Comparative study of extraction methods on the composition and physicochemical properties of a vegetable oil from the seeds of *Ricinus communis*

**ABSTRACT**

This paper carried out the effects of the extraction methods on the quantities and qualities of vegetable oil of *Ricinus communis*. The same quantities of *Ricinus communis* were been extracted using physical methods such as hydraulic press (hot and cold) and screw press and chemical method using various solvents at the same temperature. Some characterizations were carried out such as acid index, saponification index, iodine index, peroxide index, water content, specific density, kinematic viscosity at 40 °C, the color, hydrogen potential (pH), the refractive index, the fatty acid profile of the oils by gas chromatography (GC) and the density at 15 °C were in accordance with the ASTM standard specification. As a result, quantitatively, the hydraulic press has the best yield (46.25%) and qualitatively, the screw press extract had the best properties or a wide range of properties. This result allows us to conclude that the extraction method must depend on the use or application of a vegetable oil.

*Keywords: Extraction, Ricinus communis, characterizations, chromatography, yield*

**1. INTRODUCTION**

The castor plant (*Ricinus communis L*.), is a non-edible plant of the *Euphorbiaceae* family, which produces seeds known for their high abundant oil content. It is an essentially tropical plant, although it can grow in temperate regions [1]. The use of edible oils in industry such as soybean oil or palm oil risks generating new humanitarian and ethical problems. So, the inedible castor seeds make it a prime raw material for the industry. Several works have been carried out on castor oil for industrial applications. Castor oil is one of the few naturally occurring triglycerides that approach being a pure compound, since the fatty acid portion is nearly nine-tenths ricinoleic [2]. Its crude form is a pale straw colour that turns colourless or slightly yellowish after refining and bleaching. According to Marter (1981), Castor oil pale amber viscous liquid derived from the seeds of the plant *Ricinus communis* sometimes known as ricinus oil. Castor oil is one of the few naturally occurring glycerides that approach being a pure compound, since the fatty acid portion is nearly nineteenths ricinoleic acid [3]. Castor oil has been widely investigated as a raw material for the production of biofuel [4]. Nkouetcha et al (2019) used castor oil as an alternative to mineral oil in power transformers [5]. Amdebrhan et al (2015) has shown that castor oil can be used
as a bio-lubricant [5]. Castor oil can be extracted by different processes (mechanical extraction and solvent extraction) or combinations of processes [7, 8]. Castor oils studies have shown increasing growth with the number of manuscripts increasing six fold since 1980. While alternative breeding programs and marketing can lead to economic growth of castor oil production, at the commercial level, various projects fail due to the lack of knowledge about novel processing methods and parameters used in castor oil production. In 2008, three countries (India, China, and Brazil) produced 93% of the world’s supply of castor oil. However, the method used have an impact on the physicochemical properties and the quality of the oils obtained. The aim of this work is the extraction by chemical and mechanical methods followed by physicochemical characterization of castor oil from wild Ricinus communis L. seeds found in Douala, Cameroon, with the view of bringing out its biofuel potentials. To achieve this, two mechanical methods and four chemical methods are used for extraction.

2. MATERIAL AND EXPERIMENTAL METHODS

2.1 Vegetable material
The castor seeds used in this work were collected in Douala, Cameroon. Several operations are involved in the production process of a vegetable oil of Ricinus communis: the ripe castor fruits harvested were manually cleaned and sun-dried for a week on an aluminum plate, until the fruit capsules open to discharge the coated seeds. This was followed by the removal of pods and winnowing from the tray to separate the shells from the beans. The beans were then ground before extraction.

2.2 Oil yield
The extracted oil yield was expressed in percentage, which is defined as weight of oil extracted over weight of the sample taken. The percentage oil yield was calculated as follow [9].

\[
\text{Oil yield, \%} = \frac{\text{Weight of oil obtained}}{\text{Weight of seeds used for extraction}} \times 100
\]

2.3 Oil Extraction methods
2.3.1 Mechanical method
Two extraction methods (hydraulic and screw press) were used in this part.

-Screw press method
A manual diy vertical screw press was used for this method. It has a cylindrical cage perforated at the base and a tapered rod with a bar (serving as a handle) at its upper end. 80g of crushed seeds are placed in a tissue which is immediately introduced into the cylindrical cage of the press. The compression of paste immediately produces the oil.
Extraction can take 20 to 40 minutes while gradually increasing the pressure after every 5 minutes.

