

## NOTE

# Extraction and Characterization of *Trichosanthes cucumerina* Seed Oil

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**Abstract:** *Trichosanthes cucumerina* seed and seed oil have been investigated for their chemical, physico-chemical properties, characterization and fatty acid profile. The properties were assessed by standard methods and the fatty acid profile was carried out using gas chromatography fatty acid methyl ester analysis. The seed was found to contain 71.1% crude oil, 1.6% Crude Protein, 2.9% carbohydrate, 2.8% crude Fiber, and 1.6% Ash. Iodine, Peroxide, and Acid the molecular weights of the seed oil are 0.84 gI<sub>2</sub> of oil, 2.0 meq O<sub>2</sub>/kg oil and 4.0 mg/KOH/g, respectively, with 4.0 Free Fatty Acid and a Saponification Value of 379.12 mg/g. The oil is rich in polyunsaturated fatty acids that are vital for growth, maintenance of the cell membrane, development, and boosting of the immune system in humans. It qualifies to be classified as an edible vegetable oil and can also be useful in the soap and cosmetic industry.

**Key words:** snake tomatoes, polyunsaturated fatty acids, saturated fatty acids, monounsaturated fatty acids

## 1 Introduction

Several plant products, such as nuts, fruits, seeds, and vegetables, contain a high percentage of bioactive lipid constituents with recommended health benefits. These include free fatty acids and phytosterols. Plants can be said to be a good reservoir and fountain of fats and oils as well as their numerous lipid components, largely utilized in pharmaceuticals, food and beverages, cosmetics, even oleochemicals and several other industries<sup>1)</sup>.

Fat is a necessary part of every membrane, helping in the transportation of vitamins that are fat-soluble, such as vitamins A, D, and K around the body. Some foods that contain fat supply the body with two fatty acids regarded as essential fatty acids since the body is unable to make them. Every fatty acid is a molecule having mostly carbon and hydrogen atoms as components. A fatty acid with the maximum possible number of hydrogen atoms linked to every carbon atom is regarded as a saturated fatty acid. But fatty acids with more than one point of unsaturation are said to be polyunsaturated. Polyunsaturated fatty acids are omega-3 and omega-6<sup>2)</sup>.

Most of our plants and their products are rich in fatty acids, but it requires a diligent search and research to dis-

cover them. In continuation of such search and research, this work aims at extraction and characterization of seed oils from *Trichosanthes cucumerina* with the view of comparing the results with the values reported for already known and established seed oils for valuable utilization.

## 2 *Trichosanthes cucumerina*

*Trichosanthes cucumerina*, the subject of this research, is indigenous to tropical south and south-east Asia and the islands of the western Pacific<sup>3)</sup>. It is commonly referred to as "snake tomatoes," a variety of climbing plant mostly found in the south-western part of Nigeria. Reports have shown that the *Trichosanthes cucumerina* vegetable is very rich in Vitamin C, Vitamin A, calcium, and essential amino acids, with higher content as compared to the widely preferred and popular tomatoes<sup>4)</sup>. According to Ajiboye *et al.*<sup>5)</sup>, most vegetables found in Nigeria's South-West region have significant medicinal values.

*Trichosanthes cucumerina* is also said to have some medicinal values as well as antioxidants<sup>5)</sup>. *Trichosanthes cucumerina*, which bears the seed that is the sample used

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for this research, is from the family *Cucurbitasea*. It is a climbing annual plant, suspending its numerous snake-shaped fruits. Other than its basic nutrients, the plant is a rich source of functional elements such as flavonoids, carotenoids, phenolic acids, soluble and insoluble dietary fibers, and vital minerals.

### 3 Materials and Methods

#### 3.1 Sampling and preparation of samples

The ripe matured fruits of the identified *Trichosanthes cucumerina* were plucked from the *T. cucumerina* plant at Nung Oku, Ibesikpo village in Ibesikpo Asutan Local Government Area, Akwa Ibom State, Nigeria. Akwa Ibom state is in the tropical rain forest region with an average water temperature varying periodically throughout the year. December is the clearest month, with mostly clear, or partly overcast, 38% of the time. Warmer water is accessible 3.6 months of the year, from February 10 to May 30.

The fruits, soon after collection, were taken to the laboratory and washed with tap water and then with distilled water. The fruits were longitudinally cut open, the seeds removed, deshelled, and air-dried. The air-dried, deshelled seeds used for the research work were weighed and the mass recorded. The weighed seed was ground using an electricity operated blender. The ground seed sample was placed in a Soxhlet apparatus, using n-hexane to completely extract the oil content. The solvent was removed, leaving a clear oil. Some physical as well as chemical properties were determined.

