DETERMINATION OF PHYSICO-CHEMICAL PROPERTIES OF SELECTED GROUND NUT VARIETIES

(*Arachis Hypogaea .L*)

BY

ALIYU, ADINOYI

2005/21547EA

DEPARTMENT OF AGRICULTURAL AND BIORESOURCES ENGINEERING

FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA,

NIGER STATE, NIGERIA.

FEBRUARY, 2010

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BEING A FINAL YEAR PROJECT SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF BACHELOR OF ENGINEERING (B.ENG.) DEGREE IN AGRICULTURAL AND BIORESOURCES ENGINEERING

FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA, NIGER STATE, NIGERIA.

FEBRUARY, 2010.

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 or diploma or certificate at any University or Institution. Information derived from personal communications, published and unpublished works of others were duly referenced in the text.

....

Aliyu, Adinoyi Date

CERTIFICATION

This Project entitled "Determination of Physico-Chemical Properties of Selected Groundnut Varieties (*Arachis Hypogaeal .L*)" by Aliyu Adinoyi, meets the regulation governing the award of Degree 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.

Engr. Dr. A.A Balami — 23/02/10

Supervisor — Date

Engr. Dr. A.A Balami — 23/02/10

HOD, Department of Agricultural and Bioresources Engineering. — Date

External Examiner — 9/3/2010

Date

DEDICATION

This project work is specially dedicated to Almighty God, the maker of Heaven and Earth, the Author and finisher of life who has been my source of wisdom and strength since I was admitted into this citadel of learning to acquire a bachelor degree in Agricultural and Bioresources Engineering.

To my beloved parent Mr. and Mrs. Aliyu Joseph.

ACKNOWLEDGEMENTS

I give thank to God the Most High, for his grace, love, favour, guidance and protection toward my life. For his wisdom, knowledge, understanding and strength to accomplish this project work.

My utmost and profound gratitude goes to my supervisor, Eng. Dr .A. A. Balami, for his advice, words of encouragement, motivation and his painstaking to read and make necessary corrections irrespective of his other rigorous and time consuming assignments. Your assistance can never be over emphasized. May God continue to bless you in all your endeavors.

My sincere gratitude also goes to the entire staffs of Agricultural and Bioresources Engineering Department, among who are: Eng Dr .O. Chuku, Dr .B.A Alabadan, Eng .M.A Sadeeq, Eng Adeoye, Mr Kehinde, Mr Fabunmi and all those that time will fail me to mention. You are all wonderful.

However, I will not fail to express my indebtedness to my Sister and her husband Mr. and Mrs. Walter Ogar for their support and assistance towards my academics, may God bless them richly (Amen). Also my appreciations goes to my friends, Rebecca H. Musa, Alade Ridwan, Chikodi .C. Egbujor, Afe Olusegun, Adegbemi Jacob,Mrs Bunmi Adeniran,Akeem Jimoh (Saola), and many others that I could not mention because of time constraint. May this light of friendship never quench.

Finally, my sincere indebtedness goes to my parents Mr. and Mrs. Aliyu Joseph, for their care, love, and spiritual advice, vast moral and financial support. May the Good Lord continue to guide, protect and bless you. Thanks.

ABSTRACT

Physico-chemical analysis of two groundnut varieties SAMNUT10 (Improved variety), and Ogoja groundnut (Local breed) were determined, results showed that the groundnut oil contained saponification value of 189.24 (mgKOH/g) for SAMNUT 10, while the local variety has 173.91 (mgKOH/g). SAMNUT 10 has Iodine value of 37.05 (mgKOH/g), and the local pea nut has 2.79 (mgKOH/g). Acid value of 6.01 (mgKOH/g) was determined for SAMNUT 10, and the local variety has 5.6 (mgKOH/g).The peroxide value for SAMNUT 10 was 3.38 (mmol/kg), while the local variety has 2.2 (mmol/kg). Refractive index for SAMNUT 10 was 1.465 and the local variety has 1.465. The result of the physical characteristics of both groundnut show that SAMNUT 10 has 7.37% moisture content, while the local variety has 5.5%. SAMNUT 10 has viscosity of 54.6, and the local variety has viscosity of 54.7. SAMNUT 10 has specific gravity of 1.116 while the local variety has 1.106. The two groundnut varieties can thus be considered as a good source of oil for food and industrial purposes, and could be classified as a non drying oil.

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CHAPTER ONE

1.0 INTRODUCTION

1.1 Background of the Study

Groundnut or Peanut (Arachis hypogaea L.) as it is also called is a four-foliate legume with yellow sessile flowers and subterranean fruits. Native to South America. It originated between southern Bolivia and Northern Argentina from where it spread throughout the New World as Spanish explorers discovered its versatility. Today farmers in Asia and Africa also cultivate it. It is grown under a wiled range of environmental conditions in areas between 40 degrees South and 40 degrees north of the equator (CGIAR, 1997).

The largest producers of groundnut are China and India, followed by sub-Saharan Africa countries and central and South America. Most of the crop is produced where average rainfall is 600 to 1,200mm and mean daily temperatures are more than 20 degrees (FAO, 1994). Groundnut is a valuable cash crop for millions of small scale farmers in the semi-arid tropics. It generates employment on the farm and in marketing, transportation and processing groundnut is the 13th most important food crop of the world. It is the World's 4th most important source of edible oil and 3rd most important source of vegetable protein. Groundnut seeds contain high quality edible oil (50%), easily digestible protein (25%) and carbohydrates (20%). In 2004, groundnut was grown on 24million hectares Worldwide with a total production of 36million metric tons.

Groundnut is grown in nearly 100 countries. Major groundnut producers in the world are, China, India, Nigeria, USA, Indonesia and Sudan (CGIAR, 1997). Developing countries account for 96% of the global groundnut area and 92% of the global production. Asia account for 58% of the global groundnut area and 67% of the groundnut production with an annual

growth rate of 1.28% for area, 2.00% for production and 0.71% for productivity (FAO, 1994).

Groundnut is a valuable source of E, K and B vitamins (it is the richest plant source of thiamine (B1), and is also rich in niacin, which is low in cereals). Groundnut cakes, formed after the oil is extracted, are a high protein animal feed. With proper processing, people also use the cake to make products. Such as biscuits and baby food (CGIAR, 1997).