- **Hydraulic press method**

Extraction material is a 10 ton DIY hydraulic press. 80g of crushed seeds, placed in a cotton cloth, which is immediately introduced inside the press by its upper inlet. Once the inlet is closed, the hydraulic cylinder increases the pressure in the pressure chamber, which causes the crude oil to flow. The extraction can take 30 to 60 minutes while gradually increasing the pressure every 5 minutes. Oil extraction can take 30-60 minutes while gradually increasing the pressure after every 5 minutes.

### 2.3.2 Solvent extraction

Two chemical extraction techniques (soxhlet and infusion) were used in this part.

#### 2.3.2.1 Soxhlet extraction

80g of ground grains are introduced into a cartridge before being introduced into the cage of the Soxhlet before connecting to a flask comprising 750 mL of extraction solvent (hexane, acetate and methanol) and attached to a heating device. When the solvent was boiling (50-80°C), the vapor rises through the vertical tube in the condenser at the top. The liquid condensate drips into the filter paper cartridge in the center, which contains the solid sample to be extracted. The extract seeps through the pores of the filter paper and fills the siphon tube, where it descends into the round bottom flask. This operation took place for 4 hours. It was then removed from the tube, dried in the oven, cooled in the desiccators and weighed again to determine the amount of oil extracted. The solvent/oil mixture was separated using a rotary evaporator.

#### 2.3.2.2 Infusion

80g of previously crushed sample are immersed in water bring to a boil, homogenize and filter then allow the filtrate to cool and bring the mixture to a boil in order to evaporate water and obtain oil.

### 2.4 Chemical analysis

#### 2.4.1 Acid value (ASTM D664)

The free fatty acid in oil was estimated by titration using potassium hydroxide (KOH). The acid value is defined as mg of KOH required to neutralize the free fatty acids present in 1 g of sample. Acid values of garden cress seed oil was determined by titration method [10].

#### 2.4.2 Saponification value (IP 136)

The saponification value in oil was estimated by titrating the excess KOH from a mixture of 2g of oil with 0.5 N solution of KOH-ethanolic and boil for at least 60 minutes, with 0.5 N
hydrochloric acid (HCl) solution. A blank test is prepared by following the same procedure. The saponification index (IS) is determined as follows:

\[ IS = 56.1(V_0 - V_1)C/m \]

- \( V_0 \): is the volume of hydrochloric acid (mL) necessary to titrate the blank
- \( V_1 \): is the volume of hydrochloric acid (mL) necessary to titrate the test.
- \( C \): is the exact concentration, in moles per liter, of the standard solution of hydrochloric acid used,
- \( m \): is the mass (g) of the test portion

2.4.3 Iodine value (ISO 3961)

The iodine value is a measure of the degree of unsaturation of fatty acids and is used to characterize oils and fats. The garden cress seed oil contains both saturated and unsaturated fatty acids. Halogens add across the double bonds of unsaturated fatty acids to form additional compounds. Iodine monochloride (ICl) is allowed to react with the fat in the dark. Iodine gets incorporated into the fatty acids chain wherever the double bond exists. The amount of iodine consumed is then determined by titrating the iodine released (after adding KI) with standard thiosulphate and comparing with a blank in which the fat is omitted. Hence, the measure of iodine absorbed by an oil or fat gives the degree of unsaturation. Iodine value of garden cress seed oil was determined by titration method [11].

2.4.4 Peroxide value (ISO 3960)

The peroxide value (PV) was determined by iodometric titration, which measures the iodine produced from potassium iodide by the peroxides present in the fat sample. A sample of 2.0 g oil was dissolved in 30 mL mixture of glacial acetic and chloroforms (30:70 v/v). Then 0.5 mL saturated potassium iodide solution was added. After 1 min under darkness, 30 mL H\(_2\)O purified was immediately added and titrated with 0.01 N sodium thiosulphate. The liberated I\(_2\) was titrated with 0.01 N Na\(_2\)S\(_2\)O\(_3\).

