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PRODUCTION OF CASTOR OIL FROM RICINUS COMMUNIS AND ITS PHYSICOCHEMICAL CONSTITUENTS IN COMPARISON WITH PALM OIL

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1. Abstract

The aim of this paper work is to produce castor oil and compare the physicochemical characteristics of pam oil and castor oil from *Ricinus communis*. The *Ricinus communis* is the important crop and has good quality and be in medicinal and industries according to good standard of free fatty acid, total acidity; peroxide value; saponification value and moisture content. Here, the seeds were cleaned and crushed. The oil was extracted by solvents extraction, the peroxide value of castor oil was tested and the result was 11.6±2.98. Accordingly, the castor oil has longer shelf life than palm oil where its value of palm oil was 10.6±3.93. The free fatty acids were tested the results were 0.33±0.86. This implies that castor oil has less free fatty acid compared to the palm oil which cause the castor oil to be good in human body. The saponification value was tested and the result was 194±6.01. The castor oil has lower saponification than palm oil where palm oil was 209±8.01 while castor oil was 194±6.01 due to the Ricinoleic chain present in castor oil. The total acidity was tested and the result showed a value of 0.68±0.17; which is lower than palm oil. Lastly, the moisture content was tested the result was 5.00±0.78. Therefore, the castor seed oil contains a good amount of oil with good physicochemical characteristics and it could be one of the promising sources of medicinal oil in Rwanda.

Keywords: *Castor oil, Ricinus Communis, Extraction, Palm oil.*

2. Introduction

Castor oil is a vegetable oil obtained by pressing the seeds of the castor oil plant (*Ricinus communis*) (Weiss et al., 2000). The common name "castor oil", from which the plant gets its name, probably comes from its use as a replacement for castoreum, a perfume base made from the dried perineal glands of the beaver (Ogunniyi, 2006). Castor oil is one of the most versatile vegetable oils obtained from the castor bean. Its unique chemical composition makes it useful in a large number of applications. It has found usage in many chemical industries. It is a raw material for paints, coatings, inks, lubricants and a wide variety of other products (Ogunniyi, 2006). It is a triglyceride in which approximately ninety percent of fatty acid chains are ricinoleic acid.

Castor oil is fast becoming one of the most sought-after plant oils, owing to its rich properties and variety of end-uses in lubricant, pharmaceutical and cosmetic preparations. Castor oil was one of the world's first medicinal oil because it naturally contains a unique and beneficial mixture of triglycerides or fatty acids (Caupin, 1997). The presence of unusual hydroxy fatty acid ricinolate (ricinolein acid) makes this oil very unique by imparting very high density to the oil. Castor oil is a colorless to very pale-yellow liquid with mild or no odor or taste. Various attributes of castor oil like unsaturated bonds, low melting point (5°C), very low solidification point (−12°C to −18°C), high boiling point (313°C), high density (961 kg/m3), with the highest and most stable viscosity (9.5–10.0 Pa s-1) make it industrially useful than any other vegetable oil (*Miller et al., 2009*).

As of 2008, three countries (India, China, and Brazil) produced 93% of the world's supply of castor oil. Because production is concentrated mainly in these three countries, total castor production varies widely from year to year due to fluctuations in rainfall and the size of the areas utilized for planting. As a consequence, this concentration has led to cyclic castor production. Thus, diversification of castor production regions and production under irrigation would hopefully reduce the climatic impact on castor supplies*(Patel et al., 2016).* Castor (*Ricinus communis L.*), belonging to the family of Euphorbia plants, is a perennial plant of 1–2 m, and, in special cases, 3–5 m in height. It is grown in tropical and subtropical regions and produces seeds over a period of 10–15 years. In the mid-1980s, the hectare yield was an average of 650 t, with the highest being in the Philippines (3 636 ton/ha) and the lowest in Burundi (160 ton/ha; Ricinolein acid (12-

hydroxy-9-cis octadecenoic acid) a major component of castor oil is an unsaturated omega 9-fatty acid that naturally occurs in mature castor seeds. Ricinolein acid is abundant in castor oil (90%) but many common vegetable oils and oil seeds contain lower amounts of this particular fatty acid; its content amounts to 0.27% in cottonseed oil and 0.03% in soybean oil (*Yamamoto et al., 2008*). Ricinolein acid was discovered in 1848 (*Miller et al., 2009*). 2 The seed oils of *Jatropha gossypifolia* and *Hevea brasiliensis* were also found to contain high content of ricinolein acid (about 18%). Apart from ricinolein acid, castor oil also contains saturated fatty acids like palmitic acid and stearic acid (*Weiss et al., 2000*). Castor oil is a colorless to very pale-yellow liquid with a distinct taste and odor once first ingested (Duke, 1983).

