Development of an Improved Motorized Nmanu Akuoyibo (Coconut Oil) Extracting Machine for Employment Generation in Nigeria

Gbasouzor Austin Ikechukwu, *Member IAENG,* Nwanekezie Martin Nduka

Abstract - This research work was carried out in order to develop an improved motorized nmanu akuoyibo (coconut oil) extracting machine with an ability to grind, break, split akuoyibo/coconut meat. The machine can be used for other oil-bearing seeds such as ground nut and palm kernel. The machine is made up of a plunger, ram dics, expression chamber, electric heater and bearings. The extractor can process 10kg nmanu akuoyibo/coconut oil per hour. An efficiency of 15% was obtained from the akuoyibo/coconut cake of 2.9kg (wet basis) while for dry basis 40% of oil was obtained from the akuoyibo /coconut cake of 2.5kg. The machine is portable, unique in design and can be use for domestic and industrial purposes for commercialization. The machine will create job opportunities for self employment in Nigeria.

Keyword: Nmanu Akuoyibo/coconut oil, extracting, grinding, process, split, mangroves, edible endosperm, endosperm layer.

1. INTRODUCTION

Extraction is a process by which substance are removed from their original component or raw state. Hence, extraction of Nmanu akuoyibo (Coconut oil) may be defined as the removal of milk from coconut meat; the oil is separated from the skin or chaff.

To achieve coconut oil extraction force is needed and the force depends on the biological nature and structure of the coconut from which the oil is to be extracted. According to Anaekwe (2011) it is generally believed that no part of the coconut oil palm tree is useless. However, Fife (2005) stated that coconut contain an edible clear liquid that is sweet and salty, it helps in busting the brain system of human.

The coconut *(Cocosnucifera)* is a member of the family Arecaceae (palm family) and is one of the nature's gifts to mankind (William, 1997). It is the only accepted species in the genus Cocos, and is a large palm, growing up to 30m tall, with pinnate leaves 4-6 m long, and pinnae 60-90 cm long; old leaves break away cleanly, leaving the trunk smooth and the term coconut can refer to the entire coconut palm, the seed, or the fruit, which is not a botanical nut (World Wildlife Fund, 2010).

Coconut has been part of peoples' diet and livelihoods in the tropical countries of Asia, the Pacific, South and Central America and Africa for thousands of years. In these areas, native meals are cooked with either coconut milk or coconut oil. The coconut palm is grown throughout the tropics for decoration, as well as for its many culinary and non-culinary uses; virtually every part of the coconut palm can be utilized by humans in some manner. However, the extent of cultivation in the tropics is threatening a number of habitats such as mangroves; an example of such damage to an eco-region is in the Petenes mangroves of the Yucatan (Foale, 2003). Coconut palms are believed to be largely cross-pollinated, although some dwarf varieties are self-pollinating. The meat of the coconut is the edible endosperm, located on the inner surface of the shell. Inside the endosperm layer, Coconuts contain an edible clear liquid that is sweet, salty, or both (Fife, 2005).

Fig. 1: Plucked Akuoyibo/Coconut from tree

Although coconut meat contains less fat than many oilseeds and nuts such as almonds, it is noted for its high amount of medium-chain saturated fat and about 90% of the fat found in coconut meat is saturated, a proportion exceeding that of foods such as lard, butter, and tallow.

There has been some debate as to whether or not the saturated fat in coconuts is less unhealthy than other forms of saturated fat (see coconut oil). Like most nut meats, coconut meat contains less sugar and more protein than popular fruits such as bananas, apples and oranges. It is relatively high in minerals such as iron, phosphorus and zinc (Nutritiondata.com). Coconut oil is extracted from the kernel or meat of matured coconut harvested from the coconut palm (Cocosnucifera). Throughout the tropical world it has provided the primary source of fat in the diets of millions of people for generations. It has various applications in food, medicine, and industry. Coconut oil is very heat stable so it makes excellent cooking and frying oil. It has a smoke point of about 360°F (180°C). Because of its stability it is slow to oxidize and thus resistant to rancidity, lasting up to two years due to high saturated fat content. In the wet process, coconut milk is made first and then the oil is extracted from the milk (Fife 2005). Coconut kernel is shredded and mixed with water. Then it is pressed and the oil is extracted. The resulting oil/water mixture is left to sit and it separates into two layers, watery on the bottom, creamy on top. The thicker cream is decanted off the top and the original method of separation involved heating or fermenting the milk to separate the oil. This