2.4.5 Gas chromatography ASTM D-6584

Gas chromatography was measured as described by ASTM D-6584. Castor oil methyl esters were analyzed using GC - MS (Agilent 5975 GC - MSD) with software in Chem station 6890 scale mode. This method was carried out, followed by the standard method ASTM D-6584 equipped with an FID detector and a capillary column (30 m × 0.25 mm). The sample was introduced into the 7683-B injector. The initial temperature was set at around 130°C. Then it was increased to 220 °C at the ramp speed of 3 °C/min and held for 15 minutes. The carrier gas was used, that is to say helium gas at a flow rate of approximately 1 mL/min. Using a fractionated injection system, 2 μL of samples were injected. Then, 70 eV were used in a range of 50 to 550 m/z and finally obtained the different chromatograms of methyl ester samples.
2.5 Physical analysis of *Ricinus communis* oil

2.5.1 Specific Gravity (IP 190)

Specific gravity was measured as described by AOCS (1998). An empty pycnometer bottle (W1), filled with water (W2), and oil (W3) weighed separately. The specific gravity (SG) of the oil was calculated using the mathematical relationship:

\[
\text{Specific gravity (SG)} = \frac{W_3 - W_1}{W_2 - W_1}
\]

2.5.2 Density (ASTM D3505)

The density of an oil characterizes the mass of oil per unit volume. The density of oils was carried out using a 0.01 g digital analytical balance, a 25 mL pycnometer and a thermoregulated vessel. The density is determined from the weight of the oil introduced into the pycnometer.

2.5.3 Viscosity (ASTM 445) [12]

The kinematic viscosity was investigated with regard to standard ASTM 445, by means of a viscometer, capillary, made of UBLOMHEDE type glass, of a viscometer support which makes it possible to maintain in position vertical, a thermostated bath, which contains water of sufficient depth, a stopwatch for measuring time and a clean and dry paper filter. For a given test temperature, the viscosity is determined by the formula:

\[
\eta_c \left( \frac{mm^2}{s} \right) = k \times t
\]

Where \(k\) = Viscometer constant \(t\) = liquid flow time

2.5.4 Hydrogen potential (pH) (ASTM D1293)

pH of 2.30g dispersion of the oil in 15cm \(^3\) hot water was determined with the aid of a glass electrode pH meter (pH-2601).

2.5.5 Refractive Index (ASTM D1218)

Refractive index was measured at ambient temperature using a refractometer. AOAC (1990) procedure was followed.

2.5.6 Colors (ASTM D1500)

The color is often used as a qualitative method. The technique is based on the comparison of oil color to a standard colored and numbered disc. An increasing or high color number is an indication of contamination, deterioration, or both [6]. It can see in Table 1 guideline for Quality Index Number (QIN) and eventual actions to be taken on the oil.

**Table 1. Quality index number and effect of oil quality on transformer’s condition**

<table>
<thead>
<tr>
<th>Colors</th>
<th>Good Oils</th>
<th>Proposition A</th>
<th>Marginal Oils</th>
<th>Bad Oils</th>
<th>Very</th>
<th>Extremely</th>
<th>Disastrous</th>
</tr>
</thead>
</table>


3. RESULTS AND DISCUSSION

3.1 Moisture content of seeds

The result of the moisture content of seed are given in Table 2 below.

**Table 2. Moisture content of seeds**

<table>
<thead>
<tr>
<th>Time in hours</th>
<th>0</th>
<th>2</th>
<th>4</th>
<th>6</th>
<th>8</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mass in grams</td>
<td>66.24</td>
<td>64.51</td>
<td>63.27</td>
<td>62.56</td>
<td>62.3</td>
<td>62.3</td>
</tr>
</tbody>
</table>

moisture content = 6.32 %

The moisture content of *Ricinus communis* seed was 6.62%. This result is acceptable because to produce a good quality oil, the moisture must be between 5 and 7% [13].

3.2 Result of extractions

The table 3 below shows the results of the extraction of oil from castor beans.

**Table 3. Yield of oils extracted from castor seeds**

<table>
<thead>
<tr>
<th>Extraction Type</th>
<th>Soxhlet</th>
<th>Mechanical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solvent</td>
<td>HEX</td>
<td>MET</td>
</tr>
<tr>
<td>Oilyield in %</td>
<td>30.75</td>
<td>37.87</td>
</tr>
</tbody>
</table>

HEX: oil extracted with hexane
MET: oil extracted with methanol
AC: oil extracted with ethyl acetate
Water: oil extracted with water (infusion)
PHY: oil extracted with a hot hydraulic press
PHC: oil extracted by hydraulic press
PV: oil extracted with a screw press

Table 3 shows the extraction yield obtained using different extraction methods. The best yield was obtained by the cold hydraulic press (46.25%). All these methods are satisfactory considering the maximum yield which is between 30 - 55% for castor oil, whether pressed mechanically or by solvent [4]. In general, the extraction yield of oil seeds depended on plant species, genetic and climatic variations within the same species [14]. For *Ricinus communis* seed oil, our results showed that the extraction method was the main factor that could significantly influence the extraction yield.
3.3 Characterization Results

3.3.1 Chemical properties

The effect of extraction procedure on the chemical characteristics of the oil, acidity, iodine value (Iv), saponification value and peroxide index, is shown in Table 4.

