



## Comparative Studies of Oil Content and Fatty Acid Composition of Castor Bean (*Ricinus Cummunis L.*) Plant

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### ABSTRACT

This study was carried out to compare the oil content and fatty acid composition of castor seed oil (*Ricinus cummunis L.*) collected from three different locations (Gusau, Maradun and Tsafe) in Zamfara state, Nigeria. The oil was extracted through Soxhlet extractor and its fatty acid composition was determined by Gas chromatography-Mass spectroscopy (GC – MS) analysis. Results of the investigations revealed that seeds from Tsafe had the highest quantity of oil (33.3%), followed by those from Maradun (30.4%), and lastly Gusau (28.7 %), as shown in (Table I.) However, the number fatty acids were highest in seeds obtained from Gusau (8), then Tsafe (7) and finally Maradun (5). Ricinoleic, Stearic and Palmitic acids were present in oil from all the study sites. 9, 21 octadecanoic, Beta – Sitosterol; 7- and Hexadecanoic acid; Cholesta-22- 24-dien-5,4,4. found only in Gusau sample. The variation in seed oil content and fatty acids composition in *R. cummunis* may be due to spatial differences or oil extraction procedure.

### 1.0 INTRODUCTION

Castor plant (*Ricinus communis L.*) is a tropical plant belonging to the Euphorbiaceae family. It is a fast growing perennial plant which can reach the height of a small tree and is cultivated around the world for its non-edible oil seed. The leaves are alternate with long petioles and palmately 5-7 lobbed. Inflorescence is in axillary racemes on thick panicles. The orange flowers are without petal and are clustered in long panicles. They possess many stamens, the filament branches and anthers are yellow. Seed pods are clustered, green or red and spiny. They compose of three sections or capsule which split apart when matured. Each section contains a single seed (Nura *et al.*, 2012).

The castor bean plant grows wild in uncultivated land, road sides, rail road, waste ground, fallows area, human settlements, around crop fields and disturbed sites. It does best in fertile well drained soil, which is neither alkaline nor saline. Sandy and clay soils being the best (Duke,

1978).The *Ricinus cummunis* species was reported as being more toxic than any other plant species to humans. The toxicity of the castor bean due to the presence of ricin is well known, although the lethal dose in adult is considered at four to eight seeds, report of actual poisoning of castor bean are relatively rare (Wedin *et al.*, 1986). The toxin provides the castor bean plant with some degree of protection from insect pests, such as aphid. Research work is however, currently trying to genetically modify the castor bean plant to prevent the synthesis of ricin (Wood, 2000). Some methods for detoxification of castor meal had been attempted, these include treatment with higher temperature cooking or steaming, preferably in conjunction with treatment with an oxidizing agent such as chlorine ( Levente, 2011).

Castor bean plant is reported to tolerate bacterial diseases, drought, fungi, nematodes, insects, mycobacterium, virus, light, heat, salt, laterite,

low pH, slope, smog, SO<sub>2</sub>, wind and wilt (Duke, 1978).

Castor oil is a pale amber viscous liquid, almost colourless when pure, yet highly nauseous and disagreeable taste, it dissolves freely in alcohol, ether, and glacial acetic acid (Marter, 1981). The crude castor oil has distinct odour, but it can be deodorized in the refining process (Weiss, 1988). Castor oil has relatively higher viscosity and specific gravity. It has an excellent emollient and lubricating properties as well as a marked ability to wet and disperse dyes, pigment and fillers (Vertellus, 2010). Castor oil has a boiling point of 212°C and density of 961 kg /m<sup>3</sup> (Aldrich, 2003).

Castor bean contain 50% fixed oil which can be altered chemically, it can be change into sebacic acid, which can be used to manufacture plastic and synthetic durable fibres, the oil can be changed into a dyeing oil for varnishes, enamels, and paint (Welzen,1998).

Castor bean oil can be used to grease aviation motors, as well as tanning and textiles. Oil content in commercial Ricinus plants is around 46 % or wild Ricinus plants growing in semiarid areas (in the range of 10–65 %),both in non-metal-polluted conditions (Goytia et al. 2011).

The high content of ricinoleic acid (12-hydroxy-cis octadec-9-enoic acid) is the reason for the versatile value of castor oil in industry and technology, including the production of coatings, plastics and cosmetics (Suarez et al.2007).The variety of uses of the oil makes castor bean as trong candidate plant for increased production to provide as a vital raw material for the chemical industries

The oil from castor seed is one of the few naturally occurring glycerides with high purity, since the fatty acid portion is nearly 90% of ricinoleic (Hui, 1996; Akpan *et al.*, 2006).

The average fatty acid composition of castor seed oil are; ricinoleic acid 85-95%, oleic acid 6-2%, linoleic acid 5-1%, linolenic acid 1-0.5%, stearic acid 1-0.5%, palmitic acid 1-0.5%, dihydroxy stearic acid 0.5-0.3%, others 0.5-0.2% (Anon., 2010).