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traditional method made it very unstable oil with a short shelf life meant for quick daily use. Due to its miscible nature coconut oil cannot be separated naturally from the cream (Ohler, 1984). All high volume modern methods incorporate heating, fermentation, and or centrifugal force to separate the oil from the water. Some minor heating is generally done afterwards (often in a low temperature vacuum chamber) to drive off excess moisture and produce a more purified product and to extend shelf life. Proper harvesting of the coconut (the age of a coconut can be 2to 20 months when picked; the time of harvesting makes a significant difference in the efficacy of the oil making process) and the use of a centrifuge process make the best final extracted product(Woodruff,1970).

A. Background

Nmanu akuoyibo popularly known as coconut oil has a great use both is edible and non-edible fields in homes and industries in Nigeria: its extraction has been in low capacity per production run.

"Oil" is a collective term for more or less viscous, generally organic-chemical liquids. Depending on their chemical composition, a distinction may be drawn between fatty, essential, mineral and silicone oil. Coconut oil is one of the best oil; coconut oil is obtained from coconut meat.

The design objective in this case is to redesign and develop a motorized nmanu akuoyibo coconut oil extracting machine that will process 10kg of nmanu akuoyibo (coconut oil) per hour. In the extraction of nmanu akuoyibo (coconut oil) many process are involved namely: Traditional, solvent extraction and mechanical extraction methods.

In the design and development the method used is the mechanical extracting method, because it is suitable for production of small and large quantities of nmanu akuoyibo (coconut oil).Its time rate is faster and much manual labour is not required; therefore, it is cheaper than traditional method which required more manual labour.

This work which is a pilot development of a motorized nmanu akuoyibo (coconut oil) extraction of 10kg of coconut oil from coconut meat arose from the need to:

- Have a functional coconut oil extractor so as to reduce/minimize production cost of coconut oil extraction locally.
- Produce high quality and quantity of coconut oil within a specified time interval.

B. Objectives

The main objective of this research is to design and develop a motorized Nmanu akuoyibo/coconut oil extractor that will be suitable for cottage scale oil production.

- To modify the existing design of a coconut oil extractor
- To evaluate the performance of the extractor
- To reduce and eradicate poverty through skill acquisition and entrepreneurship
- To encourage rural formers and improve their Agricultural output.

C. Justification

Traditionally, virgin nmanu akuoyibo (coconut oil) is produced by fermentation method, where coconut milk expelled from freshly harvested coconuts is fermented for 36-48 hours, and during this period, the oil phase gets separated from aqueous phase. Further, the resulting wet oil is slightly heated for a short time to remove the moisture and finally filtered.

The main disadvantages of this process are low oil recovery and fermented odor, which masks the characteristic coconut flavor of the oil. The construction of a coconut oil extractor will help in alleviating the suffering experienced by the use of traditional oil extraction method thereby improving the quality and quantity obtained and this will also bring about the production of high grade oil.

D. Significance of Research

Increase technological development and self-reliance of youths in Nigeria. Create self-development, self worth and also enhance conversation of human energy, hence increase income. Eliminates meat poisoning and contamination by using corrosion resisting materials, and creating employment for the skilled, semi-skilled and unskilled youths in Nigeria.

E. Scope of Research

The scope of this research work ranges from:

- Proper material selection to ensure quality production.
- Proper measuring, cutting and welding of joints.
- Proper assembling of parts for developing of the machines.
- Dehusking and removal of the shells cracked in order to obtain the akuoyibo/coconut meat to ensure optimum/proper grinning efficiency.
- Carrying out of machine analysis.

