Equity Journal of Science and Technology, 2013, 1(1):104-109
ISSN; 2354-1814
An Official Publication of Kebbi State University of Science and Technology, Aliero Nigeria.

CASTOR SEED OIL AND ITS POTENTIAL COSMETIC APPLICATION

Warra, A. A.
Department of Biochemistry, Kebbi State University of Science & Technology, P.M.B. 1144 Aliero , Nigeria.
Corresponding author's e-mail address: aliyuwarra@yahoo.com

Abstract
In this review an attempt was made to have insight at the chemistry of castor oil and its industrial potential for cosmetics production. Concise overview of literature reports favours a step for the development of an indigenous cultivation of the plant and better extraction methods for its seed oil that could substantially be used for cosmetic preparations.

Keywords: Castor bean, oil extraction, chemistry, soap, cosmetics.

1.0 INTRODUCTION

The castor oil plant (*Ricinus communis L.*) is known in Hausa language as "Zurman" [1]. It a member of the Spurge family of plants (Euphorbiaceae). It is grown commercially for the oil contained in the seed primarily for industrial purposes and in the manufacture of cosmetics [2]. Castor oil is s grown mainly in India, Brazil, and China at a world production level of about 0.5 million tons of oil [3]. Castor (*Ricinus communis* L.) is a fast growing plant of marginal and moderately saline land widely spread throughout tropical regions. It is widely grown as a commercial crop in Ethiopia for its oil, which is a medicinal commodity. It is a non hardy fast growing suckering perennial shrub which can reach a height of 12 m. However it is cultivated in the Indo-Pakistan region as an annual crop on marginal lands and coastal sandy belts under warm climates where it reaches a height of 2-3 m and can stand moderate Arid/saline environments. Its fruits are produced in typical clusters, each pod containing well developed seeds bearing sufficient oil [4]. In Nigeria, it is grown in the northern and middle belts where the weather is favourable [5]. It has two derivatives such as blown castor and hydrogenated oil [6]. Hydrogenated castor oil and hydrogenated castor acids, with higher melting points than the non hydrogenated material, are used in cosmetics [3].

Medicinally, the oil is added to products to restore hair (one part oil to 10 parts of grain alcohol), treat constipation, skin ulcers, some infectious gynecological conditions and eye irritations [7]. People found the value in castor oil as they explored its use for conditions that afflicted their own bodies [8]. Ricinoleic acid has been shown to be effective in preventing the growth of numerous species of viruses, bacteria, yeasts and molds. This would explain the high degree of success in the topical use of the oil for treating such ailments as ringworm, keratoses (non-cancerous, wart-like skin growths), skin inflammation, abrasions, fungal-infected finger- and toenails, acne and chronic pruritus (itching). Generally, for these conditions the area involved is simply wrapped in cloth soaked with castor oil each night, or if the area is small enough, a castor oil soaked Band-Aid can be used. (For persistent infections and those finger- and toenails that have discolored and hardened, a good 10 to 20 minute soak in Epsom salts, prior to applying the castor oil, usually speeds up the healing process.). Castor oil's antimicrobial activity, while very impressive, comprises only a small part of the story concerning this mysterious oil. While castor oil has been thoroughly investigated for its industrial uses, only a minimal amount of research effort has been directed toward its medicinal benefits [7]. In Tanzania many old people indicated that they used the oil for lighting and softening the skin [9]. There are different varieties of castor seeds but on the average, they contain about 4655 % oil by eight [10]. The rich oil content and its high quality suggest that the oil is suitable for commercial exploitation as an industrial raw material in various preparations such as in cosmetics and in paints [11]. Castor oil is one of the most useful plant oils. It is the source of a number of useful oleochemicals in addition to its application in Cosmetic and Polymer industries.

1.1 Varieties of Castor

Varieties of castor differ regarding the branching habits of the plant, colour of the stem, the branches and leaves, the nature of the capsule, the duration of maturity and the size of the seeds. Two varieties were found in northern Nigeria; the big seed variety the cultivated type and small seed variety which is the wild variety.

Fig 1.1a: Cultivated castor plant (Photo credit: Author).

Fig 1.1b: Wild castor plant (Photo credit: Author)

Fig 1.1c: Big seed variety (Photo credit: Author)

Fig 1.1d: Small seed variety (Photo credit: Author)

Fig 1.1e: Hexane extract of Castor bean oil.