In Brazil, castor oil is now being used to produce biodiesel. Castor oil in a processed form called polyglycerol polyricinolate (PGPR) is currently being used in chocolate bar manufacture as a less expensive substitute to cocoa butter (Wilson, 1988). Castor oil pomace, the residue left after crushing seeds, is used as a higher grade nitrogen fertilizer, although it is highly toxic due to the ricin, a method of detoxicating the meal has now been found, so that it can safely be fed to livestock (Reed, 1976).

## 2.0 MATERIALS AND METHODS

### 2.1 Study Area

The study area covered three locations, namely: Gusau, (11<sup>0</sup>53N 6<sup>0</sup>39 E), Tsafe (11<sup>0</sup>56N 6<sup>0</sup>56 E) and Maradun (12<sup>0</sup>45 N 6<sup>0</sup>17 E) all in Zamfara state, north – western Nigeria. The area is characterized by distinct rainy and dry seasons. Rainy season in Gusau and Maradun usually starts in April and ends around October, with a mean annual rainfall of about 1300 mm. The two areas are characterized by high temperature 33.3°C. In Tsafe, rains start from May and ends in November with a mean annual precipitation of 1680 mm and an average temperature of 28°C (Mamman, *et al.*, 2000).

### 2.2 Seed Collection and Preparation

Seeds, in their dry pods, were collected in polythene bags from the three different locations in Zamfara state and air dried. The dried pods were then repackaged in bag, placed on a hard floor and crushed with wooden stick. The seeds were separated from the chap by winnowing in the open air, using a calabash and metal tray. The seeds were cleaned of all debris and further dried in the oven at 60°C for six hours. The dried seeds were allowed to cool to room temperature and kept in a polythene bags in the Departmental herbarium prior to oil extraction.

### 2.3 Oil Extraction

The oil was extracted by using the principle of the methods of semi continuous extraction described by the association of official analytic chemist (A.O.A.C., 2000).The dried castor seeds were crushed to a paste using mortar and pestle. Ten (10 g) of the crushed paste was placed in the

thimble and inserted in the centre of the Soxhlet extractor. One hundred (100 ml) of normal hexane was poured into 200 ml round bottom flask. The extractor was firmly attached to the round bottom flask containing hexane. The round bottom flask was then heated to 60°C with the aid of a heating mantle. When the solvent boil, the vapour rise through the vertical tube into the condenser at the top. The liquid condensate filtered and drips into the thimble in the centre, which contains the sample to be extracted. The extract passes through the pores of the thimbles and fills the siphon tube where it flows back into the round bottom flask. This set up was allowed to continue for two hours. It was then removed from the soxhlet extractor. The experiment was repeated using fifteen (15 g) and twenty (20 g) of the castor seeds paste respectively. At the end of the extraction, the solvent was evaporated and the percentage of the oil was determined by using the following formula:

$$\text{Percentage yield} = \frac{\text{Weight of oil} \times 100}{\text{Weight of sample}}$$

### 2.4 Gas Chromatography – Mass Spectroscopy (GC – MS) Analysis

The free fatty acid composition of the oil was determined by using Gas chromatography mass spectroscopy analysis using the GC – MS (G

p2010 plus) (Chimadzu, Japan). The oil injection was conducted in split-less mode at 250°C for 3 minutes, to minimized peak broadening. The oven temperature was held at 70°C for 5 minutes, and then allowed to rise to 280°C where it was held for 10 minutes. The temperature of the flame ionization detector (FID) was set to 250°C, ion source temperature was set at 200°C, ionization voltage was kept at 70ev. and mass scan range of M/z 30-350 at 2.50 scan /s. Thus the equipment was set to detect and determine the structure of fatty acids.

### 3.0 RESULTS AND DISSCUSSION

The result obtained from this study showed that seeds from Tsafe had the highest quantity of oil(33%), followed by those from Maradun (30.4%), and lastly Gusau (28.7%) (Table I). The fatty acids was highest in seeds obtained from Gusau (8), Tsafe (7), and Maradun(5).(Figure I).Ricinoleic, Stearic and Palmitic acids were present in all oil from the study site. Oleic acid found in Gusau and Tsafe only. Linoleic acid found in Maradun and Tsafe only.9, 21 octadecanoic, Beta – Sitosterol;7- and Hexadecanoid acid;Cholesta-22- 24-dien-5,4,4. found only in Gusau; (Table II).