F. Limitations/Modification

The machine was design mainly for the extraction of nmanu akuoyibo (coconut oil) the existing extractor consists of four integral parts namely: The expression chamber, the plunger, the compression plate, and the frame. The major problems facing the existing extractor are listed below.

- Instability of plunger
- Leakages of hydraulic oil
- Light thickness of expressing chamber which can cause damages of the chamber during compression
- Irregularity in shape of compression plate or ram press.
- No electric heater was supplied with design because its limitation is that it's still a proposal.

II. THE ECONOMIC IMPORTANCE OF NMANU AKUOYIBO (COCONUT OIL) EXTRACTOR

They are seven (7) countries which produce major quantities of coconut in the world, India, Indonesia, Malaysia, Mexico, New Guinea and Papua, Philippines, Sri Lanka

In the world Nigeria is not known to produce coconut in large quantities but we have little plantations in Akungba (Ondo State), ldi-Orogbo (Ogun State) etc. As such it stands as the nation's pride.

Coconut is available in two forms viz.,

- Wet material

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- Dry materials

These materials are commonly known as wet coconut and dry coconut or copra. The oil can be extracted from both these raw materials. However, in India and Sri-Lanka, it is a general practice to use only copra for oil extraction and the oil is used for food and cosmetic purposes. In Philippines, the oil is extracted from wet coconut also and is known as virgin coconut oil. In some countries solvent extraction of the dry coconut followed by refining, bleaching and deodorization is carried out to get the refined bleached and deodorized coconut oil. The technology for the production of coconut oil through expellers is well developed and many medium scale industries in India produce oil by this method. However, some small scale industries produce the oil by processing fresh coconut also using local expeller press.

Problems of sediments and rancidity persist in these oils (Cornelius, 1973). In the Cook Islands in the South Pacific, particularly Rarotonga Island, slices of fresh, mature coconut kernel are served with fruits after every meal. In India, the use of coconut for food and its applications in the Ayurvedic medicine were documented in Sanskrit 4000 years ago (Kabara, 2000).

Records show that in the United States, coconut oil was one of the major sources of dietary fats, aside from dairy and animal fats, prior to the advent of the American edible oil(soybean and corn) industry in the mid-1940s (Dayrit, 2005). Dayrit has reviewed the long history of usage and the diverse studies done to characterize and define the composition of the various components of the coconut tree, its fruit and the related products derived from it, established the coconut's uniqueness and superiority among agricultural crops and every part of the coconut tree and its fruit can be either consumed by humans or animals or converted into other valuable products. If properly utilized, the coconut has the highest economic value among the palm family. This is why the coconut is normally referred to as the Tree of Life, Man's Most Useful Tree, King of the Tropical Flora, Tree of Abundance.

A. Nmanu Akuoyibo (Coconut Oil)

Oil obtained from the fresh, mature kernel (meat) of the coconut by mechanical or natural means, with or without the use of heat, without undergoing chemical refining, bleaching or deodorizing, and which does not lead to the alteration of the nature of the oil. Virgin coconut oil is suitable for human consumption without the need for further processing (Fife, 2005). Virgin coconut oil consists mainly of medium-chain triglycerides, which are resistant toper oxidation. The saturated fatty acids in virgin coconut oil are distinct from animal fats, the latter consisting mainly of long-chain saturated fatty acids (Furman). The Philippine National Standard for Virgin Coconut Oil officially defines Virgin Coconut Oil as the purest form of coconut oil, essentially water clear or colorless. It contains natural Vitamin E and has not undergone any hydrolytic and atmospheric oxidation as demonstrated by its very low, free fatty acid (FFA) content (even without refining) and low peroxide value. It has a fresh coconut aroma that can be mild to intense depending on the oil extraction process used. Virgin coconut oil differs greatly from traditionally produced, copra derived coconut oil, which must undergo chemical refining, bleaching and deodorization processes to make it suitable for human consumption. RBD (Refined, Bleached and Deodorized) coconut oil made from copra is yellow in color, odorless, tasteless and does not contain natural Vitamin E, since this is removed when the oil is subjected to high temperature and various chemical processes.

