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Extraction and characterization of landolphia seed oil

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ABSTRACT

Landolphia seed oil was extracted using hexane solvent. The yield of the oil is very low (only 4.11 % by weight). The following properties of the extracted oil were determined: specific gravity, boiling point, saponification value, acid value and iodine value. The extracted oil has a very low acid value which makes it edible. The high saponification value of landolphia seed oil indicates strong cleansing ability of landolphia seed oil. The low Iodine value obtained also suggests that the landolphia seed oil will be less susceptible to oxidative deterioration.

Keywords: Landolphia, Seed, Oil, Extraction, Characterization.

INTRODUCTION

At least 17 landolphia species occur in tropical savannas and forests, mostly in Africa. About 15 species of Landolphia are rubber plants; the rubber is obtained from the bark of the trunks and branches or from the rhizomes and roots. The roots and stems of landolphia are good sources of latex for rubber production. In the beginning of the 20th century, landolphia was a major source of rubber produced in many African countries such as Senegal, Ghana, Nigeria, Sudan etc. Commercial interest in landolphia plants collapsed when, in the early 1900s due to the proliferation of Brazil's rubber tree (Hevea brasiliensis). Currently, little importance is attached to landolphia plants as potential income sources. Landolphia fruits are eaten in many parts of Africa. They are round or slightly pear-shaped and are about the size of grapefruits as shown in Figure 1. The pulp of landolphia is a good source of Vitamin C and is sometimes prescribed as an aid to digestion. The pulp is also used in making drinks. The leaf extracts are used as anti-ulcer principles and as anti-microbial agents. The decoction from the leaves is used as purgative and to cure malaria. The aqueous, methanolic and chloroform extracts of landolphia leaves have antimicrobial activities and the use of the extract from the stem bark as vermifuge. The leaf

extracts of landolphia have been known to contain anti –inflammatory and analgesic activities [1-4].

The seed of landolphia is a possible source of oil for domestic and industrial uses. In spite of the fact that landolphia plant is found in many parts of Africa, the seeds are often thrown away. Research works in the area of extraction of oils from landolphia plants are scarce in the literature [4]. This research work focuses on the extraction of oil from the seed of landolphia plant and subsequent physico-chemical analysis of the extracted oil.

Landolphia Tree *Landolphia fruit* *Landolphia Seeds*

Figure 1: Landolphia tree, fruits and seeds

MATERIALS AND METHODS

600g of crushed landolphia seed which was crushed and ground to fine powder. The powdered seed was then extracted using hexane solvent in a Soxhlet Extractor at the boiling temperature of hexane. The yield of the extracted oil was calculated as:

$$\text{Yield of oil} = (\text{Weight of oil} \times 100)/\text{Initial weight of sample}$$

The boiling point of the oil was determined by heating the oil on a heating mantle until bubbles began to form. A thermometer was then dipped into the boiling oil to record its boiling point. To determine the iodine value of the extracted oil, 0.20g of the extracted oil from Landolphia was dissolved in 15ml of carbon tetrachloride in a 100ml Glass stoppered bottle flask. 25ml of iodine (Wiji's) solution was then added and the flask was then stoppered and allowed to stand for 2hrs in the dark at room temperature. 20ml of Potassium iodide solution (10%) was added. The mixture was then titrated with 0.2N Sodium thiosulphate ($Na_2S_2O_{3)}$ using starch as indicator. A blank determination was carried out using 10ml of carbon tetrachloride and the iodine value calculated as:

$$\text{Iodine value} = 12.69 \times N \times (V_2 - V_1)/W_{sample}$$

Where W_{sample} is the weight of the sample, V_1 is the volume of thiosulphate used in test, V_2 is the volume of thiosulphate used in blank and N is the normality of thiosulphate. To determine the saponification value of the extracted oil, 1g of the oil sample was dissolved in 20ml of ethanolic