1.1.1 Pea nut Production

China leads in production of peanuts having a share of about 37.5% of overall world production, followed by India (roughly 19%) and Nigeria (roughly 11%)

Top ten producers of peanuts (with shell)-11 June 2008

Table 1.1 Shows groundnut production in the world

Country	Production (tones)
China	13,090,000
India	6,600,000
Nigeria	3,835,600
United State	1,696,728
Indonesia	1,475,000
Myanmar	1,000,000
Argentina	714,286
Vietnam	490,000
Sudan	460,000
Chard	450,000
World	**34,856,007**

Source;F.A.O/W.H.O, (2008).

In Africa the softly hairy trailing annual crop with ribbed stems and round or kidney shaped leaver 5 angled (vegetable in south East Asia. Groundnut fruit is spherical or cylindrical in nature. It is fast growing, quick maturing and tolerate the summer heat and rain. The seeds are smooth, brownish black, creamy white or pale biscuits the margin only deformed at the apex varying in length 5-15 and are not eaten raw but are cooked. In Nigeria

and in the Northern part of the country where many varieties are grown, seed are sown from mid-march to mid-may in manure pits and again sown last September to mid –December .It is largely produced in this part of the country compare to the eastern and westerns part because of less rainfall in the area. Nigeria is a major producer of groundnut for 25% of world export. In 2004 the country had 3500 hectares cultivated and production of 2750 tones. Groundnut accounted for 70% of total Nigeria export prior to petroleum oil boom. Groundnut is widely consumed in Nigeria as roasted or boiled nuts in the western and southern part of the country Homogenization of the nuts is a process carried out in the northern parts. Groundnut roasting leads to reduction in insoluble dietary fiber (I D F) and total dietary fibre (I D F). Roasting also enhances the flavors and the taste of the food in infant formulation. It also said that roasting leads to improved digestibility and reduction in formulate food

1.2 Cultivation and Harvesting of Groundnut

Peanut is a self-pollinating, indeterminate, annual herbaceous legume. Natural cross pollination occurs at rate of less than 1% to greater than 6% due to atypical flowers or action of bees (Cofflet et al, 1989). Eight to 14days after pollination, aerial pegs will grow 2 to 3 inch, into the soil and then turn to a horizontal orientation to mature into a peanut pod. Pods reach maximum size after 2 to 3 weeks in the soil, maximum oil content in 6 to 7 weeks, and maximum protein content after 5 to 8 weeks. The peanut pod matures after 7 to 9 weeks in the soil, which is indicated by maximum levels of protein, oil dry matter and presence of darkened veining and brown splotching inside the pod peanut usually require a maximum of 100 to 150 days from planting to maturity depending on the variety planted (Putnam et al, 1991).

1.2.1 Environmental Requirement

A. **Climate**

Temperature is the major limiting factor for peanut yield, since a minimum of 3,000 growing degree days (with a base of 10^0C) is required for proper growth and development. A peanut crop will not reach optimum maturity for a marketable yield to justify commercial production in areas with fewer heat units during the growing season.

B. **Soil**

Soil for peanut production should be a light- colored, light textured with good drainage, and moderately low amounts of organic matter. Such soil is preferred since it is usually loose and friable, permitting easier penetration of roots and pegs better percolation of rainfall, and easier harvesting.

Organic matter should be maintained at a level of 1 to 2% to improve water – holding capacity of the soil and supply plant nutrients. Peanut grows best in slightly acidic soils with a PH of 6 to 6.5 but a range of 5.5 to 7.0 is acceptable. Saline soils are not suitable since peanut has a very low salt tolerance (Weiss, 1983).

1.2.2 Harvesting

The groundnut plants are annually harvested by being pulled or dug up. This is usually called "Lifting". The optimum time for harvesting is when most pods have a veined surface, seed coats are colored and 75% of pods show darkening on the inner surface of the hull (Patee and Young, 1982).

1.2.3 Stripping

This is the process of removing groundnuts in-shell from the haulm after lifting and usually drying. This is normally done by hand and is a tedious and time consuming operation. The pods are removed by picking or flailing.

1.2.4 Groundnut pest and disease

Peanuts are attacked by; the bean leaf roller (*Lamprosema indicata*). Leaf minern (*stornopteryx subsectvella*), long-horned grasshopper (*Atractomorpha, pittacina*). June beetles (*Leucopholisirrorala*), and tiger moth caterpillar (*Dasychira mendosa*) among others. Mould (*Aspergillus flavours*) can attack groundnut, leading to aflatoxin contamination, if the nut are not dried sufficiently. Aflatoxin in peanuts is a serious problems .The peanuts can become infected either before or after harvest. once they are infected, there is no way that the aflactoxin can be removed and the peanut becomes dangerous for consumption if the peanut is free from the disease at harvest , correct drying can prevent later infection .some aflatoxin infection can be visible to the eye as mould, but in other cases it cannot be seen. Laboratory tests need to be carried out to confirm the presence of aflatoxin. The recommended moisture level should be less than 10 percent.

Blanching is a process that destroys enzymes (biological compound that are responsible for deterioration and off flavors in food after harvest). While retaining the color and most of the nutritional value. It is very simple process and basically involves the immersion of the foodstuff in boiling water or steam for a very short time, followed by rapid cooling by plunging in very cold water.

1.2.4.1 What are aflatoxins

Aflatoxin are one of the most potent toxic substances that occur naturally (present in air, soil and water). These are a group of closely related mycotoxins produced by fungi aspergillus flavus and aspergills parasiticus. Aflatoxicosis is poisoning that result from ingestion of aflatoxins in contaminated food or feed. Aflatoxin poisoning is reported from all parts of the World in almost all domestic and non domestic animals like cattle, horses, rabbits, and other non primates. Aflatoxin is also reported in humans in many parts of the

world (Bommakanti and Waliyar, 2008). Aflatoxins have become the subject of concern in ariculture, as well as in animal and human health on a global scale. A very small amount of aflatoxin in feed (10-20parts per billions) can produce total liver cancer in young animals. Aflatoxin contamination is a serious quality problem in groundnut (Venkataramani, 2002).