B. Characteristics of Nmanu Akuoyibo/Coconut Oil and Uses

The degree of saturation and length of the carbon chain of the fatty acids comprising particular fat or oil determines its properties, corresponding uses and its effects on human health.

The more saturated the fat and the longer the chain, the harder the fat and the higher the melting point (Fife, 2001). Coconut oil is unique amid fats and oils, as it contains the highest percentage of Medium Chain Fatty Acids (MCFA) with a carbon-chain length of 8 to 12 carbon atoms. Virgin coconut oil (VCO) behaves and metabolizes differently in the human body to other saturated and unsaturated fats or oils. MCFA in coconut oil is about 64%, with lauric fatty acid (C12) as the highest ranging from 47 to 53% depending on the coconut variety (Babayan, 1968). Babayan has reviewed that the most significant physical property of coconut oil is that unlike most fats, it does not exhibit gradual softening with increasing temperature, but passes rather abruptly from a brittle solid to a liquid within a narrow temperature range. In this respect, it resembles cocoa butter (Spectrum of Coconut Products, Philippine Coconut Authority. undated). Coconut oil is liquid at about 2rc or higher and solidifies at about 2rc when it has the consistency of butter in temperate countries. Copra-derived coconut oil has been produced and used commercially for almost a century as such, its use for edible and inedible applications have already been well established (Banzon, 1990). For edible purposes, coconut oil is generally used as (Banzon, 1990):

- As a frying and cooking oil because of its excellent resistance to rancidity development.
- It is also used as a substitute for expensive butter fat in filled milk, filled cheese and ice cream making these products cheaper without changing their palatability.
- When hydrogenated, coconut oil is used as margarine, shortening and baking fat. Other edible applications of coconut oil are (Banzon, 1990):
- As a source of fat in infant formulas and baby foods because of its easy digestibility and absorbability;
- As a spray oil for crackers, cookies and cereals to enhance flavour, increase shelf-life and impart a glossy appearance;
- As an ingredient in confectionaries such as candy bars, toffee, caramels, etc.

C. Home Uses of Coconut Meat

Food and Bakery: Nmanu akuoyibo (coconut Oil) is known to confer special attractive physical features and aroma to bakers of bread. It is also used for making other baked products; hence it is suitable for making margarine, chocolate and some other related food products. Nmanu akuoyibo (coconut oil) is further used at home for frying and cooking different types of food like plantain chips, potatoes, stew, fried fish, akara, moi moi etc.

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Uses as Cosmetics: Home made coconut extracted from fresh mature meat Coconut oil can be used as a skin moisturizer, helping with dry skin and reduces protein loss when used in hair. Therefore, the current emerging major uses of virgin nmanu akuoyibo (coconut oil) stated by Fife (2005) are as follows:

- A hair and skin conditioner;
- An oil base for various cosmetic and skin care products;
- A carrier oil for aromatherapy and massage oils;
- A nutraceutical and functional food.

Before the advent of electrical lighting, coconut oil was primary oil used for illumination in India and was exported as Cochin oil. Coconut is an important base ingredient for the manufacture of soap. Soap made with oil tends to be hard, although if retains more water than those made with other oils and therefore increases manufacturer yields. It is more soluble in hard water and salt water than other soaps allowing it to lather more easily. A basic coconut oil soap is clear when melted and a bright white when hardened. A repellent made from coconut oil may be effective to prevent tungiasis-causing sand fleas from penetrating the skin.

Fundamental Performance

- It serves as an important source of energy in the diet.
- It supplies specific nutritional requirements.
- It provides a lubricating action in dressings or leavening effect in baked items.
- It acts as carrier and protective agent for fat-soluble vitamins.
- It enhances the flavor of food.

