrial oil is the objectionable odour. The problem of objectionable odour can be therefore be solved by treatment with animal bone—based charcoal.

Table 2: **Physiochemical Properties and Fatty Acid Profile of Groundnut Oil Purified with Animal-Bone –Based Activated Charcoal.**

Parameters	**Time (Hrs)**				
	0	1	2	3	4
Unsaponifiable Matter (%)	5.20	5.70	6.40	7.10	7.10
Saponification Value (%)	167.00	175.00	188.00	193.00	194.00
Iodine Value (%)	70.30	64.00	60.50	56.90	53.00
pH Value	10.90	10.60	9.70	8.40	8.50
Peroxide Value (%)	1.95	1.80	1.72	1.54	1.40
Acid Value(%)	2.13	2.06	1.99	1.94	1.19
Refractive index	1.4781	1.4633	1.4631	1.4630	1.4630

The Table 2 shows the physiochemical properties of groundnut oil. The result showed that percentage of unsponifiable matter increased with purification time.

The result suggests that the crude oil sample is diluted with impurities; by removing the impurity the unsaponifiable matter becomes concentrated. Saponifiable value increase with time in groundnut oil sample. These observation suggest the bulk of impurities in groundnut oil may contribute to the saponification value of the oil hence the crude groundnut oil is dilute with no saponification value per unit volume of oil, and when the impurity is removed the unit saponification value increased. These observation is supported by the result of MOMa et al 2003, who have shown that impurities can increase or decrease saponification value depending on the nature of the impurity. These result further shows that refractive index reduces with time which is further confirmation of the removal of the impurity.

The result (Table 2) also shows that the parameters tended to equilibrium within three to four hours. This observation is an indication of favourable adoption system. Absorption system that tends to equilibrium are judged effective (Ahmed et al, 200, Ahmed et al,: 2004) . However, the case of attaining equilibrium is a function of the mesh size and surface area (Smith et al, 1996).

CHAPTER FIVE.

5.0 CONCLUSION AND RECOMMENDATION

5.1 CONCLUSION

The decolourization and deodorizations of groundnut oil has been successfully carried out. This has greatly improved

The quality and the appearance of the oil offered using 20g of activated charcoal for 100mil of groundnut oil, which was 78.6% colour reduction.

The highest bleaching power for activated charcoal was given as 55.2% for the same quantity of oil.

Little percentage of the carotene was removed during thermal bleaching at a temperature such as to retain the nutrients.

Other crude oil properties were tested and there was improvement.

5.2 Recommendation

Its is recommend in this work that more study should be done on the concentration and the type of acid used in activating the adsorbents. The adsorbents should be used without activation in order to give room for comparison.

Other materials available such as groundnut shell, coconut shell should be investigated to Asses their potentials as bleaching agents.

APPENDICES.

APPENDIX 1.

free fatty acid (ffa)

Percentage of free fatty acid.

Formula = mc x $\frac{0.141x100}{Wt}$

Ml, = volume of 0.5m NaOH used =6.7ml

Wt = weight of sample of oil =5g

Percentage of free fatty acid is

$\frac{6.7x0.141x100}{5}$ =18.9%

APPENDIX 2.

Peroxide value (pv) for crude groundnut oil

The formula =$\frac{VxMx100}{Wt}$

V= volume of sodium thiosulphate (Na2S2 03)acid = 1.95ml

M= molarity of Na2 S2 03 =0.025m

Wt = weight of sample of oil =0.5g

$Pr = \frac{1.95x0.025x100}{0.5}$ =9.75

APPENDIX 3.

Moisture content (m.c) of the crude groundnut oil. Mass of the flask =118.431g.

Mass of the flask + crude groundnut oil before heated =128.675g

Mass of the flakes + crude groundnut oil after heating is 128.546g

Mass of the oil before heating =128.676-118.431=10.245g

Mass of the moisture content = 10.245-10.115g= 0.13g.

Percentage of the moisture content is given as mass of the moisture content

Mass of the crude groundnut oil x100

=0.13/10.245x100=1.27%

DEFINITIONS

Free fatty acid: This is a measure of saponifiability of the oil. It is suitable in soap making.

Peroxide Value: Is usually as indicating fats deterioration. As oxidation takes place, the unsaturated fatty acid in the oil attached forming peroxide. This break down to secondary oxidation product, which indicates rancidity.

Moisture Content: This is the amount of moisture in the oil, high moisture content create a conducive atmosphere for rancidity.

Rancidity: This is the state of the oil being rancid that in the state of having a peculiar I" smell or take owing to oxidation.

Activation: treatment of a substance by heat, radiation or activating agent to produce a more ccmplete or rapid chemical or physical change.

Adsorption: The preverteaturer substance is to the bulk of solid or liquid.

Adsorbents: these are materials or agents that having the ability or tendency to adsorbs.

Adsorb ate: The adsorbed substance in the process of adsorption.

Smoke Point; The maximum temperature of which the oil start smoking.

REFRENCES.

Ahmed, A.l; sumathi, s. Hameed, B. (2004) Chitosan A natural Biopolymer for the adsorption of residual oil from oil waste water, adsorption and technology, 22(1), 75.

Ahmed A. l. suzylawati, norliza, I and subhash, B, (2003) removal of suspended solid and residual oil from palm oil mill effluence, j. chem. Tech and biotechnol. 78.971.

Ajose, E.B, (1988) Design of a plant for the production of sheabutter. HND project submitted to the Department of chemical Engineering, Federal polytechnic Bida Niger state, Nigeria.

CAH (1978). Carbon adsorption Handbook, Edited by Paul cheremisconoll and Fred Ellebusch Ann Arbor science publishing Inc.

.Dibinin, M.M, plarnik. G.m and Zevarian, F.F (1964), integrated study of the porous structure of activated carbon fro

Carbonized sucrose, carbon 2:261.

Egwim, Evans (2003) Dietary Lipid Dilema; answer in Amphibians? A paper presented at the quarterly seminar of the school of Applied Arts Science. Federal polytechnic, Bida. 23 September 2003.

Geankoplis, C.J, (1995) Transport process and unit operations. Simons and Schuster as a pte ltd, Singapore.

Hanssard, M. Gaballah, I. Kannari N. Donato, P.D, Barres o. and villieras, F, (2003) separation of hydrocarbon and lipid from water using treated bark wat. Res 37:362.

Mia siemon's Boutique www. Maisb. Com-7k.

. Moma, E.E, Omuchukwu, a. I: Onuoho, G.N; and Offrem, j.o (2003). Analytical indices for the identification of adulterated vegetable oil-palm kernel oil.j.chem.. Soc. Nig.28. (1) 87-98.

Okafor, J.O and Aneke, N.A.G (2005) characterized of adsorbent for the purification of coca cola Effluent, proceeding of the 35th Annual conference of the Nigeria society of chemical Engineering, command Guest House Kaduna, Nigeria.

Shukla, A Zhang, Y.H, Dubey, P, Margrave, J.L and shukla, S.S (2002). The role of sawdust in the removal of unwanted materials from water. J. Of Hazardous mat.B95, 137.

Smith, J.M, Van Ness, H.C and Abbot, M.M. (1996). Introduction to chemical Engineering Thermodynamics, 5th Ed, the Megraw. J.of hazardous Inc, New York.

H. Freunolich+ Colloid capillary chemistry translated from the Herman edition by H.S. Hatfield mithuen and co, London (1996).