Castor oil and its derivatives are used in the manufacturing of soaps, lubricants, hydraulic and brake fluids, paints, dyes, coatings, inks, cold resistant plastics, waxes and polishes, nylon, pharmaceuticals and perfumes. (Mutlu & Meier, 2010). Castor oil or what can be known as castor oil is vegetable oil produced from castor seeds. This jatropha plant has large oil content, which is around 55% in the seed core or 33% of the total seed weight. The oil can be produced by extracting castor seeds with mechanical presses. Castor oil can be used as a basic ingredient in making soap because it has high saturated fat content which is a major component in soap making. In addition, castor oil can also be used to dilute scar keloid, This is due to the ability of castor oil to penetrate through several layers of skin (Arasaretnam & Venujah, 2019).

Castor oil is a tasteless and odorless vegetable oil that is extracted by pressing of the seeds of the castor plant, scientifically known as *Ricinus communis(Ankul Singh et al., 2020*). Castor seeds are rich in triglyceride, which is what makes them so valuable. They also contain small amounts of a toxin called ricin, which is potentially deadly in concentrated or excess amounts. About half a century ago, castor oil was a nightmare for many children, and there were sufficient reasons for that. It was extensively used as a purgative and, most peculiarly, as a medicine against almost all ailments in children and the elderly. These possible illnesses ranged from a cough, cold, and fever to constipation and indigestion (Ibrahim & Ahmed, 2016).

Castor oil was also used to treat other problems such as ingestion of any poisonous material, tapeworms and roundworms, and skin diseases. Stomach malfunctioning was believed to be the root of all the problems. So, a thorough cleansing of your digestive system would eliminate them

altogether. All the medicinal uses of this oil are mostly due to its germicidal, toxic, purgative, and disinfectant properties (*Falasca et al., 2012)*. Castor plant grows optimally in tropical summer rainfall areas. It grows well from the wet tropics to the subtropical dry regions with an optimum temperature of 20–25°C. The high content of the oil in the seeds can be attributed to the warm climate conditions, but temperatures over 38°C can lead to poor seed setting. Additionally, temperatures low enough to induce the formation of frost is known to kill the plant.

The castor bean consists of a capsule containing dark brown seeds that are 9–20 mm long, 6–15 mm wide and 4.5–9 mm thick. The seeds have a kernel that accounts for ∼25% of the seed weight. The thousand-seed weight is ∼650 g, the bulk weight ∼400 g/L. The seeds contain lipolytic enzymes that act so vigorously that slight damage to the seed leads to enormous fat splitting Varieties that do not burst are harvested from the bush after drying; others must be gathered before drying *(Vasas et al., 2012).*

Ricinus communis (*Euphorbiaceae*), commonly known as castor oil plant, is a soft wooden small tree developed throughout tropics and warm temperature regions . This plant is indigenous to the southeastern Mediterranean Basin, Eastern Africa, and India but is widespread throughout tropical regions and is widely used as an ornamental plant . The plant is known to display antimicrobial activity and has been used to treat several ailments. Its leaf, root, and seed oil are used in inflammation treatment, liver disorders, hypoglycemic, and as a laxative. In Tunisia, the plant is used as a contraceptive. The plant is also used in African folk medicine in the treatment of warts, cold tumors, and indurations of mammary glands, corns, and moles. anti-inflammatory, antioxidant, antimicrobial, and cytotoxic activities of the plant was demonstrated*(Ghulam et al., 2012).*

Ricinus communis is classified as the most poisonous plant on earth for humans. The toxicity of raw castor beans is due to the presence of ricin, a naturally occurring lectin (a carbohydrate-binding protein). Ricin is a globular, glycosylated heterodimer of approximately 60–65 kDa. Ricin toxin A chain (RTA) and ricin toxin B chain (RTB) are of similar molecular weights, approximately 32 and 34 kDa, respectively. RTA is an *N*-glycoside hydrolase composed of 267 amino acids. It has three structural domains with approximately 50% of the polypeptide arranged into alpha-helices and beta-sheets. RTB is a lectin composed of 262 amino acids that is able to bind terminal galactose residues on cell surfaces (*M*onda*l et al., 2019)*.

Ricinus communis plant mainly the oil derived from its seed has primary constituent, Ricinolein Acid, along with certain of its salts and esters that functions primarily as skin-conditioning agents, emulsion stabilizers, and surfactants in cosmetics(Fiume, 2018). *Ricinus communis* plant is now grown in tropical and warm temperate regions throughout the world and is becoming an abundant weed in region of east Africa. In Rwanda, *Ricinus communis* plants grow naturally over a wide range of geographical regions and is taken as weed to the majority of farmer.

The presence of ricinolein acids, oleic acid, palmitic acid, stearic acid and dihydroxyl stearic acid in *Ricinus communis* oil is an indication of good quality that can be utilized for use in cosmetics and soap industries. The aim of the study of production of physicochemical properties of castor oil from *Ricinus communis* is about reduction of high cost of body lotion due to the presence availability of the *Ricinus communis* that became the raw materials used to produce oil, that is the reason why the oil produced from *Ricinus communis* will be more affordable in terms of cost, and the value of *Ricinus communis* it can be increase on market. The oil dilute scar in a cosmetics condition, reduction of waste increases profit, reduces liability and also creates good public relations. Oil extraction can contribute to reduction of waste and it can be the solution to food industries and benefits to producers of *Ricinus communis*. Therefore, the extraction of oil from *Ricinus communis* is of great significance.