D. Industrial Uses of Coconut Meat

Coconut oil has been tested for use as a feedstock for biodiesel to be used as a diesel engine fuel. In this manner, it can be applied to power generators and transport using diesel engines. Since straight coconut oil has a high gelling temperature (22-255^{o}c), a high viscosity, and a minimum combustion chamber temperature of 500°c (932°f) (to avoid Polymerization of the fuel), coconut oil typically is transesterified to make biodiesel. Use of BI00 (100% biodiesel) is possible only in temperate climates, as the gel point is approximately 10°c (50^{o}f). The oil must meet the Wiehenstephan standard for pure vegetable oil used as a fuel, otherwise moderate to damage from carbonization and clogging will occur in an unmodified engine.

Fuel and Biodiesel:

The Philippines, Vanuatu, Samoa, and several other tropical Island countries are using coconut oil as an alternative fuel source to run automobiles, trucks, and buses, and to power generators. Coconut oil is used as a fuel for transport in Philippines. Further research into the potential of coconut oil as a fuel for electricity generator, Africans use nmanu akuoyibo (coconut oil) to fuel native lamps for lighting in rural communities that are not connected to electricity. Although till date it appears that it is not useful as a fuel source due to the cost of labour and supply constraints. Coconut oil has been tested for use as an engine lubricant and as transformer oil. Acids derived from coconut oil can be used as herbicides. Coconut oil (and derivatives, such as coconut fatty acid) are used as raw materials in the manufacture of surf act ants such as cocamidopropyl betaine, cocamide MEA, and cocamide DEA.

The major inedible use of coconut oil is as a raw material in the manufacture of laundry and bath soaps; as coconut chemicals for production of biodegradable detergents, shampoos, shower gels and other cleaning agents; for cosmetics and toiletries; for foam boosting of non-coconut oil based soaps; for the production of synthetic resins and plasticizers for plastic etc. (Pattra, 2004). In Thailand, coconut oil is mixed with 10 to 20% kerosene, settled to remove free fats, filtered and used as a diesel fuel substitute. In Vanuatu and other Pacific Islands, coconut oil is used directly as a substitute for diesel (Bawalan, 2005).

E. Coconut Oil Processing Technology and Equipment

Virgin coconut oil can be produced directly from the fresh comminuted (grated, chopped, granulated) coconut meat, or from coconut milk, or from coconut milk residue. The choice of the technology to be adopted depends to a great extent on the scale of operation, the degree of mechanization desired, the amount of investment available and the demands of the prospective buyer. The scale of operation to be implemented is significantly dependent on the available coconut supply base (Weiss, 1999). Oil can be extracted manually by pressing softer oilseeds and nuts, such as round nuts and Shea nuts, whereas harder; more fibrous materials such as copra and sunflower seed can be processed using Ghanis. Pulped or ground material is loaded into a manual or hydraulic press to squeeze out the oil-water emulsion. This is more efficient at removing oil than traditional hand squeezing, allowing higher production rates. Fresh coconut meat is removed from the shell using a manual or (Weiss, 1999) motorized grater (Fig. 2).

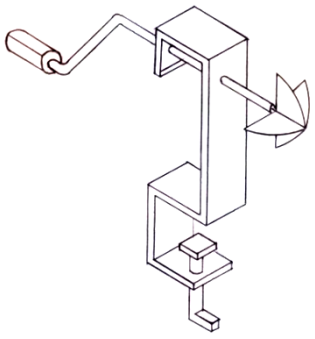

Fig. 2 Manual Akuoyibo/Coconut grater as stated by UNIFEM {1986}

While UNIFEM (1987) classified expression devices in three categories viz:

1. plate presses
2. ghanis
3. expellers.

Oil plate presses are of two types:

1. screw press
2. hydraulic press.

