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Study of the physicochemical properties of castor seed oil

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Abstract: *The physicochemical properties of castor (Ricinus Communis) seed oil were determined to know if the properties are up to the standard that can make castor seed oil to be used in soap making. This was done by extracting oil from castor seed and measuring its physicochemical properties in the laboratory. The result showed that the castor seed oil has a saponification value of 147.63 mgKOH/g, an iodine value of 51.11 I_2/100g and an acid value of 12.83 mgKOH/g. The saponification value and the acid value are not within the limits that can make castor seed oil to be used for making soap, therefore the castor seed oil will not be useful for soap making. Since the castor seed is used for making "ogili" which is used in cooking, it is therefore recommended to continue to use the castor seed in making "ogili".*

Key Words: *Castor seed oil, Soap making, Saponification value, Iodine value*.

1. INTRODUCTION:

Fats and oils are used in the manufacture of soap. Soap is important in the lives of people since it is used for cleaning and other industrial purposes, therefore the importance of fats and oils can never be over-emphasized since they are an important ingredient in soap making. Fats are usually gotten from animal origin while oils are gotten mainly from plants; and these fats and oils reacts with caustic alkali (NaOH or KOH) to produce soap in a process known as saponification reaction (Ababio, 2005).

Oils can be extracted from plants and the seed of plants like castor seed, palm oil seed, olive seed , groundnut, soybean, rapeseed, etc. Oils extracted from different Nigerian plants can be used to make quality soap if these oils reach the acceptable specifications (physicochemical properties) needed for making soap. Warra, et al. (2010) used sheanutoil and groundnut oil to make soap that are good in lathering and cleaning. There is therefore need to know if other oils found in Nigeria have the desired quality needed for making soap. Castor oil plant is grown in some parts of Nigeria, the oil from this plant is known as castor oil. The availability of this castor oil plant has made it necessary to know if the quality of its oil can be employed to make soap.

This research aims to check if the quality of castor oil is up to the standard that can be employed in soap making. This is done by measuring the physicochemical properties of the castor oil like saponification value, iodine value and acid value.

2. LITERATURE REVIEW:

Much research has been done on the different oils from different Nigerian seeds to see if the properties of the oil is up to the standard for making soap. Saeed and Shola (2015) measured the physicochemical properties among other properties of moringa seed oil, cashew seed oil, sesame seed oil, castor seed oil and water castor seed oil. They noted that these oils can be employed for industrial purposes. These industrial purposes includes soap making. Idoko (2021) in his work ascertained that the physicochemical properties of bleached palm oil and moringa oleifera seed oil were within the standard specifications of oils that can be used for making soap. He went ahead to produce good soaps that are good for the skin using these oils in his research. Ejeromedoghene, et al. (2023) measured the physicochemical properties of coconut oil which showed a saponification value of 259 mgKOH, acid value of 1.2 mgKOH, free fatty acid of 2.6% etc. They ascertained that these properties are within the standard for making soap and they eventually produced soap of good quality using the coconut oil and plantain peel as source of alkali.

3. MATERIALS AND METHODS:

Castor seeds were bought from a local farmer in Aguluezechukwu Town, Anambra State, Nigeria. Castor plant is grown locally in Anambra state and some other Nigerian states, it is also known as Ricinus Communis.

PROCEDURE FOR EXTRACTION OF CASTOR SEED OIL

The seed coat of the castor seeds were removed manually by cracking it open with stones after which the main endosperm (castor seed) were collected. The castor seeds were then taken to the laboratory and dried in an oven to remove moisture from it. The dried castor seeds were then ground for extraction using soxhlet extraction apparatus. The ground castor seed was introduced into the thimble of the soxhlet extractor. The extracting solvent (95% n-hexane) was put into the round-bottom flask. The round-bottom flask containing the n-hexane was heated, which caused the n-hexane to evaporate and condense into the thimble containing the ground castor seed. The desired oil now dissolved into the condensed n-hexane was siphoned back to the round-bottom flask. The process was continued until all the oil was extracted from the sample. The residue in the thimble was removed and the round-bottom flask containing the solvent and oil was heated till only the oil was left in the round-bottom flask

$$\% \text{ oil content} = \frac{\text{Weight of oil obtained}}{\text{Weight of sample used}}$$

DETERMINATION OF THE PHYSICOCHEMICAL PROPERTIES OF THE OIL

The saponification value, iodine value, acid value and free fatty acid were determined using AOAC (1984) official methods of analysis.