3. Materials and methods

3.1 Seed Collection and Preparation

Seeds were obtained from castor plants grown in Mwendo sector, Bwemeramana cell in Ruhango District, Southern Province, Rwanda. Harvested ripe castor fruits were manually cleaned and sun-dried for 4-5 days to reduce the moisture content, until fruit capsules split open to discharge encased seeds. This was followed by seed pod removal and tray-winnowing to separate shells from beans (cotyledons). Castor beans were further dried (per 100g sample) at 500 ^{o}C to constant weight for 9hrs in a hot air oven. The beans were then ground to a paste using mortar and pestle, prior to extraction (*Omari et al., 2015*).

Figure 1: Castor seeds from Ruhango District

Source: Photo taken by Author, September 2022

3.2 Oil Extraction

Castor bean paste was wrapped in clean cloth and mechanically cold-pressed (below 450ºC) using a manual machine extractor to obtain clear, viscous, pale-yellow virgin oil (Ogunniyi, 2016). 8.42kg of paste yielded 3.20 litres of the virgin oil. Percentage oil yield was evaluated using the expression (Muzenda et al., 2012):

$$\%Yield = \frac{Y1-Y2}{Y1} * 100$$

Where Y_1 and Y_2 are the weights of castor beans before and after extraction. After settling for about 1 hr. good quality cold-pressed oil was further purified by filtration through sintered glass (fine mesh screen) in a Buchner funnel. This was to eliminate any dust, gum or other particulates present. The purified oil was kept in tightly stoppered dark bottles and stored in a refrigerator at 40ºC.

3.3 Castor oil filtration/purification

Following extraction of the oil through the use of a press, there still remain impurities in the extracted oil. To help the removal of the remaining impurities, filtration systems are usually employed. The filtration systems are able to remove large and small size particulates, any dissolved gases, acids, and even water from the oil The filtration system equipment normally used for this task is the filter press. Crude castor seed oil is pale yellow or straw colored but can be made colorless or near colorless following refining and bleaching. The crude oil also has a distinct odor but can also be deodorized during the refining process (*Akpan et al., 2016*).

3.4 Castor oil refining

After filtration, the crude or unrefined oil is sent to a refinery for processing. During the refining process, impurities such as colloidal matter, phospholipids, excess free fatty acids (FFAs), and coloring agents are removed from the oil. Removal of these impurities facilitates the oil not to deteriorate during extended storage. The refining process steps include degumming, neutralization, bleaching, and deodorization. The oil is degummed by adding hot water to the oil, allowing the mixture to sit, and finally the aqueous layer is removed. This process can be repeated. Following the degumming step, a strong base such as sodium hydroxide is added for neutralization. The base is then removed using hot water and separation between the aqueous layer and oil allows for removal of the water layer. Neutralization is followed by bleaching to remove color, remaining phospholipids, and any leftover oxidation products. The castor oil is then deodorized to remove any odor from the oil. The refined castor oil typically has a long shelf life about 12 months as long as it is not subjected to excessive heat (*Conceição et al., 2017*).

3.5 Bleaching

Castor oil is used for many applications where the final product's appearance is extremely important. For instance, cosmetics formulations, lubricant additives, and biomaterial manufacturing all demand the final product's color to be within a certain limit. Although castor oil obtained after degumming and neutralization processes yield a clear liquid by appearance, it may still contain colored bodies, natural pigments, and antioxidants (tocopherols and tocotrienols), which were extracted along with the crude oil from the castor beans. The color pigments are extremely small ranging from 10 to 50 nm, which cannot be removed from the oil by any unit

operation. However, an adsorption process called “bleaching” can be used to remove such colored pigments and remaining phospholipids, using activated earths under moderate vacuum conditions between 50 and 100 mmHg. The reduction in the oil color can be measured using an analytical instrument, called a tintometer (*Perea-Flores et al., 2011).*

3.6 Characterization of Castor Oil

3.6.1 Physical analysis

PH of 2.30g dispersion of the oil in 15cm3 hot water was determined (after cooling to 30 ^{o}C in a water bath) with the aid of a glass electrode pH meter (HANNA-209-209R). A soxhlet extractor was used for solvent extraction of the oil. Refractive index was measured at 30^{o}C using a refractometer couple with thermometer, calibrated specimen and light source, DIGITAT REFM960.4d.p. Procedure was followed by place a small amount of oil (usually like 2-5 drops) on the prism, and secures the cover plate. This will evenly distribute the liquid on the prism. Point of the prism end of the refractometer toward a light source and focus the eyepiece until the scale is clearly visible.