Presses have a number of different designs, commonly based on a bridge press. In all types, a batch of raw material is placed in a heavy-duty perforated metal cage and pressed by the movement of a plunger. The amount of material in the cage varies from 5-30 kg with an average of

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20 kg. Layer plates can be used in larger cages to provide a constant pressure through the bulk of material and speed up removal of oil. The pressure should be increased slowly to allow time for the oil to escape. Screw types are more reliable than hydraulic types but are slower and produce less pressure. Potts (1993) reviewed that in a hydraulic press, pressure is exerted by a hydraulic device which requires a heavy - rigid framed structure. Hydraulic presses

F. Traditional/Mechanized comparism

Having completed this extraction, it is important to note the following comparism between the mechanized extraction and the traditional method. Or we may say the advantage mechanized extraction has over the local method.

- The mechanized extraction saves time unlike the traditional method which is time consuming.
- In mechanized extraction, a greater percentage of oil is obtained unlike the traditional method where much oil been loss.
- The stress undergone in the traditional method is highly reduced when it is done mechanically.

However, in traditional method, the mechanized extraction has disadvantage, if not properly checked the fluid will contaminate the oil.

Extracted Nmanu Akuoyibo/Coconut Oil.

Fig. 3: Nmanu Akuoyibo/Coconut Oil

After much heating, the oil was then extracted till no further oil was coming out from the coconut meat.

In order words health risks are minimized more in the traditional method when compared to mechanized extraction.

III. DESIGN OF NMANU AKUOYIBO/COCONUT OIL EXTRACTING MACHINE

In the design of nmanu akuoyibo/coconut oil extracting machine many thing were considered when analyzing the system.

Manufacturing processes includes the processes involved in using various construction methods in producing the extracting machine. In manufacturing, the principal common characteristic is that something physical is being produced or created i.e. output consists of goods or machine, which differs physically.

Manufacturing therefore requires some physical transformation or a change in utility of resources. The parts are different components that when assembled make up the unit in such processes care precision should be the top most priority when carrying out the construction. As far as the selection of material for the construction of machine component and parts is a vital aspect of design.

A. Theoretical Design Methodology

In this study the improved coconut oil extractor. The coconut oil extractors are capital intensive and of complex design and construction. Although these are of high production capacities and are appropriate for the producer on small scale with limited supply of coconut. A functional, manually hydraulic operated oil extractor containing a finely perforated cylinder which carries an internal pressure plate that can be moved upwards and downwards within the cylinder was modified.

B. Design Features

The following points are considered:

- The design should be simple and the construction should be at minimum cost.
- Power requirement to operate the equipment should be minimal. This is to be achieved by providing means for efficient power utilization.
- The component parts should be easily replaceable in case of any damage.

C. Design Conception

Base on the above, the following specifications were conceived:

- The extractor is a cage/screw press type. It inculcates plunger (shaft) with an expression chamber. The plunger (constitute hub and shaft) is to be bolted at the top of the frame.
- The input capacity of the extractor is to be 10kg per batch.

D. Design Assumption

For simplicity of design, the following assumptions are made;

- A technologies has an average power of 0.05kw can conveniently apply a hand force of 210N at a speed of 60rpm for the time duration depending on the material being compressed (Sanders and McCormick, 1987).
- In one revolution of the screw shaft, discharge of coconut oil is advance by one pitch of the hydraulic pump.

IV. DESIGN ANALYSES OF COMPONENTS

The process description for the mechanical extraction of 10kg of nmanu akuoyibo (coconut oil) per hour is as follows:

Before the commencement of the extraction proper, a laboratory test was carried out to determine the composition of nmanu akuoyibo (coconut oil) in a given quantity of akuoyibo (coconut) using solvent extraction method. The coconut oil extractor made up of the following components:

- Hydraulic pump
- Plunger/ram (constitute hub and shaft)
- Ram disc
- Expressing chamber
- Electric heater

The design of each component is described as follows:

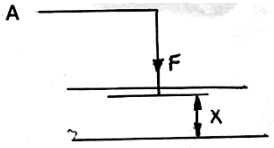

Fig 4: Hydraulic pump requirement of the plunger shaft

At point end A of the plunger (shaft), a force F is applied at distance x from the axis of the ram disc attached to the

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bottom of expression chamber where the coconut materials being compressed. The turning moment transmitted by the shaft is, T= Fx.