Aflatoxin contamination is widespread in groundnut – based food and feed drain in Indians farmers, traders and consumers are not aware of the risks associated with aflatoxin contamination in food and feeds. Low – cost technologies that can reduce aflatoxin contamination at source have been developed. This involved pre – harvest control through cultivation of aflatoxin resistant groundnut cultivars, and post – harvest control by improved post - harvest processing of groundnut crop. In addition, an integrated crop management package was developed by combining cultural practices and use of inorganic, organic and biocontrol agents, to increase groundnut productivity and to reduce aflatoxin contamination. These methods need to be implemented through via farmer- participatory approach in groundnut – growing countries in the world (ICRISAT, 2006).

- Aflatoxins are toxic metabolic substances produced by certain toxigenic strains of *Aspergillus flavus* and *A. Parasiticus* fungi growing in various feed and food commodities.
- They are the most potent hepatocarcinogens among all the known natural and synthetic compounds.
- Historically, the most fatal effect of aflatoxin was the report of heavy loss of turkey poults in the UK, where more than 10,000 young turkeys died in 1960.
- The disorder was then tentatively named as Turkey-X-Disease. In turkey birds, this disease was characterized by loss of appetite, lethargy and a weakness of the wings followed by death within a week or so.

- The factor for the disease was known to be incorporation of Brazilian groundnut metal into the rations of livestock and poultry.
- The meal was examined for several possible causes and finally it was found to be contaminated with *Aspergillus flavus*.
- The toxic principle was isolated from the contaminated groundnut meal and named as "aflatoxin" where A stands for Aspergillus, fla for flavus and toxin for poison.
- Thus aflatoxin was established as the cause of Turkey-X-Disease. Difurano coumarin compounds designated as aflatoxins have been discovered since then.
- A very small amount of aflatoxin in feed (10-20 ppb) can produce fatal liver cancer in young animals.
- Aflatoxins have also been implicated in human diseases.
- The amount, kind and composition of aflatoxin produced vary with the substrate, environment, and the strain of Aspergillus of *Aspergillus flavus* (and consequently the production of aflatoxins).
- Aflatoxin contamination is a serious quality problem in groundnut.
- High aflatoxin load in HPS-grade kernels and deoiled cake has seriously jeopardized our export earnings.
- Thus, aflatoxins have become the subject of concern in agriculture, as well as in animal and human health on a global scale.

1.2.4.2 Toxic Effects of Aflatoxins

- Aflatoxins are carcinogenic (cancer-producing) and mutagenic (having power to produce mutation) in their biological activity.

- The LD50 values (the dose required to kill 50% of the treated animals) for ducklings were 18.2, 84.8, 392 and 172.5 Mg of B1, B2, G1 and G2, respectively, indicating that aflatoxin B1 is most toxic.
- Liver is the organ principally affected, in which the toxins induce malignant hepato-cellular carcinomas.
- However, in a few instances tumors of other organs, especially the kidney, are associated with aflatoxins.
- A total dose of 3.6-10 mg of aflatoxin was found to induce hepato-cellular carcinomas in Fischer rats with a frequency of 100%.
- Aflatoxins were also implicated in an outbreak of hepatitis in India in 1974 in tribal areas covering more than 200 villages of Rajasthan and Gujarat. The outbreak lasted for about 2 months and was confined to the population whose staple food was maize, which was found to be contaminated heavily with *A. Flavus*. Analysis of the contaminated samples revealed that affected people might have consumed between 2 and 6 mg of aflatoxin daily over a period of few weeks.
- It has also been reported that in Indian children there exists a condition commonly known as Indian Childhood Cirrhosis due to the consumption of groundnut contaminated with aflatoxin. The disease is known to be predominant in early stages of child growth (at the age of 3 years) affecting the liver cells, causing degeneration, fibrosis and hepatomegaly and in advanced stages proceeds to jaundice, ascites and hepatic coma. It has been reported that cirrhosis occurs not only in India but all over the world, especially in the tropical countries.

1.2.4.3 Control of Aflatoxins

- In view of the known hepatotoxic properties of aflatoxins, their widespread occurrence during cultivation, harvest, drying, storage and transit of groundnut and also loss of HPS (Hand picked selected) export markets, immediate attention and efforts are needed towards achieving effective control measures.
- Three basic approaches of prevention, removal and detoxification seem to be promising for aflatoxin control. Of these, prevention is considered to be the best.

1.2.5 Drying and Storage

The two most important operations in handling peanut after harvest are cleaning and drying to safe moisture content (5 to 10%). Pods should be kept dry and protected against infestation from insects or rodents as well as from loss of natural color and flavor, and prevention of the development of off-flavors and rancidity.

1.2.6 Groundnut Oil Extraction

Oil contains high amounts of energy and fat – soluble vitamins (A, D, E and K) and essential fatty acids. The oil content of the kernels is between 45% and 55%.

The peanuts are prepared for the oil extraction process by being shelled and cleaned. Oil production requires some types of press with which to extract the oil from the groundnuts and filtering equipment. Practical action has developed a simple manual screw press that would be suitable for extracting oil from peanuts, as well as many other agricultural crops. There are quite a number of presses of very similar design, they are simple to make, except for the screw which would have to be machined.

1.3 Types of Groundnut

Although groundnuts comes in many varieties which includes, the following. Runners, Verginia, Spanish and Valencia. Each of the groundnut types is distinctive in size,

flavour and nutritional composition within each basic types of groundnut there are several varieties for seed and production purposes. Each variety contains a distinct characteristic which allows a producer to select the product that is best suited for its region and market.

1.3.1 Runner

Runners have become the dominant types due to the introduction in the early 1970s of a new runner variety, the florunner which was responsible for a spectacular increase in groundnut yields. Runner have rapidly gained wide acceptance because of the alternative uniform kernel size. Fifty-four percent of the runners grown are used for butter; runners are grown mainly in Georgia, Alabama Florida, Texas and Oklahoma.

1.3.2 Verginia

Verginias have the largest kernels and account for most of the groundnuts roasted and processed in the shell. When shelled, the larger kernels are sold as snack groundnuts. Virginias are mainly grown in Virginia north coastline.

1.3.3 Spanish

Spanish – type groundnuts have smaller kernels covered with a reddish – brown skin. They are used predominantly in peanuts candies, with significant quantities used for snack nuts and peanut butter. They have a higher oil content than the other types of groundnuts which is advantageous when crushing for oil. They are primary grown in Oklahom and Texas.