PROCEDURE FOR THE DETERMINATION OF SAPONIFICATION VALUE

2g of the extracted castor seed oil was added into a conical flask and 25ml of alcoholic potassium hydroxide solution was added to it. The flask was added to a reflux condenser and heated for 1 hour with frequent shaking. 1mlphenolphthalein (1%) solution was added to it. The solution was titrated hot with 0.5M HCl. A blank titration was also done without any oil in the potassium hydroxide.

$$\text{Saponification value} = \frac{(b-a)x\ 28.05}{\text{Weightofcastor seed oil used}}$$

b = Titre value for the blank titration.
a = Titre value for the titration with oil sample.
The multiplication by 28.05mg is because 1ml of 0.5M KOH contains 28.05mg of KOH.

4. RESULT AND DISCUSSION:

The physicochemical properties of the castor seed oil were measured which is used to know if the castor seed oil will be suitable if employed to make soap. Saponification value is the number of miligrams (mg) of potassium hydroxide needed to saponify 1 gram of a fat or oil in standard conditions. Aremu, et al. (2015) stated that oil low in saponification value may not be suitable in soap making. Maliki & Ifijen (2020) noted in their work that oils with high saponification values has a greater potential to be used to make soap. Therefore the higher the saponification value of an oil, the better the suitability of the oil for making soap. The castor seed oil has a saponification value of 147.63 mgKOH/g (Table 1) after measurement. This saponification value of the castor seed oil is very low and therefore is not within the standard of saponification value suitable for soap making because a cashew seed oil with a saponification value of 169.42 mgKOH/g in the work of Saeed and Shola (2015) was not recommended for making soap in their work because it falls below the standard value of 180 mgKOH/g as recommended by a standard. Therefore the saponification value of the castor seed oil is not within the limits of oil that is suitable in soap making.

TABLE 1. Physicochemical properties of the castor seed oil

Parameter	
Saponification value (mgKOH/g)	147.63
Iodine value (I_2/100g)	51.11
Acid value (mgKOH/g)	12.83

Iodine value is used to know the degree of unsaturation of a given fat or oil. Aremu et. al (2015) in their work said that oils with iodine value less than 100g I_2/100g are known as non- drying oils and they said in their research that the lower the iodine value then lesser the number of unsaturated bonds and therefore the lower the susceptibility of such oil to

oxidative rancidity. They implied that these non-drying oils may be used in soap making. The castor seed oil has an iodine value of 51.11 I_2/100g, and it is a non-drying oil because the iodine value is less than 100 I_2/100g. This shows that the iodine value is within the limit for making soap. Acid value shows the extent in which the oil has gone through hydrolysis or oxidation (Pearson's Composition and Analysis of Foods as cited in Ndukwe & Chahul, 2016). The higher the acid value of an oil, the higher the extent it has deteriorated (Okpala, 2021). The castor seed oil has an acid value of 12.83 mgKOH/g. The acid value gotten is higher than the acid value of 3.6 mgKOH/g (Legesse, et. al., 2020) which was used to make soap in their work, it is also higher than a recommended maximum acid value of 4 mgKOH/g. Therefore the acid value of the castor seed oil is not up to the standard. Oil content shows the quantity of oil that is gotten from a given seed sample. Seeds with high oil content is desirable. The castor seed oil has an oil content of 54.87% The castor seed oil has a high oil content which is a desirable property. The castor seed oil has an oil content which is higher than the oil content of 33.2% for castor seed oil in the work of Akpan, et. al. (2006). The castor seed oil also has a higher oil content than all the seed oil in the work of Saeed and Shola (2015) where they classified the different seed oils with oil contents of 40.6%, 49.34%,47.8%,38.3% and 28.68% as desirable and economical for commercial oil production. Therefore the castor seed oil has oil content that is good and desirable.

5. CONCLUSION:

After measuring the physicochemical properties of the castor seed oil, the result obtained showed that the saponification value and the acid value are not of the standard that can be employed to make soap. Therefore the castor seed oil will not be suitable in making soap. But the castor seed will continue to serve as an ingredient in the production of "Ogili" which is an important ingredient used in cooking in south eastern Nigeria. Therefore it is best to continue to use the castor seed in the production of "Ogili" but local "Ogili" producers and castor farmers should be sensitized of the poisonous nature of castor plant and its seed because it has ricin which is poisonous.

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