From design assumptions, a force of 210N can be applied by a man at a speed of 60rpm and at a distance 0.2m from the axis and tangential to the shaft .i.e.

T = 210 x 0.2 = 42Nm (1)

The pressure required from the pump to express the coconut oil from the Coconut base on the maximum applicable load is given as:

Pressure, P = F/ A (2)

P = pressure required from the pump

F = 210N

A = rrd2/4

Where d = diameter of the expression chamber which is 240mm

A = 3.142 x 0.242/4

=0.0452m2

P= 210/0.0452 (3)

p= 4.6KN/ m2

Therefore, the pressure required from the pump to extract oil from the coconut cake is 4.6KN/m2

The power requirement to pump the hydraulic through the handle and eventually express the coconut oil from the coconut based on the maximum applicable load is given as;

Px =2rrNT (4)

Where;

N = Speed of rotation = 60rpm (in the design assumption)

T = Torque on the shaft = 105Nm (5)

A. Design of Shaft

The extractor shaft is to be designed on the basis of torsional load only. These involve analyses based on strength and rigidity.

B. Strength Criterion

The required diameter for a solid shaft having torsional load only is obtained from ASME code equation (Hall, et al., 1980) as follow:

D3 = 16T /5 (6)

Where,

S = allowable stress = 55Mpa (for shaft without keyway)

T = Torque (7)

A. Torsional Deflection

The design of shaft for torsional rigidity is based on the permissible angle of twist. The permissible angle of twist for steel is 3deg/m [Surrender, 1979).

For limiting the twisting to the given limit, the angle of twist (radian)

θ =TL/GJ (8)

where,

T = Torque (Nm) = 42Nm (3.5.2.1)

L = Length of shaft (m) = 0.6m (assumed)

J = Polar moment of inertia for the shaft section = rrD4/32 (for circular shaft)

G = Modulus of rigidity of the shaft material = 80GN/m2

From the above equation, the polar moment of inertial will be equal to:

J = TL/G8 (9)

For both stress and the twist to be within permissible limit, a steel shaft (plunger) of 25mmdiameter is chosen.

B. Weight of Shaft

The weight of the shaft is expressed below:

Ws = S8 V8 g (10)

C. Ram Disc

The ram disc (working like a piston) is expected to compress the material fed into the expressing chamber as a result of the axial pressure from the hydraulic pump, the material being extracted at the same time exert a pressure equal but opposite on the point face. This force and pressure considerations necessitate the choice of a rigid and strong material for the point. A stainless steel of 240mm in diameter and 40mm long is chosen.

The weight of the piston,

Wp = SpVp g (11)

D. The Expressing Chamber Type Equation here.

The chamber is to be designed on the basis of internal pressure only. If the housing is treated as a thin walled cylinder, then using the standard stress (stiffness) analysis applied to thin walled pressure vessels (Surrender, 1979), the maximum shear stress,

0= Pr/ 4t (12)

Where;

σ = the maximum stress the cylinder will be subjected to at failure by yield. For steel, the ultimate or yield stress is 140MN/m2 the stress using a factor of safety of 2 is 70MN/m2.

P = Internal pressure which equal to 35MN/ m^2

r = internal radius of the cylinder = 0.120m

t = thickness of the cylinder

From the design, expression chamber of 15mm thickness is require to withstand the pressure which will be too costly for stainless steel and therefore stainless steel cylinder of 5mm was selected and mild steel plate of 10mm thickness were cut and place at the bottom of expression chamber (ie. expression chamber sit on the mild steel plate which resist the pressure as the materials being compressed).

E. Torsional Springs/Returning spring

Helical spring made up of circular diameter was selected based on the following equation.