1.3.4 Valencia

Valencia usually has three or more small kernels to a pod and is covered in a bright – red skin. They are very sweet groundnut and are usually roasted and sold in the shell they are also excellent for fresh used as boiled groundnuts. New Mexico is the primary producer of Valencia groundnut.

1.4 Types of Groundnut in Nigeria

According to Anyasor et al, (2009). The following groundnut varieties are found from three geographical zones in Nigeria. Northern, Eastern and Western, and they are as follows; Boro red, Boro light, Mokwa, Ela, Campala , Guta. Also, the following are ground nut varieties that are available in Institute for Agricultural Research,(IAR).Amadu Bello University Zaria; SAM NUT 10, SAM NUT 22, and SAM NUT 23. The following ground nut varieties are also available in Minna Niger State; Ogoja, Kampala and Gwari ground nut.

1.5 Uses of Groundnut

All parts of peanut plant can be used. The peanut grown primarily for human consumption, has several uses as whole seeds or is processed to make peanut butter, oil and other products. A pound of peanut is high in food energy and provides approximately the same energy value as 2 pounds of beef, 1.5 pounds of cheddar cheese, 9 pints of milk or 36 medium size eggs (Woodroof, 1983).

The following are the various ways which groundnut can be consumed.

A. As food Product

i. As a source of edible oil

ii. For peanut butter production

iii. Salted and shelled peanut

iv. Candy.

B. Non-food products (Application industries)

1. Soap making
2. Medicine (Pharmaceutical products)
3. Cosmetics products
4. Lubricants (Emulsion for insecticides)

1.6 Statement of the problem

With the increasing demand of groundnut and ground-nut product generally, there is need to classify the oil extracted from the various groundnut varieties available in Nigeria. A good idea of the physico-chemical properties of the extracted oil from groundnut will enhance the maximization of the great potentials in groundnut to the industrialist and as food product.

1.7 Objectives of the Study

Edible oils from plants source are of important interest in various food and application industries, they provide characteristic flavours and textures to foods as integral diet components (Odoemelam, 2005) and as a source of oleo chemicals (Morrison et al, 1995). Ole chemicals are completely, biodegradable (Kifli and Ahmad, 1986) and so could replace a number of petro- chemicals.

Hence the objectives of this study are to determine the physico-chemical properties of selected groundnut varieties.

The specific objectives are as follows:

i. To determine the chemical properties of the selected groundnut varieties.

ii. To determine the physical properties of the groundnut oil.

1.8 Justification of the project

In Nigeria, the major source of edible oil are groundnut (*Arachis hypogaea L.*) and oil palm (Elacis guineesis) oil quality and its stability are therefore very important for food and application industries, thus this study investigate the physical and chemical properties of selected groundnut (Peanut) varieties, with the view of evaluating the industrial (food and application) suitability.

1.9 Scope of the Project

This project is limited to determination of the physico-chemical properties of selected groundnut varieties.

CHAPTER TWO

2.0. LITERATURE REVIEW

2.1 Introduction

Drying is used to removed water from food for two reasons; to prevent (or inhibit) micro-organism and hence preserve the food and to reduce the weight and bulk of the food for easy transport and storage. When carried out correctly, the nutritional quality, colour and texture of rehydrated food are slightly less than fresh food but, for most people this has only minor nutritional significance as dried foods form one component in the diet however, if drying is carried out incorrectly, there is a greater loss of nutritional eating and industrial applicability qualities and more seriously a risk of microbial spoilage and possibly even food poisoning (Pearson, 1981).

2.2 Moisture Content Requirement

Harvesting is normally followed by mechanical drying. Moisture in groundnuts is usually kept below 12% to prevent aflatoxin moulds from growing. This low moisture content is difficult to achieve under field conditions without over drying vines, and stems which reduces efficiency (Less foreign material is separated from the pods) on-farm dryers usually consist of either storage trainers with air channels along the floor or storage bin with air vents. Fan below heated air (approximately 35°c (95°F)). Though the air channels and up through groundnuts. Groundnuts are dried to moisture of roughly 7 to 10 percent before roasting.

2.3 Drying Methods

Drying can be carried out using hot air or less commonly, hot metal pans (Atiku, 2004). However, drying can be carries out through the following methods. Sun drying, solar drying, roasting and oven drying.

2.3.1 Sun Drying

Drying done in open sunlight is weathers, temperature and relative humidity dependent. Sun drying may be successful in a hot, dry climate. What would take 6 to 10 hrs to dry using another method take 3 to 5 days in sun drying. The groundnut moved into a shade to complete the drying. When its two-third dry.

2.3.2 Solar Drying

Solar drying is popular with agencies and research stations and it is a modification of sun drying in which sun rays are collected inside a specially designed unit in adequate ventilation for removal of moisture air. The temperature in the unit is usually 20 to 30 degress higher than in open sunlight, which result in a shorter drying time, solar drying, have many advantages over sun drying. Lack of control over the weather is the main problem with both methods.

2.3.3 Oven drying

This is usually a good choice of only 20 to 40 kg of produce is to be dried at a time on a small-scare drying. Disadvantages are the cost of the energy and having the oven on constantly. Oven drying takes 2 or 3 times longer than a dehydrator. The groundnut must be turned occasional to assure even drying by shifting the trays every half hour.

2.3.4 Roasting

Roasting impacts the typical flavor many people associated with groundnuts. During roasting, amino acid and carbohydrates react to produce a tetrahydrofuran derivative.

Roasting also dries the groundnuts further and causes them turn brown as groundnut oil causes their turn brown as groundnut oil stains the groundnut cell. Following roasting, groundnuts are prepared for packaging or for further processing into comedies or peanut butter and groundnut oil (Anyasor et al, 2009). Roasting reduces the moisture content, develops a pleasant flavour and makes the product more acceptable for consumption. However, it is important to note that excessive heating during roasting lowers the nutritional quality of proteins (Atiku, 2004). Groundnuts are roasted at 425°F (218°C) for 40-60 minutes on trays in an oven and turned frequently for even roasting (Atasie et al, 2009).

2.4 Importance of drying

In food processing, the importance of drying can not be neglected (Grosso et al, 1999). Hence the reason for drying groundnut before further processing are as follows;

i. To inhibit (or prevent) micro-organism

ii. To preserve the groundnut and to reduce the weight and bulk mess

iii. To develop a pleasant flavor

iv. To prevent molding and reduces staling and rancidity.

v. To maintain the natural nutritional qualities of the groundnut while making processing faster and easier (Atiku, 2004).