The measurement of specific gravity also followed AOAC (1990) procedure. Relative viscosity of oil (in chloroform) was determined at 300 ^{o}C from viscometric measurements using dilution type viscometer with an efflux time of about 120 seconds for the solvent. The color was determined using Lovibond tintometer and half inch cells. The color which was in unit was calculated based on the formula (5R+Y-B), Where R is the red pigment (Carson, 2019). The equipment used for the determination smoke point was SETA 104000 the smoke point apparatus and ASTM D1322, the sample was introduced into the candle stand, the SETA wick trimmer insert wick and automatically set to correct length. The measuring scale was viewed through the SETA mirror of the lamp body and chimney to detect the first indication of smoke. The temperature was recorded as the smoke point. Turbidity was determined using Palin test turbidity tube (*Conceição et al., 2017*). The tube was held vertically over a white surface and viewed downward, gradually pour sample until the black cross was no longer visible.

3.6.2 Chemical analysis

The chemical properties of the oil sample were determined using the method specified by the association of official analytical chemists (AOAC) official methods of analytical chemists, (2010).

The chemical parameters determined include free fatty acid, acid value, iodine value, saponification value and peroxide value. Fatty acid composition of the oil was determined as described (Bello E, 2015). Analytical test method for fatty acid methyl esters, the fatty acid methyl esters were analyzed using Agilent 6890 series Gas chromatography filled with a flame ionization detector and enhanced integrator. Helium gas was used as carrier gas. The column initial temperature was 250 ºC rising at 10 ºC/mm to final temperature at 300 ºC while the integrator and the detector were maintained at 250 ºC respectively (*Akpan et al., 2016*). A polar capillary column (30m*0.25mm) was used to separate the esters. The peaks were identified by comparison with standard fatty acid methyl esters obtained (*Conceição et al., 2017*).

3.6.2.1. Determination of Free fatty acid

Free fatty acids are the amount of fats present in one gram of edible oil. This analysis is based on calculating the amount of caustic soda (NaOH) required to neutralize one gram of oil. To determine free fatty acid, take a 250ml conical flask on an electronic balance and tare the balance. 10 g of castor oil sample on small beaker add 50-100 ml of ethanol (96%) in a beaker; add 3 drops of phenolphthalein indicator. Some few drops of 0.1 N NaOH and shake. Put the solution into a sample-containing conical flask and shake. Put the flask on a heater at 50 ºC for 1 minute. Remove the solution and let it to cool. Titrate the solution with 0.1 N NaOH. Record the initial volume and final volume (*Sreenivasan et al., 2010).*

The formula is provided below:

FFA = ($\Delta V \; x \; 0.1 \; x$ Mw)/Ws

3.6.2.2 Determination of Deodorized oil Analysis of FFA

The sample was taken in a 250ml conical flask on an electronic balance and tare the balance and was about 50.05 g of castor oil sample. Put 50-100 ml of ethanol (96%) in a beaker; add 3 drops of phenolphthalein indicator. Put some few drops of 0.1 N NaOH and shake. Put the pink solution into a sample-containing conical flask and shake. Put the flask on a heater at 50 ºC for 1 minute. Remove the solution and let it to cool for a while. Titrate the solution with 0.1 N NaOH. Record the initial volume and final volume *(Khaskheli et al., 2015)*.

The formula is provided below:

FFA = ($\Delta V \; x \; 0.1 \; x$ Mw)/Ws

3.6.2.3 Determination of Total Acidity Analysis

To determine the total acidity, put 10 g of castor oil sample in 250ml conical flask. Put 50-100 ml of ethanol (96%) in a beaker; add 3 drops of phenolphthalein indicator. Put some few drops of 0.1 N NaOH and shake. Pour the pink solution into a sample-containing conical flask and shake. Put the flask on a heater at 50 ^{o}C for 1 minute. Remove the solution and let it to cool for a while. Titrate the solution with 0.1 N NaOH. Record the initial volume and final volume *(Khaskheli et al., 2015)* The formula is provided below:

FFA = ($\Delta V \; x \; 0.1 \; x$ Mw) Ws

3.6.2.4 Determination of Peroxide Value Analysis

To determine peroxide value, put a 250 ml conical flask on a balance and tare the balance back to zero. Put 5 g of the castor oil sample. 30 ml of a solution of acetic acid mixed with chloroform in a ratio of 3/2 Shake/swirl. 0.5 ml of saturated fresh potassium iodide then Shake. Put in the dark place for one minute. Measure 30 ml of distilled water in a measuring cylinder. Pour the water in your solution and shake. 0.5-1.0 ml of dilute starch (diluted at 1%) as an indicator and shake. Titrate the obtained solution against penta-hydrated sodium thiosulphate ($Na_2S_2O_3.5H_2O$), *(Khaskheli et al., 2015)*.