Table 4. Chemical index for oils

<table>
<thead>
<tr>
<th>Extraction</th>
<th>IA (mg KOH/g)</th>
<th>% AGL (mg KOH/g)</th>
<th>II (g I₂/100g)</th>
<th>IP (m_eqO₂/Kg)</th>
<th>IS (mg KOH/g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HPY</td>
<td>2.36 ± 0.00</td>
<td>1.18 ± 0.00</td>
<td>60.74 ± 7.48</td>
<td>8.33 ± 2.89</td>
<td>176 ± 2.04</td>
</tr>
<tr>
<td>HC</td>
<td>3.74 ± 0.32</td>
<td>1.87 ± 0.16</td>
<td>58.16 ± 7.48</td>
<td>11.67 ± 2.89</td>
<td>190 ± 7.48</td>
</tr>
<tr>
<td>HPV</td>
<td>1.50 ± 0.32</td>
<td>0.75 ± 0.16</td>
<td>52.88 ± 14.96</td>
<td>12.50 ± 3.54</td>
<td>178 ± 1.86</td>
</tr>
<tr>
<td>HEX</td>
<td>2.81 ± 0.00</td>
<td>1.40 ± 0.00</td>
<td>68.74 ± 22.43</td>
<td>15 ± 10</td>
<td>187 ± 2.57</td>
</tr>
<tr>
<td>AC</td>
<td>1.32 ± 0.31</td>
<td>0.75 ± 0.16</td>
<td>31.73 ± 29.91</td>
<td>11.67 ± 2.87</td>
<td>181 ± 2.23</td>
</tr>
<tr>
<td>MET</td>
<td>0.56 ± 0.00</td>
<td>0.28 ± 0.00</td>
<td>63.45 ± 0.00</td>
<td>17.5 ± 10.61</td>
<td>185 ± 3.06</td>
</tr>
<tr>
<td>INF</td>
<td>2.43 ± 0.32</td>
<td>1.21 ± 0.16</td>
<td>47.59 ± 7.48</td>
<td>10 ± 5</td>
<td>184 ± 7.25</td>
</tr>
</tbody>
</table>

3.3.2 Iodine value (Iv)

The iodine index provides information on the degree of unsaturation of the oil and makes it possible to classify non-drying (Iv < 100), semi-drying (100 < Iv < 130) and drying (Iv > 130) oils. The oils extracted would be non-drying oils consisting of a small amount of polyunsaturated fatty acids (PUFA) [15]. The significant difference between these oils is due to the auto-oxidation (catalyzed by temperature) of the unsaturated fatty acids. These values between (31.73 - 68.74) g I₂/100g of oils were lower than the limit (82-88) g I₂/100g of oil) fixed by the ASTM standard for the qualitative classification castor oil.

3.3.3 Acid value (Ia)

The acid value of the oils extracted were all different and ranged from (0.5-3.74) mg KOH/g of oil. The acidity was significantly higher in the oil extracted with the method of hot hydraulic press (3.74 %) in comparison to the other methods. This could be explained by the presence of immature sheaths. The low fatty acid content of the oils will result in a low percentage of free fatty acid. These values (0.5-3.74 mg KOH/g of oil) were lower than the upper limit (0.4-4 mg of KOH / g) set by the ASTM standard for the qualitative classification of castor oil.

3.3.4 Saponification value (SI)
The saponification index of the extracted oils was different and ranged from (176-190) mg KOH/g oil. Some oils (HC, HEX, MET and INF) had a saponification value greater than 182 mg KOH/g oil [4]. This could be explained by the polarity of the solvent used and the extraction method.

3.3.5 Peroxide index (PI)
The peroxide index of the oils obtained was different and ranged between (8.33 -17.5) meq O$_2$/kg of oil. These values were lower than the standard defined by the codex alimentarius (10 to 20 meq O$_2$/Kg of oil) and show that the oils studied had not yet undergone any alteration. Fresh oils have a peroxide index of less than 10 meq O$_2$/Kg of oil and they degrade gradually when the peroxide index is between 20 and 40 meqO$_2$/kg [16].

3.4 Physical properties

Table 5 presents a comparison between the physical properties of the castor oil extracted.