2.5 Groundnut processing

2.5.1 Conditions for processing

For optimum roasting of groundnut of good quality, the processing condition based on Experimental findings and test carried out should be observed.

(i) Roasting groundnut should stir continuously to prevent burning.

(ii) The average charring temperature should maintain between 170°C – 120°C for 45 minutes for a maximum roasting.

The use of warm water sugar should be applied because it hasting roasting and there by prevent boiling or soaking of seeds.

2.5.2 Traditional Processing Method

Locally, the roasting of groundnut and its products (raw or fried cake) is an important source of income for women in rural areas of Nigeria and Africa as a whole. Though there may be regional variation in processing groundnut, it is almost the same (Khan and Hanna, 1983). Groundnuts are harvested manually. Harvested groundnut kernels are soaked in water with 4% salt (NaCl) for 12hrs. The soaked kernels are dried and roasted with sand. Roasted groundnut kernels are packed.

2.6 Groundnut oil

Peanut oil (known also as arachis oil, groundnut oil, or earthnut oil) is the expressed oil from the seeds of peanuts (*Arachis hypogaea L*)

It is a nondrying vegetable oil (defined as oils whose iodine values (IV) are< 125), (Cox and Pearson 1962). And has a high proportion of unsaturated fatty acids, oleic acid (50 – 65%) and limoleic acid (18 – 30%), stearic, arachis behenic, and lignoceric acids account for 10 -20% of the total fatty acids (Hilditch and Williams, 1964). Arachidic acid is the characteristic component of peanut oil and was the basis for the Bellier, evers, eversbellier, and renard test that were used before the development of gas chromatography (Jacobs, 1973).

Peanut oil is used mainly for edible purposes in the preparation of shortenings, margarines, and mayoniaise, as cooking and frying oil and as a salad oil. A non edible use of peanut oil is as a diesel fuel in specifically modified engines (Robbelen et al, 1982) but it is more expensive than conventional no. 2 diesel fuel and has the added drawbacks of lower

heating value, greater surface tension, greater viscosity, and greater density (Goodrum and Law, 1982).

2.7 Physico-chemical Properties of Groundnut.

Several researchers and research institute have done a great work on the physico-chemical properties of groundnut, for this study several important and relevant literatures were studied.

The following are the basic characteristics for most fats and oils:

1. Iodine value
2. Saponification value
3. Specific gravity
4. Acid value
5. Free fatty acid
6. Refractive index
7. Peroxide value

2.7.1 Iodine value:

The iodine value of oil is related to its instauration. It is a measure of unsaturated acid present. The test measures the amount of iodine that can be absorbed by the acid. One major property of unsaturated compounds is the presence of double bonds and the ability to undergo addition reaction especially with halogens. The higher the iodine value, the greater the instauration and the greater the liquidity.

2.7.2 Saponification value:

In this process, ester is saponified and then back-titrated to determine the mean molecular weight of the glycerol molecules, acid measure of the mean molecular weight of fatty acid present in the fat/oil. This is also the hydrolysis of triglycerides into glycerol and potassium salts of fatty acids, using a solution of potassium hydroxide on alcohol;

saponification value gives the actual amount of alkali required by a fat/oil. The lower the molecular weight, the greater the specification value.

2.7.3 Refractive index:

This is measured by the angle through which light is bent when passing through a thin film of melted fat. The index of each fat falls within a narrow range and can be used in checking the purity of the oil. It is temperature dependent and usually measured at 40°C, temperature at which most fats are liquid.

2.7.4 Specific gravity:

This is defined as the density of substance relative to that of water. It compares the sample relative to water.

2.7.5 Acid value:

This is defined as the number of potassium hydroxide or sodium hydroxide that is required to neutralize the free fatty acid in one gram of the sample. This result is usually expressed in percentage of free fatty acid.

2.7.6 Free Fatty Acid

The present free fatty acid in peanut oil varies between 0.02 and 0.6% (Guthric et al, 1949). Lipase hydrolysis of tricalglycerols, into free fatty acids and glycerol occurs before germination (Sanders and Pattee, 1975) and during adverse storage (Worthington et al 1984). Consequently high free fatty acid values indicates poor handling immaturity, mold growth or other factors that lead to triglyceetide hydrolysis (Sanders and Co-workers, 1992).

2.7.7 Perioxide value

The perioxide value measures a fat's reactive oxygen content in terms of milliequivalents per 1000g fat, following AOCs method Cd 8 – 53 or AOAC method 965.33 (AOAC, 1960).

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 Sources of groundnut

Groundnuts (*Arachis Hypohaea L*), (SAM NUT 10) were obtained from the Institute for Agricultural Research (IAR), Amadu Bello University Zaria, Nigeria, while the Local variety called "Ogoja" (Also known as; Na Dakar, Yar Tiv and Wata Uku) were purchased from Minna Ultra Modern market Niger State.

3.2 Project Site

This project was carried out in two sites, which are:

- National Cereal Research Institute, (NCRI) Badeggi.Niger State. and
- Animal Science Laboratory of Federal University of Technology Minna, Niger State.

3.3 Apparatus used: This includes:

1. Electronic weighing balance
2. Measuring cylinder
3. Beakers
4. Burette
5. Pipette
6. Hot plate
7. Soxhlet extractor
8. Thimble
9. Round bottom flask
10. Blender

11. Oven
12. Abbe's refractometer
13. Viscometer
14. Conical flask
15. Density bottle
16. Filtr paper

3.3.1 Reagents/Chemicals

1. Sodium thiosulphate (na2s2o3)
2. Phenolphthalein
3. Starch solution
4. Potasium iodide solution
5. Hydrochloric acid solution
6. Ethanol
7. Alcoholic potassium hydroxide solution
8. Ground nut seed
9. Distilled water

3.4 Moisture content determination

The method adopted was that of air oven as outlined by food and agriculture organization FAO, (1981). Three clean crucible with tight fittings lids were dried in an oven until const weight was obtained and were cooled in the desiccators and the weight of the crucibles were taken (W_1). For each determination, a known weight of the sample was weighted into each of the three crucibles and the crucible with lid and their contents were weighted (W_2). They were then put into. The oven and dried at 105°E for 24 hours after which they were allowed to cool in a desiccators and then weighted. The drying and the weighting process were repeated at intervals until a constant weight was obtained (W_3)

The moisture content (m.c) was calculated using the given formula:

$$\frac{wt\ of\ sample + crucible + lid\ (before\ drying) - wt\ of\ sample + crucible + lid\ (after\ drying)}{wt\ of\ sample\ taken} x\,100$$

wt represents weight

$$\%moisture = \frac{W_2 - W_3}{W_2 - W_1}, \%$$

3.5 Oil extraction

Extraction of groundnut oil from the groundnut seed of each sample employ the use of the extractor, condenser, heating mantle, round-bottom flask, wool, groundnut seed and the solvent.