potassium hydroxide solution in a conical flask. The mixture was then heated in boiling water for two minutes while shaking the flask frequently. 1ml of Phenolphthalein indicator was added and the hot soap solution was titrated with 0.5N H_2SO_4. A blank determination was carried out under the same condition and the saponification value was calculated thus:

$$\text{Saponification value} = (V_{blank}-V_{sample}) * N* 56.1/W_{sample}$$

Where V_{blank} is the volume of H_2SO_4 used for the blank, V_{sample} is the volume of H_2SO_4 used for the sample, W_{sample} is the weight of sample, N is the normality of the H_2SO_4 solution. The acid value was determined by adding 25ml of diethyl ether and 25ml of ethanol to 0.20g of the extracted oil sample. The mixture was then titrated with 0.1N sodium hydroxide (NaOH) with phenolphthalein as indicator. The acid value was then calculated using the following formula:

$$\text{Acid value} = (56.1 \times N \times V)/ W_{sample}$$

Where N is the Normality of the NaOH solution, V is the volume of NaOH used, W_{sample} is the weight of the oil sample. The Free Fatty Acid of the oil was then calculated by dividing the acid value by two:

$$\text{Free Fatty Acid (FFA) value} = \text{Acid value}/2$$

RESULTS AND DISCUSSION

The yield of the extracted landolphia oil is 4.11% by weight. This yield is very small when compared to the obtained yields of other seeds using solvent extraction. For example, the obtained yield of olive oil can be as high as 70% [5,6].

Table-1 Physico-Chemical Properties of the extracted landolphia seed oil

Property	Value
Specific Gravity	0.87
Boiling Point, ºC	157
Acid Value, mg/g	17.31
Free Acid Value, mg/g	8.66
Saponification Value, mg/g	254.62
Iodine Value, mg/g	16.49
Color	Dark Yellow

The measured physico-chemical properties of the extracted landolphia oil are presented in table 1. The boiling point of the oil is found to be 157 ºC. Specific gravity is the ratio of the mass of a given volume to the mass of an equal volume of water. The specific gravity of most mineral oils varies from 0.86 to 0.98 [6]. Iodine value is expressed as the number of grams of iodine that will react with the double bonds in 100 grams of fats or oils. The iodine value determines the degree of unsaturation of fats and oils. This unsaturation is in the form of double bonds which readily add iodine to themselves [7]. The higher the iodine number, the more unsaturated fatty acid double bonds are present in fats and oils. In other words, the Iodine value is a measure of the total number of double bonds present in fats and oils.

Acid value is the mass of potassium hydroxide (KOH) in milligrams that is required to neutralize one gram of chemical substance. The free acids present in an oil or fat, impacts sharp unpleasant flavor to edible oil. The Acid value of the oil was determined to be 17.31 mg/g. This gives an indication of its edibility. The oils intended for human dietary purpose should not contain high Free Fatty Acid. Edible oils such as palm oil have been reported to contain an average of 19.3 acid values [9]. The acidity of oil is dependent on the amount of free fatty acids present. This in turn is dependent on the degree of hydrolysis of the oil or the nature of the processing which the oil may have undergone. The high Acid value of the oil from this research is because the oil is raw and crude and thus is naturally hydrolyzed.

Saponification value is the number of milligrams of potassium hydroxide or sodium hydroxide required to saponify 1g of fat under a given set of experimental conditions. It is a measure of the average molecular weight or chain length of all the fatty acids present. Saponification values are highly significant in the making of soap. The saponification value was found to be 254.62 mg/g. This falls within the range of oils with strong cleansing ability. Generally, if saponification value is too high, the soap might contain too much alkali which may lead to its reaction with the skin. If the saponification value too small, the fatty acid salts may not to be sufficient enough to remove fat or oil.

CONCLUSION

Based on the results obtained from the extraction and characterization of landolphia seed oil, the oil is found to be edible. The percent yield of the oil is very low (only 4.11 % by weight). The high saponification value of landolphia seed oil indicates strong cleansing ability of landolphia seed oil. The low Iodine value obtained also suggests that the landolphia seed oil will be less susceptible to oxidative deterioration.

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