Table 5. Results of physical properties of extracted oils

<table>
<thead>
<tr>
<th>Extraction type</th>
<th>Soxhlet</th>
<th>Infusion</th>
<th>Mechanical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solvent</td>
<td>HEX</td>
<td>MET</td>
<td>AC</td>
</tr>
<tr>
<td>Specific density</td>
<td>0.913</td>
<td>0.939</td>
<td>0.922</td>
</tr>
<tr>
<td>Specific gravity g/cm$^3$</td>
<td>0.864</td>
<td>0.888</td>
<td>0.872</td>
</tr>
<tr>
<td>Refractive index</td>
<td>1.479</td>
<td>1.477</td>
<td>1.477</td>
</tr>
<tr>
<td>Viscosity</td>
<td>864</td>
<td>1004</td>
<td>804</td>
</tr>
<tr>
<td>pH</td>
<td>6.02</td>
<td>5.92</td>
<td>5.70</td>
</tr>
<tr>
<td>Color</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

This table shows that there are significant differences between the physical properties of these oils.

3.4.1 pH
The pH of the oils is between 5.5 and 6.1. This result shows that castor oil is made up of fatty acid, which explains why it is acid.

3.4.2 Color
The color of the extracted oils is slightly different. The difference is in the HC oil which had a bright yellow color. This color was due to the temperature because the extraction was done hot. Nevertheless, this oil was of good quality [5]

3.4.3 Specific gravity and density
The specific gravity and density being closely linked, the density of the oils extracted is between 0.903 - 0.943. This difference could be due to the extraction method (presence of particles in the oil) and to the extraction temperature.

3.4.4 Refractive index
The refractive index of the extracted oils is between 1.476 - 1.480. This slight difference can be attributed to the presence of impurities in the extraction method.

3.4.5 Kinematic Viscosity

Differences were observed between the values obtained for the viscosity of the oils extracted (804-1048) Cst. This large difference could be attributed to the presence of impurities, the extraction temperature and the polarity of the solvent used.

3.5 Fatty acid composition of extracted oils

Fatty acid profile of castor vegetable seed oil extracted by different method is presented in table 6 below.

Table 6. Fatty acid composition of castor oils extracted by all methods

<table>
<thead>
<tr>
<th>Extraction type</th>
<th>Soxhlet</th>
<th>Infusion</th>
<th>Mechanical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solvent</td>
<td>HEX</td>
<td>MET</td>
<td>pH</td>
</tr>
<tr>
<td>Hexadecanoic acid methyl ester</td>
<td>3.15</td>
<td>2.69</td>
<td>2.61</td>
</tr>
<tr>
<td>9,12-octadecadienoic acid (Z, Z)-, methylester</td>
<td>8.02</td>
<td>8.46</td>
<td>8.46</td>
</tr>
<tr>
<td>9-octadecenoic acid (Z)-,methylester</td>
<td>4.48</td>
<td>4.95</td>
<td>4.92</td>
</tr>
<tr>
<td>Trans-13-octadecenoic acid, methyl ester</td>
<td>0.62</td>
<td>0.52</td>
<td>0.70</td>
</tr>
<tr>
<td>Octadecanoic acid, methyl ester</td>
<td>2.97</td>
<td>2.45</td>
<td>2.4</td>
</tr>
<tr>
<td>9-octadecenoic acid,12-hydroxy-,methyl ester,(Z)-</td>
<td>77.42</td>
<td>78.82</td>
<td>79.08</td>
</tr>
<tr>
<td>9-octadecenoic acid, 12-hydroxy-2,3dihydroxy-propyl ester</td>
<td>1</td>
<td>1.13</td>
<td>1.44</td>
</tr>
<tr>
<td>Octadecanoic acid,9,10-epoxy,methyl ester</td>
<td>1</td>
<td>/</td>
<td>1.12</td>
</tr>
<tr>
<td>10,13-eicosadienoic acid methyl ester</td>
<td>1.34</td>
<td>/</td>
<td>1.43</td>
</tr>
<tr>
<td>Octadecanoic acid,9,10-dihydroxy,methylester</td>
<td>/</td>
<td>0.97</td>
<td>1.43</td>
</tr>
<tr>
<td>Phthalic acid,di(2-propylpentyl) ester</td>
<td>/</td>
<td>/</td>
<td>1.3</td>
</tr>
<tr>
<td>9-hexadecenoic acid, methyl ester,(Z)-</td>
<td>/</td>
<td>/</td>
<td>1.92</td>
</tr>
</tbody>
</table>

The Ricinus communis vegetable oil extracted by different methods did not have the same fatty acid composition. We note the presence of seven fatty acids whose composition varies. We distinguish palmitic acid (2.37 - 3.80%); stearic acid (2.31 - 3.47%); oleic acid (3.89 - 4.9%); linoleic acid (7.04 - 8.4%); Ricinoleic acid (75.97 - 81.2%); 13-octadecenoic acid (0.4
- 4.6)%; and 10.13 eicosadienoic acid (1.07 - 1.4)%. This difference could be attributed to the extraction method used.