Factors affecting the rate of extraction

The selection of equipment for an extraction process is influenced by some factors which limit the extraction rate. These factors are discussed below:

Solvent: The properties of the solvent like viscosity density, vapour pressure and so on vary from solvent to solvent. In this research work, the solvent used in the extraction of oil from groundnut was petroleum ether and it has the following properties.

Chemical properties

- Highly flammable
- Can be explosive at high temperature
- Reacts vigorously with oxidizing materials
- Attacks rubber, plastic, skin, eye etc
- Slightly toxic
- No self-reactivit

Physical properties

- Colourless
- Slightly soluble
- Specific gravity of 0.659
- Vapour density of 2.97 g/ml
- Boiling point of 60 °C
- Molecular weight of 86.17
- Easily evaporates

1. **Solvent selection:** The solvent used must be pure, should have a high solvency power, should be relatively volatile, and should have a distinct colour from that of the solute, not toxic, readily available and inflammable.
2. **Particle size:** The smaller the particle size, the greater the interfacial area between the solute and solvent and hence the higher the rate of transfer of material. Smaller size also means that the solvent will have a smaller distance to travel through the solute and hence an increase in the rate of extraction.
3. **Time:** The rate of extraction increases initially as time increases and late decreases as the extraction process proceeds.
4. **Temperature:** Increase in temperature lowers the viscosity of oils and solvents. Which in turn increase diffusion coefficient, Care must be taken in choosing extraction temperature so as to prevent explosion especially when dealing with a flammable solvent.
5. **Flake thickness:** The particle size flake thickness is directly proportional to the rate of extraction. This is because as the flake thickness decreases, the cell wall thickness also decreases thereby resulting into higher diffusion.

6. **Agitation of fluid:** This increases diffusion of the solvent and increase the transfer of material from surface of particle to bulk of solution. Agitation also prevents sedimentation and more effective use is made of the interfacial area.

7. **Moisture content:** This affects the rate of extraction as a decrease in moisture content, means a high yield of oil to be recovered.

The oil contained in groundnut is maintained in small tough cell walls and during extraction; the solvent migrates to the pore in order to extract the oil. In designing a large scale solvent extraction apparatus, particle size distribution should be considered to allow for optimum oil extraction.

Procedure:

The soxhelt apparatus was set up. A known weight of the sample was put into a thimble and covered with wool. The thimble was then placed into the extraction column of the extractor. A known volume of the solvent was poured into the round-bottom flask and placed on the heating mantle. The heater was then put on. The solvent boiled gently and recycled continuously. The set-up was left for 2-3 hours. The principle behind this experiment is that as the solvent boils, it heats up the ground nut sample in the thimble and the vapour is continuously cooled by the water supplied to the condenser.

As the process proceeded, oil from the sample settled on a part of the apparatus as the solvent evaporated. At a subsequent time chosen, the oil produced was recovered, the oil was then placed in an oven to dry any possible solvent left in the oil sample.

3.6 Analysis of extracted oil

3.6.1 Determination of Acid Value

Acid value was determined using the titre metric method of Pearson (1970). 5g of the oil sample was weighed and 75ml of hot neutral alcohol was added with a few drop of

phenolphthalein. The mixture was shaken vigorously and titrated with 0.1m NaOH solution with constant shaking until the pink coloration remains permanent. Acid value was then calculated using the formula;

$$Acid\ value = \frac{V\ x\ 5.6}{weight\ of\ sample}$$

Where, V = titration end point value.

3.6.2 Determination of Iodine Value

Iodine value was determine using the titre metric method of Pearson (1970), 1g of oil sample was weighed into a dry glass stopper bottle of 250ml capacity and 10ml of Carbon tetrachloride was added to the oil. About 20ml of wijs solution was then added and allowed to stand in the dark for 30min. 15ml of (10%) potassium iodide and 100ml of water was added and then titrated with 0.1ml sodium thiosulphate solution using starch as indicator just before the end point. A blank was also prepared alongside the oil samples iodine value was calculated from the formula:

$$Iodine\ Value = \frac{(b-a)\ x\ 1.269}{weight\ of\ sample\ (g)}$$

Where;

V_2 = titer Value for blank, V_1 = titre Value for sample (s)

3.6.3 Determination of Peroxide Value

Peroxide Value was evaluated according to AOAC (1984). 2g oil sample was weighed into a tube and1g of powdered potassium iodide with 20ml of solvent mixture (glacial acetic acid and chloroform) was added. This was them placed in boiling water for 30 sec. the content was poured into a flask containing 20ml of 5% iodide solution. The tube was then washed with 25ml of distilled water and titrated with 0.002N sodium thiosulphate solution using starch as indicator. A blank was prepared alongside the oil samples. Peroxide was obtained using the formula.

$$Peroxide\ value = \frac{2\,(V_2 - V_1)\ mEq/kg}{weight\ of\ sample\ (g)}$$

Where;

V_2 = Blark titre Value

V_1 = Sample (s) titre Value

3.6.4 Determination of Saponification Value.

The saponification Value was determined according to the titer metric method of Pearson (1981), 3g of oil sample was weighed into a conical flask and 25ml of alcoholic potassium hydroxide was added solution was heated in boiling water for 1hr. 1ml of 1% phenolphthalein was added and titrated with 0.5N HCL. A blank was prepared alongside the oil sample. The value was calculated by the formula:

$$Saponification\ Value = \frac{b - a\ x\ (28.05)}{M}$$

Where;

m = weight of oil used

b = volume of Acid

a = volume of acid for sample

3.6.5 Determination of specific gravity

A density battle was used for this. It was weighed as W_1 and than filled with oil. A stopper was inserted and then re-weighed as W_2. The battle was then emptied, washed as W_3. The specific gravity was calculated from the formula:

$$SG = \frac{W_2 - W_1}{W_3 - W_1}$$

3.6.6 Determination of Refractive index

This is the rate of sine of angle of incidence to that of sine of angle of refraction. The oil was rendered optically clear and the aid of Abbe's refracto meter, the refractive Index was read.