Fig 1.1f: Hexane extract of wild Castor bean oil

1.2 Chemistry of Castor oil

This oil differs from all other commercial oils in being rich in ricinoleic acid (~90%, 12-hydroxyoleic). Compared with the common vegetable oils, castor oil is more viscous, less soluble in hexane, and more soluble in ethanol, all as a consequence of the presence of the hydroxy acid. This hydroxy acid has several interesting properties by which it can be converted to useful products $CH_3(CH_2)_5CHOHCH_2CH{=}CH(CH_2)_7COO$ ricinoleic acid (12-hydroxyoleic acid) [12]. Sulfation converts the hydroxyl group to a sulfate ($-OSO_2OH$) with improved surfactant properties. Apart from soap, it is the earliest anionic surfactant (dating back to 1874) and is still used in textile processing, leather treatment, and as an additive for cutting oils and hydraulic fluids. The sulfated hydrogenated oil has the consistency of an ointment and gives adjustable viscosity to water-based formulations with excellent skin compatibility [3].

Dehydration of castor oil and of castor acids gives products enriched in diene acids, some with conjugated unsaturation. These products are valuable alternatives to drying oils such as tung oil. Hydrogenated castor oil and hydrogenated castor acids, with higher melting points than the nonhydrogenated material, are used in cosmetics, coatings, and greases. Greases prepared from tallow are much improved when salts of 12-hydroxystearic acid are added. Splitting ricinoleic acid with steam gives C7 and C11 products. This splitting process has been much improved by the development of a continuous steam cracking process. Heptanal is used in perfumes, and 10-undecenoic acid can be converted to a polyamide (Rilsan) while its salts show antifungal properties. Several new uses developed for these C7 and C11 compounds have been described [13]. The ester linkages, double bonds and hydroxyl groups in castor oil provide reaction sites for the preparation of many useful derivatives.

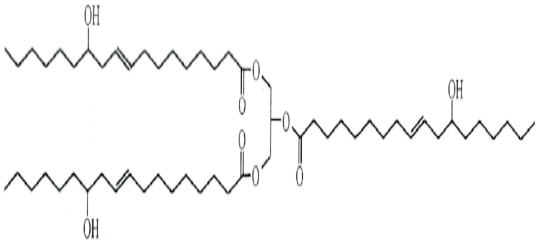


Fig 1.2a: Ester linkages in the structure of castor oil

Chemical composition

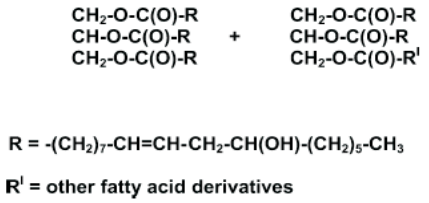


Fig 1.2b: Equation showing the constitution of castor oil

1.3 Properties of Castor oil

Castor oil, like all other vegetable oils, has different physical and chemical properties that vary with the method of extraction. Cold-pressed castor oil has low acid value, low iodine value and a slightly higher saponification value than solvent-extracted oil, and it is lighter in colour. The chemistry of castor oil is centered on its high content of ricinoleic acid and the three points of functionality existing in the molecule. These are: (1) the carboxyl group which can provide a wide range of esterifications; (2) the single point of unsaturation which can be altered by hydrogenation or epoxidation or vulcanization; and (3) the hydroxyl group which can be acetylated or alkoxylated, may be removed by dehydration to increase the unsaturation of the compound to give a semi-drying oil. The hydroxyl position is so reactive the molecule can be split at that point by high-temperature pyrolysis and by caustic fusion to yield useful products of shorter chain length. The presence of hydroxyl group on castor oil adds extra stability to the oil and its derivatives [14].

2.0 PRODUCTION OF TRANSPARENT SOAP FROM CASTOR BEAN OIL

Production of transparent soap from an Indigenous Castor bean oil extracted using n-hexane solvent was reported. The soap solution prepared was yellow, transparent and completely soluble in distilled water [15]. The quality control parameters have shown that the seed oil is utilizable for soap production on industrial scale. The saponication value of the oil 123.3 ±3.428 mg KOH/g obtained even though was lower than that of *Terminalia catappa* seed oil 207± 0.13 suggested for use in the production of liquid soap, shampoos and lather shaving creams [16] but is higher than that of beeswax (93 mg KOH/g, [17] and shea nut fat [18] 136.32 ±1.943 mg KOH/g which are commonly used in soap making. This indicates that the oil could be used in soap making since its saponification value falls within the range of these oils. Higher saponification justifies the usage of fat or oil for soap production. Iodine value of 76.93 ± 0.397 g I_2/100 g (less than 100) was reported [15] which shows that the oil belongs to the class of Non-drying oils, which are useful in the manufacture of soaps [19]. Castor oil has only one double bond in each fatty acid chain and so is classified as nondrying oil. The value is higher than Iodine value of *Jatropha curcas* L. seed oil, 73.46 ± 5.00 g I2/100 g [20]. An Acid value of 2.39 ± 0.065 mg KOH/g was reported [15] which is lower than 3.83mgKOH/g reported for groundnut oil [21] and 4.18 ± 0.01 mg KOH/g reported for garlic oil [22] which were recommended for soap making. The value is higher than 0.81 ± 0.01 mg KOH/g reported for cotton seed oil [23] recommended for soap making.