A portion of the powdered form was stored in an airtight bottle for other analysis, while the portion of the powdered form obtained was weighed using a digital weighing balance and the mass recorded. 55 g of the powdered sample was inserted into the thimble and placed in the inner tube of the Soxhlet extracting apparatus. In this process, n-hexane was employed to completely extract the oil content. The solvent was removed, leaving a clear light-yellow oil. The mass of the oil extract, being 39.7 g, was measured and recorded. The percentage yield of the oil was found and recorded to be 71.1%. Some physical as well as chemical properties were determined.

#### 3.2 Physiochemical characterization

The indices determined using the procedure include saponification value, acid value, and iodine value. Methods recommended by AOCA for the determination of refractive index, viscosity, color, melting point, and specific gravity were employed.

#### 3.3 Analysis of fatty acids

50 mg of the extracted fat content of the sample was saponified (esterified) for five (5) minutes at 950C with 3.4 mL

of 0.5 MKOH in dry methanol. 3 mL of the 14% boron tri-fluoride was added. The mixture was heated for 5 minutes at a temperature of 900C to achieve a complete methylation process.

The content of the samples was extracted by HP Chem Station Rev. A09[206] software with split injection temperature and a split ratio of 20:1 employing nitrogen as a carrier gas. The inlet temperature of the GC is 2500C and the detector temperature was 3200C. The hydrogen pressure is 22 psi and 35 psi for compressed air.

### 4 Results and Discussion

Table 1 shows the chemical composition of the *Trichosanthes cucumerina* seed used for this analysis. The percentage value of oil content of 71.1% qualifies the seed to be classified as an oil seed. The value is higher than that of peanuts, which are reported to have 36% to 54% oil content, and sesame seeds, with 47.1 to 48.4%. The protein content is lower in *Trichosanthes cucumerina* oil than the value reported for peanut oil as 16% to 36%. The value for carbohydrates is equally lower in our sample than that of peanut seed, with 10% to 20% as reported by Sing *et al.*<sup>(6)</sup>. Our recorded percentage value for protein is not in accord with the percentage value reported by Yusuf *et al.*<sup>(4)</sup> as 30.2% for *T. cucumerina* seed flour, whereas ours is 1.6%. However, they were not harvested from the same environment.

The low percentage of moisture content (20%) recorded for our seed sample as compared to the high percentage of oil content is a strong indicator that the seed can be stored and suitable for preservation for a long time without deterioration. The ash content recorded for our seed sample in Table 1 (1.6%) is within the range of limits acceptable for edible oils (1.5–2.5%) as reported by Ozioko<sup>(7)</sup> and Odufoye<sup>(8)</sup>. Ash content suggests the presence of minerals and abrasive solids among other residues in the seed. It also suggests the level of adulteration in food.

Table 2 shows that *Trichosanthes cucumerina* seed oil has mean values of Free Fatty Acid (FFA) of 0.00%, with Iodine Value (IV) of 84.00 g I<sub>2</sub> / 100 g of oil, Refractive Index

**Table 1** Chemical composition of defatted *Trichosanthes cucumerina* seed.

| Assay              | Value (%)  |
|--------------------|------------|
| Crude Lipid        | 71.1 ± 0.0 |
| Crude Protein      | 1.6 ± 0.0  |
| Moisture content   | 20.0 ± 0.0 |
| Carbohydrate (CHO) | 2.9 ± 0.0  |
| Crude Fibre        | 2.8 ± 0.0  |
| Ash                | 1.6 ± 0.0  |

**Table 2** Physico-chemical properties of *Trichosanthes cucumerina* seed oil.

| Assay                     | Value                                         |
|---------------------------|-----------------------------------------------|
| Free Fatty Acid (FFA)     | (3.96 ± 0.08) %                               |
| Saponification value (SV) | (184.93 ± 3.17) mg KOH/g of oil               |
| Iodine value (IV)         | (84.00 ± 0.01) gI <sub>2</sub> / 100 g of oil |
| Refractive index          | 1.45 ± 0.05                                   |
| pH                        | 5.69 – 6.48                                   |
| Viscosity at 28°C         | (10.43 ± 0.17) kg / m /s                      |
| Specific gravity          | 0.96 ± 0.00                                   |
| Acid value (AV)           | (3.86 ± 0.04) mg / KOH /g                     |
| Peroxide value (PV)       | (2.03 ± 0.06) mg /kg                          |
| Boiling point             | 79 – 82°C                                     |
| Opacity                   | Clear                                         |