3.6.7 Determination of Viscosity

The viscosity was read with the aid of a viscometer.

The different varieties of groundnut used in this work are shown on plate 3.1-3.4.

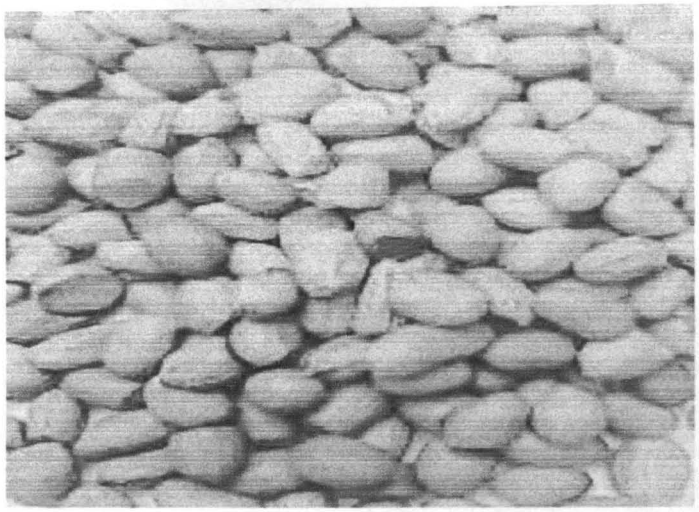

Plate 3.1: Picture of Shelled Ogoja Peanut (Local Variety)

Plate 3.2: Picture of Unshelled Ogoja Peanut (Local Variety)

Plate 3.5: Picture of SAMNUT 10 (shelled)

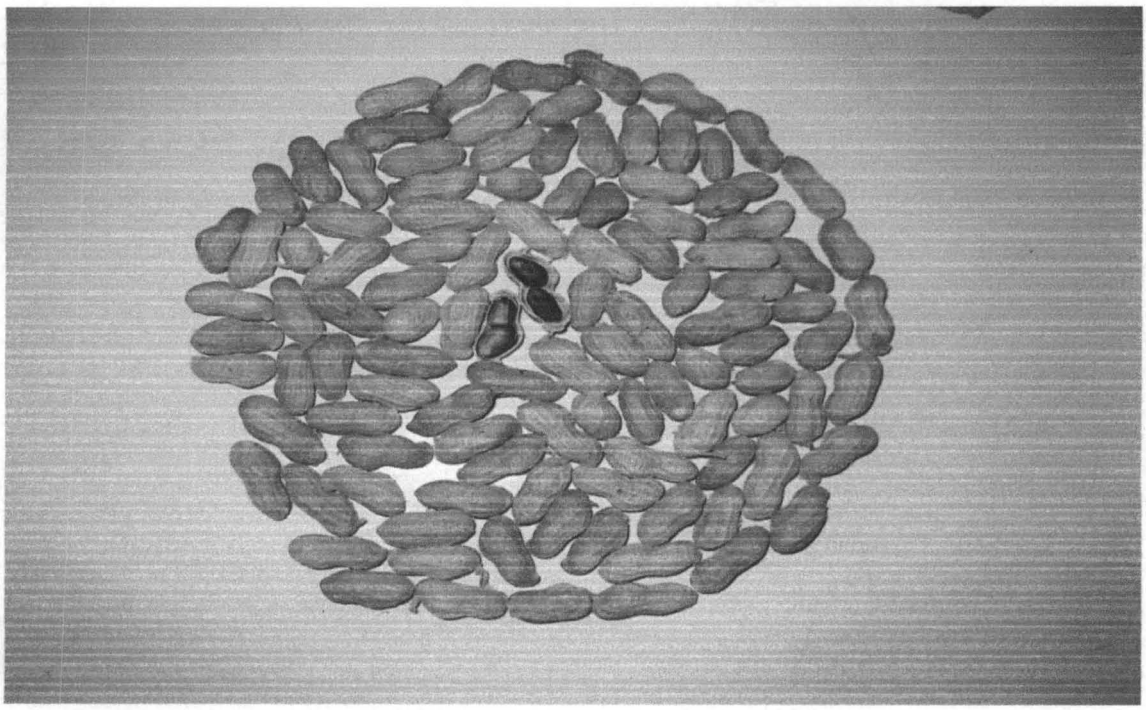

Plate 3.6: Picture of SAMNUT 10 (unshelled)

CHAPTER FOUR

4.0. RESULTS AND DISCUSSION

4.1 Presentation of results

The results obtained from the research work are presented in table 4.1 and 4.2 respectively; they include the analysis of the physical and chemical properties of the extracted oil from the two varieties of groundnut selected.

Table 4. 1. Physical properties of Groundnut oil.

Properties	SAMNUT 10	Ogoja groundnut	Standard
Moisture content (%)	7.37%	5.5%	<10%
Viscosity	54.6 kg/m^3	54.7 kg/m^3	60kg/m^3
Specific gravity	1.116	1.106	1.116

Table 4. 2. Physico – Chemical properties of Groundnut oil.

Properties	SAMNUT 10	Ogoja groundnut	Standard
Specification value (mgKOH/g)	189.24	173.91	187-196
Iodine Value (g/100g)	37.05	2.79	80-106
Acid Value (mgKOH/g)	6.01	5.6	4
Peroxide Value(MMol/kg)	3.38	2.2	10
Refractive Index	1.465	1.465	1.460-1.465

4.2 Discussion of Results

The results obtained was compared to F.A.O/W.H.O international standards for edible oils as stated by Chopra and Kanwar (1992), in Analytical Agricultural Chemistry.

Table 4.1 above show that SAMNUT 10 has 7.37% moisture content while 5.5% for Ogoja groundnut, an indication that both groundnuts are dried to safe moisture content (less than 10%), for storage without deterioration arising from moisture content.

Viscosity

SAMNUT 10 has viscosity of 54.6 while the local breed has 54.7 and this shows no significant difference, and both conform to the standard.