A comparison between the extracted oils and other castor oils was made and the results recorded in the following table.

Table 7. Comparison of fatty acid contents of extracted oils and other oils

<table>
<thead>
<tr>
<th>Fatty acid</th>
<th>Percentage</th>
<th>Malaysia [17]</th>
<th>Brazil [18]</th>
<th>This work</th>
</tr>
</thead>
<tbody>
<tr>
<td>Palmitic (C16:0)</td>
<td>1.3</td>
<td>0.7</td>
<td>2.37 - 3.80</td>
<td></td>
</tr>
<tr>
<td>Stearic (C18:0)</td>
<td>1.2</td>
<td>0.9</td>
<td>2.31 - 3.47</td>
<td></td>
</tr>
<tr>
<td>Oleic (C18:1 ω 9&lt;sup&gt;e&lt;/sup&gt;)</td>
<td>5.5</td>
<td>2.8</td>
<td>3.89 - 4.9</td>
<td></td>
</tr>
<tr>
<td>Linoleic (C18:2 ω6)</td>
<td>7.3</td>
<td>4.4</td>
<td>7.04 - 8.4</td>
<td></td>
</tr>
<tr>
<td>Linolenic (C18:3 ω3)</td>
<td>0.5</td>
<td>0.2</td>
<td>/</td>
<td></td>
</tr>
<tr>
<td>Ricinoleic (C18:1ω OH)</td>
<td>84.2</td>
<td>90.2</td>
<td>75.97 - 81.2</td>
<td></td>
</tr>
<tr>
<td>13-octadecenoic (C18:1ω 13&lt;sup&gt;e&lt;/sup&gt;)</td>
<td>/</td>
<td>/</td>
<td>0.4 - 4.6</td>
<td></td>
</tr>
<tr>
<td>10, 13 Eicosadienoic (C20:2ω)</td>
<td>/</td>
<td>/</td>
<td>1.07 - 1.4</td>
<td></td>
</tr>
<tr>
<td>Saturated fatty acids</td>
<td>2.5</td>
<td>1.6</td>
<td>4.68 - 7.2</td>
<td></td>
</tr>
<tr>
<td>Unsaturated fatty acids</td>
<td>97.5</td>
<td>97.6</td>
<td>93.05 - 99.1</td>
<td></td>
</tr>
</tbody>
</table>

It can be seen that the oils extracted using several methods were different on composition and by the fatty acid content castor oil from the others countries (Malaysian and Brasilia). This difference could be attributed to climatic conditions, the sensitivity of the acid profile determination devices and the extraction method used.

Regarding the physicochemical properties studied and the content of ricinoleic acid (which gives castor oil good adhesion to metal surfaces), the oils extracted comply with international standards and can be used for multiple purposes. An in-depth analysis shows that the oil extracted with hexane (HEX) and screw press (PV) could be used as biodiesel; oil extracted with methanol (MET) and hydraulic press (PHY) as FR3 insulating liquid; the oil extracted with a hot hydraulic press (PHC) and ethyl acetate (AC) as Rhodorsil insulating liquid; oil extracted with water (WATER) as biolubricant/biodiesel. In general, all the oils extracted have characteristics required in industry and can therefore be used as industrial oils.

4. Conclusion

This study has investigated the comparative study of extraction methods and evaluated the effect of the method on the composition and physicochemical properties of a vegetable oil
from Ricinus communis seeds. We varied the extraction methods, and each product obtained was subjected to the analysis of a chromatographic profile and to a physicochemical characterization in order to evaluate the effect of the method on the ricinoleic acid composition, on the physicochemical properties of the oils extracted and on the use of the oil. It emerges from these studies that quantitatively, the hydraulic press offers a good yield (44.47%) and qualitatively, the screw press offers excellent physicochemical properties and a better yield of ricinoleic acid compared to other methods. Thus, the choice of the extraction method leads to a very precise use. An improvement of the screw press would make it very efficient, inexpensive and easily accessible. An improvement in viscosity by chemical treatment will increase the range of use of our oils.

REFERENCES


APPENDIX