The formula is provided below:

PV = ($\Delta V \; x$ N of $Na_2S_2O_3 \; x$ 1000)/Ws

3.6.2.5 Determination of saponification value analysis

To determine saponification value, put a sox-let flask on a balance. Put 1.50-2.00 g of Sample oil in flask. Use with a pipette put 20 ml of KOH solution (diluted at 4%) in a sample containing sox-let and mark this as sample test. Put 20 ml of KOH solution (diluted at 4%) in a new fresh sox-let flask and mark it as blank test. Put both the solutions in a water bath/or distiller for one hour. After one hour remove both solutions and let them a while to cool so as titration can be effective. In both flasks (sample and blank) 2-3 drops of phenolphthalein. Titrate both solutions against 0.5 N HCl until the color turns back to colorless *(Khaskheli et al., 2015)*.

3.6.2.6 Determination of moisture content analysis

To determine moisture content must put a small beaker on a weighing scale and 50 g of castor oil sample. Record the mass of both beaker and sample. Put the beaker containing sample in an oven at 105^0 C for one hour. Remove both the sample and container from the oven after Measure. Record the mass again the weight of both the sample and container *(Khaskheli et al., 2015)*.

4. Results

The results of the various analyses done to determine physicochemical analysis of both crude castor oil and palm oil such as the Free fatty acid, acid value, peroxide value, saponification value, moisture content, are presented in Table 1.

Table 1: Change in physicochemical parameters of both castor oil and palm oil with their standard deviation

Parameters	FFA	TA (°C)	PV	SV	Moisture (%)
Palm Oil	0.37±0.47	0.75±0.95	10.6±3.93	209±8.01	6.6±0.85
Castor Oil	0.33±0.86	0.68±0.17	11.6±2.98	194±6.01	5.00±0.78

FFA: Free fatty acids

PV: Peroxide Values

SV: Saponification Values

TA: Total acidity

4.1 Free Fatty Acid

Figure 3 below shows the value amount of free fatty acid after extraction of crude castor oil against crude palm oil.

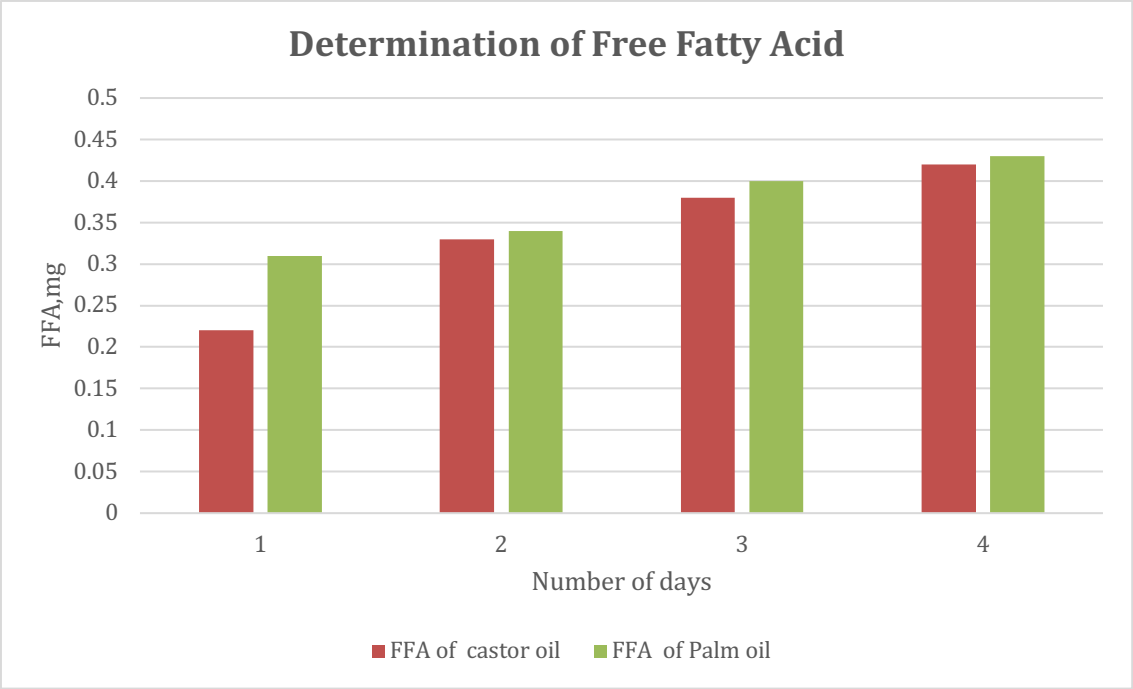

Figure 2: Free Fatty Acid on both castor oil and palm oil

The amount value of free fatty acid, which was analyzed, was based on calculating the amount of caustic soda (NaOH) required neutralizing one gram of oil. Free fatty acid value was lower in crude castor oils than crude palm oils because crude palm oil was more saturated (50%) than crude castor oil (40%), the oil has not yet been taken through processing to remove them. However, the result free fatty acid's value of crude castor oil was ranged 0.33±0.86 and free fatty acid's value of palm oil was ranged between0.37±0.47 respectively, the statistical analysis revealed a significant difference ($p<0.05$) on free fatty acid value between the two samples.