**Table 3** Fatty Acid Methyl Ester analysis of *Trichosanthes cucumerina* seed oil.

| Name                                  | Normalized Percentage |
|---------------------------------------|-----------------------|
| Palmitic Acid Methyl Ester (C16:0)    | 14.00                 |
| Palmitoleic Acid Methyl Ester (C16:1) | 0.04                  |
| Margaric Acid Methyl Ester (C17:0)    | 0.11                  |
| Stearic Acid Methyl Ester (C18:0)     | 4.67                  |
| Oleic Acid Methyl Ester (C18:1)       | 39.02                 |
| Linoleic Acid Methyl Ester (C18:2)    | 41.16                 |
| Linolonic Acid Methyl Ester (C18:3)   | 0.29                  |
| Arachidic Acid Methyl Ester (C20:0)   | 0.20                  |
| Arachidonic Acid Methyl Ester (C20:4) | 0.04                  |
| Behenic Acid Methyl Ester (C22:0)     | 0.13                  |
| Erucic Acid Methyl Ester (C22:1)      | 0.20                  |
| Lignoceric Acid Methyl Ester (C24:0)  | 0.14                  |

of 1.45, pH of 5.69 – 6.48, Acid Value (AV) of 3.86 mg KOH / g, specific gravity value of 0.96, Peroxide value of 2.03 meq of active O<sub>2</sub>/kg oil, Viscosity of 10.43 kg / m /s at 28°C and Saponification Value (SV) of 184.93 mg KOH /g. The refractive index is within the range given under the physical and chemical indices of the Codex Standard. The values recorded for acid value for our research sample are within the maximum permissible value. The mean viscosity value of our oil extracted from *Trichosanthes cucumerina* seed, 10.43 kg/m/s, is an indication of its resistance to shear.

The saponification means value of 184.93 mg KOH/g of oil recorded for our research seed oil suggests the possible utilization of *Trichosanthes cucumerina* seed oil for cosmetic purposes.

The iodine value indicates that the oil contains a few unsaturated bonds and is non-drying, hence little affected by deterioration and oxidative rancidity. This is further confirmed by its low peroxide value, which indicates that there are anti-oxidants present in the oil. **Table 3** presents the actual values of the fatty acid composition found in the oil analyzed. It can be seen in **Table 3** that caprylic acid (C8:0), capric acid (C10:0), lauric acid (C12:0) and myristic acid (C14:0) are not found to be present in the oil for the four aforementioned fatty acids. In other words, the four fatty acids may be said to be non-detectable.

The results of the fatty acid profile of *Trichosanthes cucumerina* seed oil are as shown in **Table 3**. Caprylic acid (C8:0), capric acid (C10:0), lauric acid (C12:0) and myristic acid (C14:0) are not detectable in our sample. This is in agreement with the reported codex standards for oils from most vegetable sources as given by FAO<sup>9)</sup>. Our recorded value for palmitic acid (C16:0) of 14.00 is within the standard codex for arachis, maize and cottonseed oils. Our value for palmitoleic acid (C16:1) being 0.04 falls within the codex standard values for arachis, cottonseed, grapeseed, maize, mustard seed, palm, palm kernel, rapeseed, rapeseed (low erucic acid), safflower seed, safflower seed (high oleic acid), soyabean, sunflower seed, sunflower seed (high oleic acid) oils, palm stearin and palm olein. The 0.11 margaric acid (C17:0) value recorded for our sample is within the range of codex standard values reported for most oils from vegetable sources. It is very slightly higher than that of mustard seed, palm kernel, babassu, coconut, arachis, sunflower seed (high oleic acid) and soyabean oils.

Our sample value for oleic acid (C18:1) recorded as 39.02 is within the range of codex standard reported for arachis oil (35.0–69.0) and maize (20.0–42.2). Palm oil (36.0– 44.0), rape seed oil (8.0–60.0), sesame seed oil (35.9–42.3), and sunflower seed oil (14.0–39.4). But very slightly lower than the value reported for palm olein (39.8–46.0).

Considering our recorded value of 41.16 from the analysis of our sample for linoleic acid (C18:2), it is observed that ours is within the range of codex standard values reported for arachis oil (12.0 – 43.0) and maize oil (34.0 – 65.6), but is slightly lower than the values reported for sesame seed oil (41.5–47.9), soyabean oil (48.0–59.0), sunflower seed oil (48.3–74.0), and cotton seed oil (46.7–58.2).