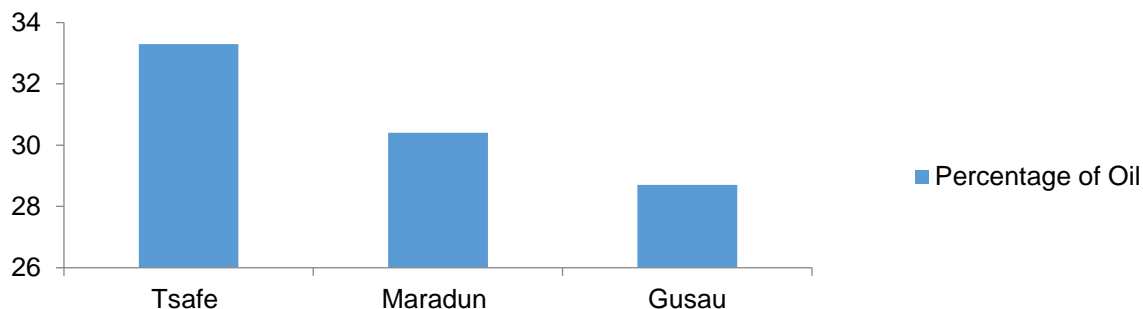


Figure 1: Percentage of Oil content from various location.

Table I: Fatty acid identified using GC- MS

Name of Fatty acid	Locations		
	Gusau	Maradun	Tsafe
Ricinolic acid	+	+	+
Stearic acid	+	+	+
Plamitic acid	+	+	+
Oleic acid	+	-	+
Linoleic acid	-	+	+
9, 21 octadecanoic	+	-	-

Beta – Sitosterol	+	-	-
11, 14 octadecanoic	+	-	-
7-Hexadecanoic acid	+	-	-
Cholesta-22- 24-dien-5,4, 4,+	+	-	-

**KEYS** + = Present, - = Absent.

This finding is in line with (Goytia et al. 2011). Oil content in Ricinus plants is around 46 % or wild Ricinus plants growing in semiarid areas (in the range of 10–65 %); because from all the three sample we have ten to thirty percentage, and this is contrary with the finding of (Welzen,1998). Castor bean contain 50% fixed oil.

In fatty acid composition, our finding is in accordance with the work of (Suarez et al. 2007). The high content of ricinoleic acid (12-hydroxy-cis octadec- 9-enoic acid) is the reason for the versatile value of castor oil in industry and technology. This is because all the sample from different location have higher content of ricinoleic acid. The result obtained in fatty acid composition is relevant with the research of (Hui, and Akpan 2006). The oil from castor seed is one of the few naturally occurring glycerides with high purity, since the fatty acid portion is nearly 90% of ricinoleic acid.

**REFERNCES**

Aldrich (2003) Hand book of fine chemical and Laboratory equipment Sigma- Aldrich publication co. America Pp. 29

Anonymous,(2010)<http://edgarea.org/health/database/aboutcastoroil.html>.  
Retried on 5/5/2010.at 9:45 am.

A.O A.C. (2000).Official method of analysis Association of analytic chemist Washing ton D.C5Th Edition Pp. 17.

Duke J. A. (1978). The Quest for Germplasm .Crop tolerant to sub optimal land condition in U.S.A.Special symposium 32 American society of Agronomy. Madison W. I. P1-7.

Goytia-Jime´nez MA, Gallegos-Goytia CH, Nu´n˜ez-Coli´n CA (2011) Relationship among climatic variables with the morphology and oil content of castor oil plant (*Ricinus communis* L.) seeds from Chiapas. Rev Chapingo series Ciencias Forestales Amb 17:41–48.

Hui, and Akpan. (2006).Toxicity and nutritive assessment of Castor (*Ricinus cummunis* L.) oil and processed cake in rat diet). Pak. J. Nutr., 5: 106-109

Levente H. D. (2011). Processing and industrial uses of Castor bean and oil. First Edtion. Guelpl .Pub. Co. Toronto. P 1- 29.

Mamman, A. B., Oyebanji, j. O. and Peter, S. W. (2000). Nigeria a people United A Feature assured. Survey of State, Millenium edition, 2: 547- 550.

Marter. A. D. (1981). Castor: Market Utilization and prospects. Tropical product institute. G. 152. P 55-78.

Nura S. (2012). A Study on influences of Habitat variation on Quantity and chemical Composition of Castor Seed oil (*Ricinus cummunis* L.) M. Sc. Dissertation By Suleiman Nura.

Reed, C. F. (1976). Information summaries on 1000 economic plants Typed Scripts Submitted to USDA. Pp.87

Suarez P, Meneghetti SMP, Meneghetti MRM, Wolf CR (2007)Transformation of triglycerides into fuels, polymers and chemicals: some applications catalysis in oleochemistry. *Quim Nova* 30:667–676.

Vertellus, G. R. (2010). Castor oil and its chemistry First edition, Finingan Publication corporation U. S. A. 1 -9

Welzen, P. C. and Van, E.(1998).Malaysian Euphorbiaceae Description: *Revision andPhylogeny of Malaysian Euphorbiaceae*43: (3) 131-161.

Wilson, R. (1998). ‘Overview of the preparation used and Biological studies on Polyglycerol polytricinoleate (PGRR)’ *Journal of Toxicology* 3: 9 - 10.

Wedin, G. R., Neal, J.S., Everson, G. W., and Krenzelok, L. P. (1986). Castor poisoning. *American Journal of Medicine*4 (3): Pp 61.