The increase of free fatty acid in crude castor oil and crude palm oil is caused by the oxygen and sunlight. Where oxygen consumption was further increased by an average during exogenous supply of free fatty acid; The amount of free fatty acid was even higher in crude palm oil due to high temperature and exposure to air occurring during frying promote the hydrolysis and oxidation of triglycerides and increase the content of free fatty acid in the oil. Free fatty acids of both crude castor oil and palm oil are the major fat fuel in the body, and when they are elevated in the blood, they are thought to raise the risk of cardiovascular disease by causing insulin resistance (in some cases leading to diabetes), raising blood pressure, and other effects but when they are more than standard value of free fatty acid of crude oil. As explained by (*Weiss et al., 2013*). The standards the crude castor oil and crude palm oil's free fatty acid value should be ranged between 0.16mg to

0.53mg. So the result obtained which is good enough to prevent auto-oxidation and provides a trust of health for consumers.

4.2 Total Acidity

Figure 4 below shows the value amount of total acidity that was found in crude castor oil against total acidity of crude palm oil.

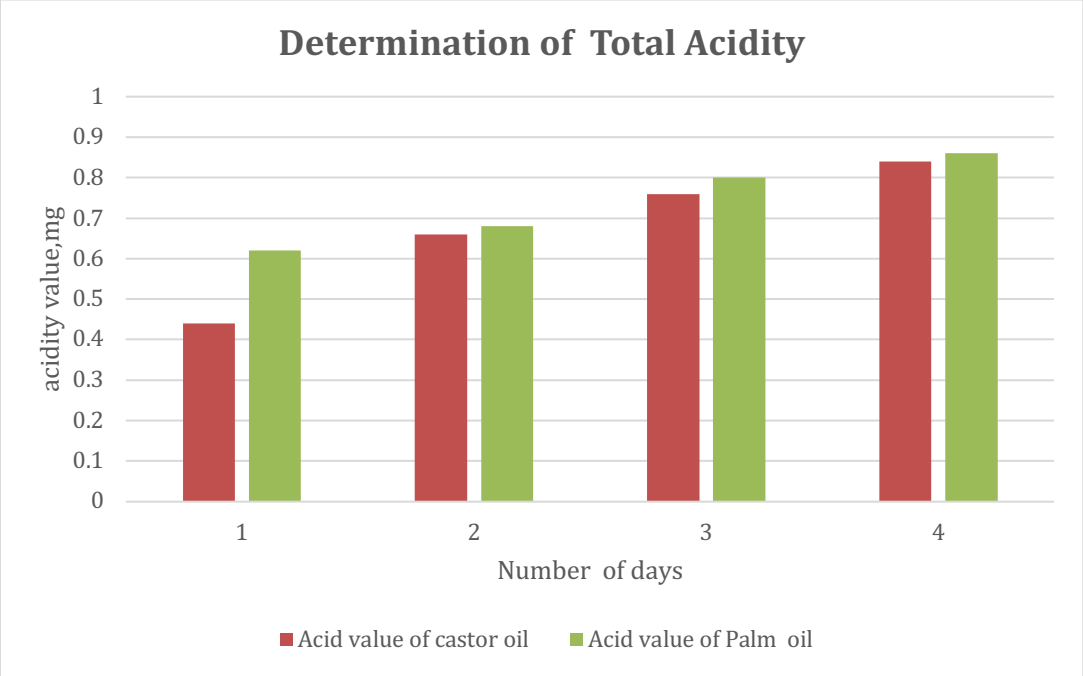

Figure 3: Total Acidity on both castor oil and palm oil

The result of this study which were analyzed amount of total acidity found castor oil as the number of milligrams of KOH required to neutralize the free fatty acids present in one gram of fat or oil, The experiment was carried out in four days and obtained different amount of acidity where by 0.68±0.17 value for crude castor oil and where 0.75±0.95 value for crude palm oil, the statistical analysis revealed a significant difference ($p<0.05$) on total acidity between the two samples (Appendix 6). The change of the amount happened because crude palm oil was more acidity than crude castor oil because action of lipase it is easily hydrolyzed the triglycerides into fatty acid than in crude castor oil; the seeds were collected from the ground where they had spent time and thus the action of lipase enzyme probably had already hydrolyzed the triglycerides into free fatty acid and hence elevating the acid value.

Generally, the values indicated the low level of hydrolysis by lipase in the oil had occurred, since the parameter was determined immediately after solvent extraction had completed. These values are small but falls within the ASTM specifications, and then it is fresher. It implies that this crude castor oil has little susceptibility to decomposition thus auto oxidation cannot be enhanced hence the oil can be kept for long time before expiry.