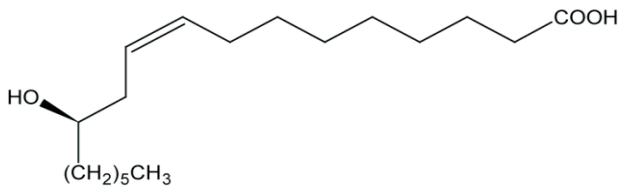
Table 2.1: Quality characteristics of an indigenous castor bean oil

Parameter	Values
Saponification value mgKOH/g	123.3 ±3.428
Iodine value I_2/100g	76.93 ± 0.397
Acid value mgKOH/g	2.39 ± 0.065
Oil yield (%)	42
Physical state at room temperature	Liquid

The values are mean and standard deviation of triplicates determinations.
Source: [15]

2.1. Justification for Cosmetic Applications

As stated earlier Castor oil is rich in very unique hydroxy fatty acid; ricinoleic acid $C_{18}H_{34}O_3$ structurally as *cis*-12-hydroxyoctadeca-9-enoic acid, 18-carbon hydroxylated fatty acid having 1 double bond



Chemical structure for Ricinoleic Acid [24].

The hydroxyl group provides additional functionality and polarity in a mid-chain position. Compared with common vegetable oils, castor oil is more viscous, less soluble in hexane, more soluble in ethanol, and is optically active. It can be converted to a range of interesting and useful materials [25]. Sulfation converts the hydroxyl group into a sulfate ($-OSO_2OH$) with improved surfactant properties. Hydrogenated castor oil and hydrogenated castor acids, with higher melting points than the nonhydrogenated material, are used in cosmetics [26] The physical properties of castor oil, including high viscosity and miscibility with polar and nonpolar compounds, make it a widely used ingredient in cosmetics, such as lip- stick. Its noncomedogenic interaction with skin underlies its widespread application in skin creams. Salts of ricinoleate, zinc ricinoleate in particular, also have deodorant properties and are used in personal deodorant applications. Because of the midchain hydroxyl group in ricinoleate, soaps made from castor oil have very good emulsifying properties. Chemical modification of the hydroxyl group can be used to alter these properties. The first synthetic surfactant was the sulfated product of castor oil, known as Turkey Red Oil. It is still produced and is used in the tanning process, textile manufacture, and in cosmetic applications. Since it is completely soluble in water, it is an effective emulsifying agent for water immiscible substances. The hydrogenated form is solid and has no harmful effect on the skin, so it is used in skin creams as an emulsifying agent [25].

3.0 CONCLUSION

Conclusively, Castor seed oil appears to be a thick, golden viscous liquid which has gained popularity for its various applications especially its potential cosmetic application.

REFERENCES

[1] Blench, R., 2007: Hausa Names for Plants and Trees. Printout December 11, 2007. Accessed at http://www.rogerblench.info/Ethnoscience%20data/Hausa%20plant%20names.pdf p67. 11/05/2012.

[2] European Food Safety Authority, 2008: Ricin (rom (*Ricinus communis*) as undesirable substances in animal feed. Scientific Opinion of the Panel on Contaminants in the Food Chain. *The EFSA Journal,* **726**, 9-38

[3] Gunstone, F. D., 2005: Vegetable Oils (ed) in *Bailey's Industrial Oil and Fat Products,* 6th Edition, Vol.1. Edited by Fereidoon Shahidi. John Wiley & Sons, Inc., pp 224- 225.

[4] Mohammed, H. C. and Rafiq, A., 2008: Trans esterification studies on castor oil as a first step towards its use in bio diesel production. *Pakistan Journal of Botany*, 40(3): 1153-1157.

[5] Annongu, A. A. and Joseph, J. K., 2008: Proximate Analysis of Castor Seeds And Cake. *Journal of Applied Science and Environmental Management* . **12**(1): 39-41.

[6] Behera. D., 2010: Study on the performance and Emission characteristics using castor and mustard seed oil mixture and diesel blend in C.I Engine. B.sc, Project report. Department of Mechanical Engineering National Institute of Technology Rourkela. p20.