Linolenic Acid (C18:3) value of 0.29, recorded for our sample agrees with the range of values for the acid published by FAO as the Codex Standard for arachis oil, coconut oil, grape seed oil, maize oil, sunflower seed oil, and safflower seed oil (high oleic acid).

Our recorded value of 0.20 for (C20:0) corresponds to the range of values provided by FAO as Codex Standard for coconut oil (ND – 0.2), cottonseed oil (0.2–0.5), grape seed oil (ND–1.0), and other oils such as rapeseed oil and safflower seed oil. The result of our test sample with the FAO published data on arachidic acid (C20:0), it is obvious that our recorded value does not deviate from this range.

The behenic acid (C22:0) value of 0.13 recorded for our research sample falls within the range of values given by FAO as Codex Standard for cotton seed oil, grape seed oil, maize, palm oil, palm kernel oil, palm olein, palm stearin, rape seed oil, soya bean oil and sunflower seed oils.

The erucic acid (C22:1) value of our analyzed oil sample is recorded as 0.20. This value compares favorably with the range of values for this fatty acid reported under codex Standard by FAO for arachis oil (ND – 0.3), cotton seed oil (ND – 0.3), grape seed oil (ND – 0.3), maize oil (ND – 0.3), rape seed oil (low erucic acid) (ND – 2.0), safflower seed oil (ND – 1.8), safflower seed oil (high oleic acid) (ND – 0.3), soya bean oil (ND – 0.3), sunflower seed (ND – 0.3), sunflower oil (high oleic acid) (ND – 0.3).

Gas chromatography fatty acid methyl ether analysis of our research sample recorded a lignoceric acid (C24:0) value of 0.14 for the sample. A value that falls within the range of FAO-reported Codex Standard values for grape seed oil (ND – 0.4), maize oil (ND – 0.5), mustard seed oil (ND – 0.5), rape seed oil (ND – 2.0), rape seed oil (low erucic acid) (ND – 0.3), safflower seed oil (ND – 0.2), safflower seed oil (high oleic acid) (ND – 0.3), sesame seed oil (ND – 0.3), soya bean oil (ND – 0.5), sunflower seed oil (ND – 0.5), sunflower seed oil (high oleic acid) (ND – 0.5).

Lauric acid (C12:0) value is in agreement with what is laid down in the Codex Standard for fats and oils from vegetable sources. FAO values of other fatty acids that are in agreement include those for myristic acid, palmitic acid, and margaric acid. Our sample records a value for linoleic acid higher than the value in the Codex Standard, while that of erucic acid is very low. The results predict that *Trichosanthes cucumerina* seed competes favorably in terms of fatty acid content with other known and established vegetable oils.

The reports of Asuquo *et al.*<sup>10)</sup> and Salunkhe *et al.*<sup>11)</sup> show

that linoleic and linolenic acids are the most essential fatty acids needed for physiological functions, growth, and body maintenance. *Trichosanthes cucumerina* oil with 41.16 and 0.29 percent values of linoleic acid and linolenic acid, respectively, would perform these functions creditably.

Linoleic is a leading Omega-3 fatty acid found in vegetable oils, such as flex seed, soybean, canola, walnut, and wheat germ oils. This fatty acid is very vital for the maintenance of the immune system, as well as other functions. *Trichosanthes cucumerina* seed oil has the potency to lower LDL cholesterol since the values of polyunsaturated and monounsaturated fatty acids are higher than those of saturated fatty acids. The iodine value also expresses the degree of unsaturation of the fats, which has good influence on the human body metabolism. There is low protein as well as low fiber content in this oil compared to other types of oils.

## 5 Conclusion

*Trichosanthes cucumerina* seed can be conveniently classified as an oil seed. The oil extracted from the seed has properties that are similar to some well-known and established industrial and edible seed oils. Its saponification value endears it to the cosmetic industry as a raw material. *Trichosanthes cucumerina* seed oil is rich in polyunsaturated fatty acids that are necessary for growth and development, maintenance of cell membranes, and boosting the human immune system. It may even surpass and be richer than other known and industrially established seed oils of vegetable origin. It has sustainability, and the plant is environmentally friendly. From the results of the analysis of oil extracted from *Trichosanthes cucumerina* the oil can be adjudged to be multipurpose in usage.

## Conflict of Interest

The authors declare no competing financial interests.

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