According to *Omar et al. (*2015) he reported that acid values in crude oil ranges from 0.14 to 1.97 mg/g oil and this result was lower than that who recorded by (Yusuf, *et al*., 2015) who reported that the total acidity of castor oil seed was 0.56mg/g.

4.3Peroxide value

Figure 5 below shows the value amount of Peroxide value after extraction of crude castor oil against Peroxide value of crude palm oil.

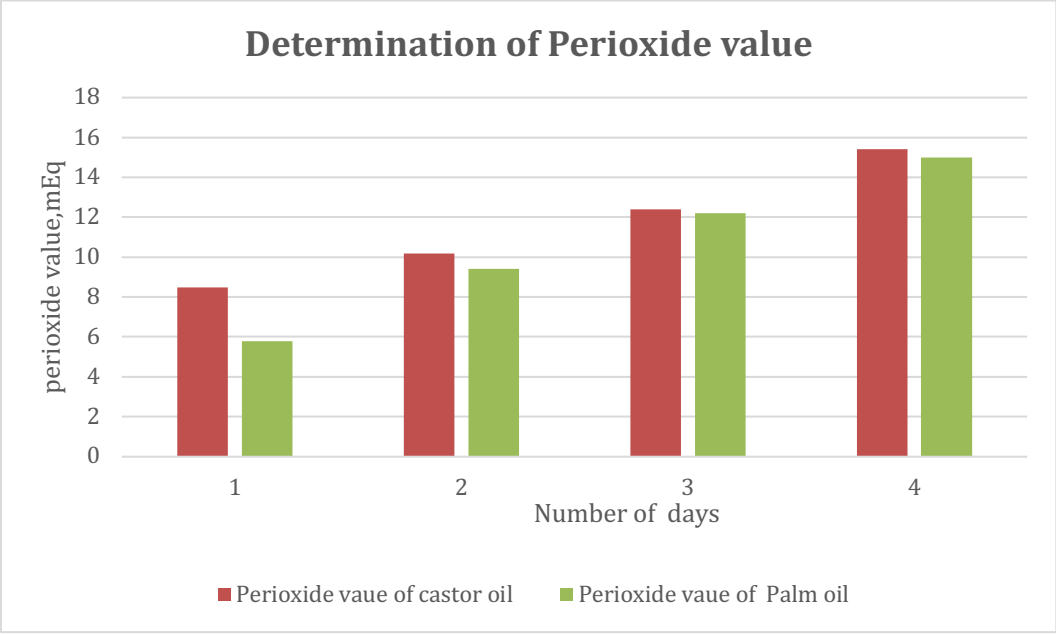

Figure 4: Peroxide value on both castor oil and palm oil

The value of peroxide value which presented on figure 3 the result showed on 11.6±2.98, in crude castor oil and 10.6±3.93 in crude palm oil respectively, the statistical analysis revealed a significant difference ($p<0.05$) on peroxide value between the two samples (Appendix 6). Then it is fresh soft oil. Normally crude castor oils are likely to show lower peroxide value than palm oils because of less saturated Ricinoleic chain which are more saturated in their carbon chains than chain found in

crude palm oil. This access of double bonds to oxygen accounts for reactions which participate in auto-oxidation of soft oils hence easy expiration which is the main cause of packing soft oils in small detailed containers so that they won't expire before use. Crude oil showed 11.6±2.98, respectively; which approved its higher quality hence it can take long without expiry than crude palm oil showed 10.6±3.93.

According Yusuf, *et al*. (2015) who reported that the peroxide value of castor oil was 9.22; this result was good quality to have shelf life Akpan, *et al. (*2014) stated that the peroxide value of crude castor oil ranged between 5.56Meq -20Meq; and more crude oil has high peroxide value more have good shelf life.

4.4Saponification value

Figure 6 below shows the value amount of Saponification value after extraction of crude castor oil against Saponification value of crude palm oil.