[7] Williams, D. G., 1995: Castor oil - Natural Protection from Deadly Viruses. *Complementary Newsletter*. Vol. 6, No1, July 1995

[8] William, A. M., 1993: The oil that heals: A physician's successes with castor oil treatments. A.R.E. Press, Virginia Beach, VA 23451 -2061. p2

[9] Rucodia and Enerm Consult, 2007: Exposure tour report on integrated use of oil-bearing seeds in the rural economy of Tanzania . Main report pp 19-26.

[10] Ogunniyi, D. S., 2006: Castor oil: A vital industrial raw material. *Bioresource Technology,* **97**:1086-1091.

[11] Mensah, B. and Ochran, R., 2005: Physicochemical Characteristics of Castor oil from local wild castor plant in Ghana. *Ghana Journal of Science*, **45:** 41-44.

[12] Gunstone, F. D., 2004: The Chemistry of Oils and Fats: Sources, Composition, Properties and Uses. 1st Edition. Blackwell Publishing Ltd, 9600 Garsington Road, Oxford OX4 2DQ, UK. Pp 20-21.

[13] Caupin, H. J., 1997: Lipid Technologies and Applications. In Gunstone, F. D. and. Padley F. B., eds, Marcel Dekker, New York, , pp. 787795.

[14] Shahidi, F., 2005: Industrial and Non edible Products from Oils and Fats in *Bailey's Industrial Oil and Fat Products,* 6th Edition, Vol. 6. John Wiley & Sons, Inc.

[15] Warra, A. A., Wawata, I. G., Umar, R. A. and Gunu, S. Y.,. 2012a: Extraction of oil from Indigenous Castor seed using n-Hexane: Chemical Analysis and Transparent soap preparation. *International Journal of Chemistry.* **4**(2) In press.

[16] Nzikou, J. M., Mvoula-Tsiéri, M., Pambou-Tobi, N. P. G.,. Ndangui, C. B., Kimbonguila, A., Silou, T., Linder, M., Scher, J. and Desobry, S., 2010 : Proximate Composition And Physico- chemical Characteristics of Seed and Seed Oil from *Terminalia Catappa L.* and the Kinetics of Degradation of the Oil during Heating. *Australian Journal of Basic and Applied Sciences,* **4(7):** 2039-2047, 2010.

[17] Mabrouk, S. T., 2005: *Making useable quality, opaque or tranparent soaps*. *Journal of Chemical Education*, **82(10):** 1534-1537.

[18] Warra, A. A., Wawata, I. G., and Gunu, S. Y., 2011a: Chemical analysis and base- Promoted hydrolysis of locally extracted shea nut fat. *Chemsearch Journal, 2(1): 12 15.*

[19] Kochhar, S. L., 1998: *Economic Botany in the tropics,* 2nd ed. Macmillan India Ltd, Delhi, India.

[20] Warra, A. A., Wawata, I. G., Umar, R. A. and Gunu, S. Y., 2012b: Soxhlet extraction, Physicochemical Analysis and Cold process saponification of Nigerian *Jatropha curcas* L. Seed oil. *Canadian Journal of Pure and Applied Sciences*, **6** (1) **:** 1803-1807

[21] Warra, A. A., Hassan, L. G., Gunu, S. Y. and Jega, S. A., 2010: Cold- Process Synthesis and Properties of Soaps Prepared from Different Triacylglycerol Sources. *Nigerian Journal of Basic and Applied Sciences*, **18**(2)**:** 315-321.

[22] Gafar, M. K., Itodo**,** A. U., Warra, A. A. and Abdullahi, L., 2012: Extraction and Physicochemical Determination of Garlic *(Allium sativum L)* Oil. *International Journal of Food and Nutrition Science,* **1**(2) : 4-7.

[23] Warra, A. A., Wawata, I. G. Gunu, S. Y. and Aujara, K. M., 2011b: Extraction and Physicochemical Analysis of some selected Northern Nigerian Industrial oils. *Archives of Applied Science Research,* **3** (4): 536-541.

[24] Jumat, S, DinaAzleema, M, Nazrizawati, A. T., MohdFirdaus, M. Y. and Noraishah, A., 2010: Fatty Acid Composition and Physicochemical Properties of Malaysian Castor Bean *Ricinus communis* L. Seed Oil. Sains Malaysiana 39(5): 761764.

[25] Gunstone, F. D. John, L., Harwood, J. L. and Dijkstra, A. J., 2007: The lipid handbook. CRC Press, Taylor & Francis Group, LLC Boca Raton, FL 33487-2742 pP 28.

[26] Shahidi, F., 2005: The Major Vegetable Oils and Fats in *Bailey's Industrial Oil and Fat Products,* 6th Edition, Vol. 6. John Wiley & Sons, Inc. pP 225