T = W (0/2) {Khurmi, Guputa (1979)} (13)

Where T = Torque (N.m)

D= Mean Diameter of the spring coil

W = Axial load on the spring

From the design T ~ 42Nm, W= 210N

D = 42x 2/210= 0.4m

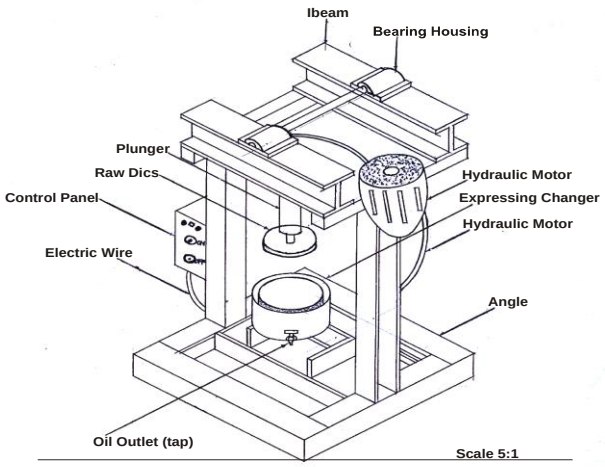

Fig. 5: The Designed Nmanu Akuoyiobo (Coconut Oil) Extracting Machine

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Table 1: Various components of nmanu akuoyibo coconut oil extracting machine

Item	Description	Item	Description
1	I beam	**2**	Bearing Housing
3	Hydraulic Motor	**4**	Hydraulic Hose
5	Angle	**6**	Oil Outlet (Tap)
7	Expressing Chamber	**8**	Plunger
9	Ram Disc	**10**	Control Panel
11	Electric Wire		

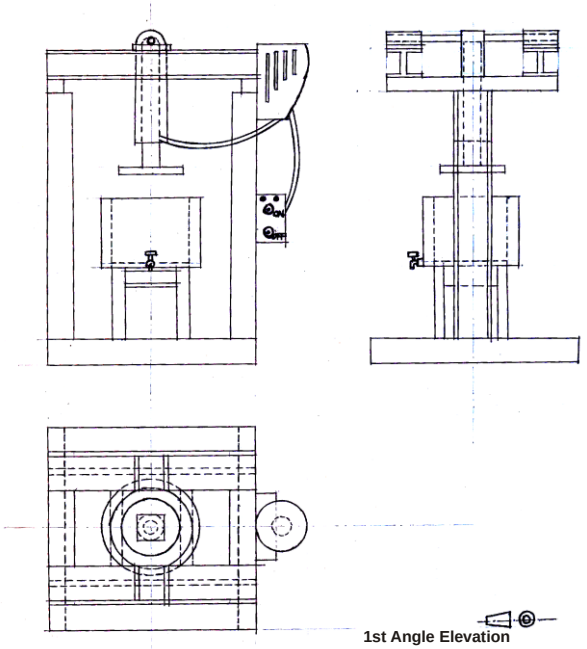

Fig. 6: Technical Views of Nmanu akuoyibo Coconut Oil Extracting Machine

V. CONCLUSION AND RECOMMENDATION

This research work has successfully presented a functional and highly efficient low cost Nmanu Akuoyibo (Coconut oil) extractor by minimizing the traditional technique of extracting and health condition of individual, by avoiding labour in convenience in other to improve a healthy and hygienic condition of an individual. It is expected that an average home, industries in Nigeria can afford the machine. This machine is design for home and industrial usage.

Furthermore, in this research, we recommend that in order to achieve a better operation and more efficient oil extraction, increasing the efficiency of the machine an electric motor should be employed in the machine construction. The room for improvement of the efficiency and physical outlook of the machine. Cleanness of the machine after processed coconut meat must be adopted in every six hours of end product as to enable it free from grease/ hydraulic fluid mixing with the coconut oil and adhering product particles. Filtration method should be included for large scale production. The development of the machine is subject to serve as a stepping stone for further and well defined fabrication.

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