Specific Gravity

The specific gravity of the oil extracted from the two groundnut samples shows that SAMNUT 10 has 1.116 while the local breed ("Ogoja" groundnut), has 1.106. This shows that the two samples have similar specific gravity, which is not far from peanut (0.915) by Pearson (1981).

From Table 4.2, the result of Physico – chemical properties of groundnut oil shows that:

Saponification Value

Results of the chemical properties of groundnut investigated show that the saponification value of SAMNUT 10 is 189.24 mgKOH/g and 173.91 mgKOH/g for the local breed (Ogoja groundnut). These values are close and agreed with F.A.O/W.H.O' (187 – 196 mgKOH/g) for Groundnut. This property makes the groundnut oil useful in soap making.

Iodine Value

The iodine value for SAMNUT 10 is 37.05 g/100g and the local breed (ogoja groundnut), has 2.79 g/100g. The improved variety performs relatively higher than the local variety, though they both fall below the standard considered. The low values indicates low degree of unsaturation and classified both oil as non-drying oil, as recorded by Chopra and Kanwar, (1991) for most edible oil.

Acid Value

SAMNUT 10 has Acid value of 6.01mgKOH/g and the local breed has 5.60 mgKOH/g, these shows no difference and is close to Arachis (4.0mgKOH/g) by Pearson (1981) and Groundnut (4mgKOH/g) (Virgin oil, maximum) by F.A.O/W.H.O international standards for edible oils.

Peroxide Value

The peroxide value for SAMNUT 10 is found to be 3.38mmol/kg and 2.2mmol/kg for Ogoja groundnut shows no much difference, this property is lower than 10mmol/kg by F.A.O/W.H.O international standards for edible oils. But agreed with 2.5mmol/kg for cotton seed oil by Popoola and Yangomodou (2006). The low value indicates that the oil from both groundnuts can resist Lipolytic hydrolysis and oxidative deterioration.

Refractive Index

The refractive index for SAMNUT 10 is 1.465 and 1.465 for the local breed agreed with ground nut, 1.460 – 1.465 by F.A.O/ W.H.O. International standards for edible oils in Analytical Agricultural Chemistry by Chopra and Kanwar, (1991) this shows that both oil contained some double bond in its fatty acid composition.

CHAPTER FIVE

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

Oil from the selected ground nut varieties has been extracted, and their physical and chemical properties determined. The result of the physical properties of oil from the two varieties of ground nut agreed with Arachis by Pearson, (1981). However, from the oil characterization analysis, the saponification value for SAMNUT 10 and Ogoja ground nut are (189.24, 173.91mgKOH/g) respectively, the two varieties of ground nut also have Acid value of (6.01mgKOH/g and 5.6mgKOH/g). Their Iodine value was found to be (37.05g/100g, and 2.79g/100g) respectively. The result shows that SAMNUT 10 and Ogoja ground nut has Peroxide value of (3.38mmol/kg and 2.2mmol/kg) respectively. And Refractive Index for the two varieties is (1.465 and 1.465). The ground nuts oil based on the results can be classified as non drying oil and agreed with Arachis by Pearson, (1981) and F.A.O/W.H.O. International standards for edible oil in Analytical Agricultural Chemistry by Chopra and Kanwar, (1991). The oil is also good for soap making (considering the saponification value), and the result of the Iodine value show that the oil from the two varieties of ground nut are suitable for cooking.

5.2 Recommendations

Having determined the physico-chemical properties of two selected groundnut varieties SAMNUT 10 (Improved variety) and Ogoja groundnut (local variety), the following are therefore recommended:

1. That more instruments that will enable detail oil characterization should be made available in the laboratories of Federal University of Technology Minna.
2. Further studies should be carried out on other varieties of ground nut available locally and other improved varieties.
3. Chemical and physical properties of other oil seeds should also be determine

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APPENDIX I

Calculation of Peroxide Value

Parameters	*SAM NUT 10*	*Ogoja groundnut*
Blank titre value (V_2)	20.04ml	2.2ml
Sample (oil) titre value (V_1)	16.66ml	1.1ml
Weight of sample (oil) used	2g	1g
Peroxide value	3.38mmol/kg	2.2mmol/kg

$$Peroxide\ value = \frac{2\,(V_2 - V_1)}{weight\ of\ sample}\ (\text{mmol/kg})$$

APPENDIX II

Calculation of Acid Value

Parameters	*SAM NUT 10*	***Ogoja groundnut***
Sample (oil) titre value (V)	5.4ml	1ml
Weight of sample (oil) used	5g	1g
Acid value	6.01mgKOH/g	5.61mg/KOH/g

$$Acid\ value = \frac{V\ x\ (0.1\ x\ 56.10)}{weight\ of\ sample}$$

APPENDIX III

Calculations for Saponification Value

Parameters	SAMNUT 10	Ogoja ground nut
Blank titre value(b)	44.26ml	51.1ml
Sample (oil) titre value (a)	24.02ml	32.5ml
Weight of sample	3g	3g
Saponification Value	189.24	173.91

$$Saponification\ Value = \frac{b - a\ x\ (28.05)}{Weight\ of\ sample}$$

APPENDIX IV

Calculation of Iodine Value

Parameters	SAMNUT 10	**Ogoja ground nut**
Blank titre value (b)	39.62ml	2.2ml
Sample titre value (a)	10.42	1.1ml
Weight of oil used (m)	1g	0.5g
Iodine Value	37.05g/100g	2.79g/100g

$$Iodine\ Value = \frac{b - a\ x\ (1.269)}{m}$$

APPENDIX V

Calculation of Percentage Moisture

Parameters	**SAMNUT 10**	**Ogoja ground nut**
Weight of sample before drying (W_1)	400g	500g
Weight of sample after drying (W_2)	370.54g	472.50g
Moisture Content (%)	7.37%	5.5%

$$Moisture\ Content = \frac{W_1 - W_2}{W_1} x\,100$$

APPENDIX VI

Calculation of Specific Gravity

Parameters	SAMNUT 10	Ogoja ground nut
Weight of bottle (W_1)	10.56g	10.56g
Weight of bottle + Water (W_2)	41.26g	41.26g
Weight of bottle + oil (W_3)	38.69g	38.90g
Specific gravity	1.116	1.106

$$SG = \frac{W_2 - W_1}{W_3 - W_1}$$