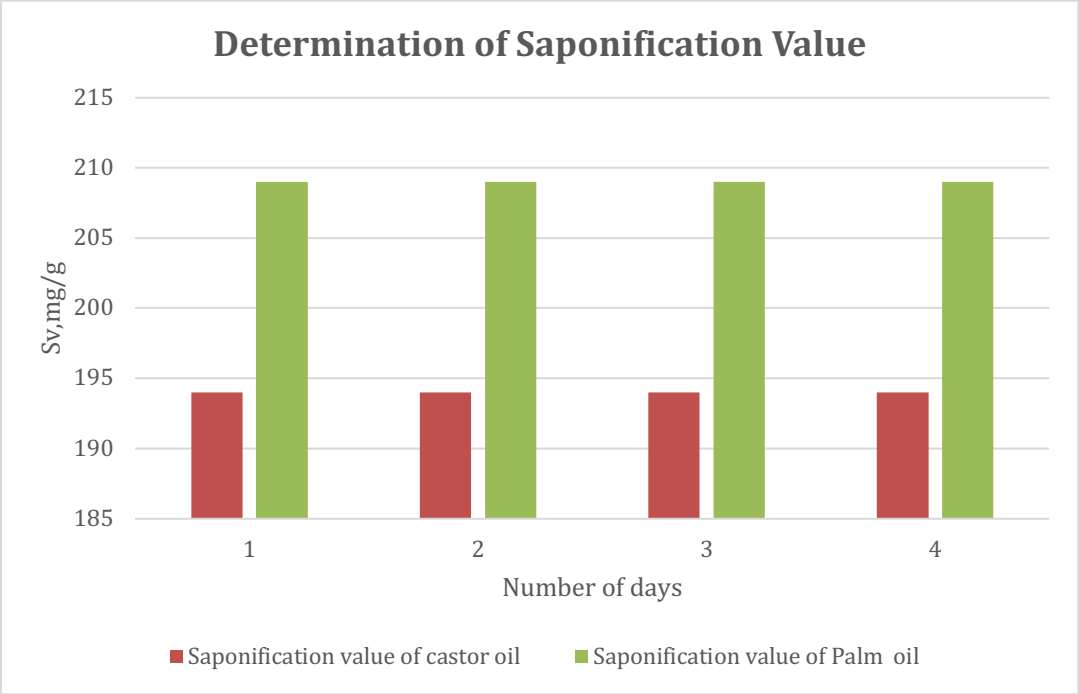

Figure 5: Saponification value on both castor oil and palm oil

The Saponification value ranges from 190- 209 for crude oil. Since this analysis aims at finding the level of interaction between KOH with fatty acids in oil so as to ensure the efficiency of the fat/oil in making soaps. So crude palm oil has shown saponification value of 209±8.01 which was higher than crude castor oil has saponification value of 194±6.01; the statistical analysis revealed

a significant difference ($p<0.05$) on saponification value between the two samples (Appendix 6). This is the reason why palm oils are the most efficient in soap production than of crude castor oil, this result was higher than that who reported by Yusuf, *et al*.(2015) who reported that saponification value of crude castor oil seed was 175.3mg/g, Saponification value ranges from 190- 209 for crude oils. Here conclusion that crude palm oil is the best oil for soap industries than crude castor oil.

4.5 Moisture Content

The table 2 below shows the amount of moisture content of crude castor oil alongside with amount of moisture content of crude palm oil in different days.

Table 2: Moisture Content on both castor oil and palm oil

Days	**Moisture content of crude castor oil**	**Moisture content of crude palm oil**
1	5.0	6.6
2	5.0	6.6
3	5.0	6.6
4	5.0	6.6

- For crude castor oil:

Moisture content $=\frac{mass(final)-mass(initial)}{mass(initial)} * 100$

$$\text{Moisture content} = \frac{63.04-60.02}{60.02} * 100 = 5.0\%$$

- For crude palm oil:

Moisture content$=\frac{mass(final)-mass(initial)}{mass(initial)} * 100$

$$\text{Moisture content}=\frac{64.04-60.02}{60.02} * 100 = 6.6\%$$

The moisture content of crude castor oil was 5.0% and moisture content of crude palm oil was 6.6%; the statistical analysis revealed a significant difference ($p<0.05$) on moisture content between the two samples (Appendix 6). This result was lower than that recorded by Arasaretnam, *et al.* (2019) who reported that moisture content of crude castor soil was 6.9%, The average

moisture content ranged between 5.00% -10.00% with the value reported by Akpan, *et al.* (2014). Moisture content must never exceed 10%. Crude castor oil shows that only 5 % of the sample is water so this is not something that can make the oil spoiled; crude castor oil is more favorable than crude palm oil because moisture content at high levels affected the colour of the oil and compression of strength which means on crude palm oil can be affected than crude castor oil due to total acidity.

5. Conclusion

The present research focused on the production of castor oil and its physicochemical constituent in comparison with palm oil. According to the results from this study, Castor oil is a promising commodity that has a variety of applications in the coming years, particularly as a renewable energy source. Among key physicochemical characteristics of this oil are, good quality of free fatty acid value, total acidity and peroxide values and moisture content and has a moderate saponification value, content as crude castor oil compared the crude palm oil; Fatty acids present in the oil as confirmed by this study Oil composition and oil characteristics are definitely affected or influenced by oil seed variety and quality, as well as the interaction of environmental factors around the castor crop. Overall result from our study indicates good quality oil, good yield and high prospects for commercialization and industrial usage, especially in the areas of medicine, soap and cosmetics, lubricants, food additives, as well as in biopolymer and biofuel production. As non-edible oil, castor oil bought to be fully exploited to replace edible ones in this role. According to the objectives was achieved, castor oil production needs to be boosted by mass cultivation of the *Ricinus communis* crop.

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Conflict of Interest

The authors declare that there is no conflict of interest.

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