Gas Chromatographic Study of Bio-active Compounds in Methanolic Extract of Leaf of *Crateva adansonii* DC

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**Abstract.** This study investigates the volatile bioactive components in *Crateva adansonii* plant that has been applied in the treatment of diverse ailments in the Western part of Nigeria and in Africa. The methanolic leaf extract of *Crateva adansonii* was subjected to analysis using gas chromatographic-mass spectrometric technique. The mass spectra of the compounds were analysed and identity of the compounds confirmed using the data base of the National Institute of Standard and Technology (NIST) library. The compounds identified includes n-Hexadecanoic acid; 9,12-Octadecadienoic acid (Z,Z); 9-Octadecenoic acid; (Z,E)-2,13-Octadecadien-1-ol; 9,17-Octadecadienal; cis-9-Hexadecenal; cis-Vaccenic acid; Z,Z-10,12-Hexadecadienal; 13-Octadecenal; Hexadecanoic acid 2-hydroxy-1-(hydroxymethyl)ethyl ester; E-11-Hexadecenal. Most of the compounds identified have antibacterial, anti-oxidant, anti-inflammatory and hypocholesterolemic properties, which affirms the therapeutic applications of *Crateva adansonii* as a medicinal plant.

**Keywords:** *Crateva adansonii*, GC-MS, medicinal plants, ethnobotany, antimicrobial

**INTRODUCTION**

Medicinal plants have been important tools as food, for prevention and treatment of ailments. Several modern medicines that have been in use in the treatment of various ailments have their origin from plants. It is imperative, therefore, to identify the chemically active
constituents of such medicinal plants. This will further advance the synthesis of drugs that are therapeutic[1]. The application of medicinal plants as therapeutic agents began as far back as 2600 B.C. with the Egyptians, the Greeks, Chinese, and Romans which applied the use of natural products in diverse forms ranging from decoctions, gargles, ointments, pills and infusions being used to treat disorders ranging from mild to complex states [2]. *Crataeva adansonii,* (CA) is a deciduous plant, found mainly in Africa. It grows to a height of about 10 metres. The plant, *Crataeva adansonii* is from the family, Capparaceae and species *C. adansonii,* commonly distributed across the savannah and forest areas across Nigeria [3]. It has close similarity with another species, *Crataeva religiosa* G. Forst from Asia, which is reported to exhibit same properties [4]. The bole is short and irregular. The surface of its bark is smooth, while the inner part of the bark is yellow. The leaves are in alternate positions, they are clustered at the end of the twigs, with 3 leaflets.

The leaves are used in sauces, soups and prepared as cooked vegetables. Decoctions from the leaf part of the plant is functional as a vapour bath against yellow fever, eye complaints and jaundice [5]. It is also taken orally in the treatment of pains, malaria[6][7], hypertension[8], oedema, jaundice, epilepsy, skin diseases [9]dysmenorrhoea and abscesses[10]. The dried and ground leaves are used to stimulate production of milk for lactating mothers in Burkina Faso [4] An earlier study on the methanolic extract of the leaf of CA against free radicals and antibiotic resistant organisms revealed the anti-oxidant and antibiotic potentials in the plant [7][11]. The phytochemical constituents and antimicrobial properties of this plant have been reported[12]. An important technological platform for profiling of volatile secondary metabolites in plant species is the employment of gas chromatography-mass spectrometry (GC-MS). Here we report on the gas chromatography coupled with mass spectrometry study of the leaf extract of CA. This study aims to investigate the volatile chemical components from the leaf of CA. It commences by first preparing the methanolic extract of the leaf, separation and identification of its components by subjecting the extract to GC-MS analysis.

**MATERIALS AND METHODS**

**Collection of plant materials**
The leaves of CA plant were collected from Iyesi village, in Ado-Odo/Ota local government of Ogun State, Nigeria. The plant identification was carried out by a botanist at the Forestry Herbarium, Forestry Reserve Institute of Nigeria, (FRIN), Ibadan, with No. FHI 110016.

**Preparation of Plant Extracts**

Dried leaves of CA were soaked in methanol (500 mL) and left for 72 hours. The mixture was filtered and the filtrate concentrated on a rotary evaporator. The crude extract of C. adansonii obtained was kept in the refrigerator for further analysis.

**Gas Chromatography-Mass Spectrometry analysis**

Analysis of the methanolic leaf extract of the CA plant was carried out on a GC-MS equipment by Agilent 7890A. The experimental conditions of the equipment are: HP-5MS ultra inert capillary non-polar column, dimensions: 30 mm × 0.25 mm; ID: 0.25 mm, film thickness: 0.25 μm. Flow rate of mobile gas: 1.0 ml/min. The oven temperature for the gas chromatographic part was 50°C raised to 300°C at 7°C/min for 10 min. The nature and structure of compounds were identified by the mass spectrometer. Appearance of peaks on the spectrum is as a result of the fragmentation of large compounds into smaller compounds at various m/z ratios. Spectrum of unidentified components was compared with the spectrum of identified components stored in the NIST library [13][14].

**RESULTS AND DISCUSSION**

The results of the study are presented in Table 1. One of the current techniques employed in compound identification from natural products is the gas chromatography equipment. It offers a simple and fast analytical approach to identification of low molecular weight compounds in plant extracts. Volatile components of extracts can be easily identified using this equipment. Compounds identified from the chromatographic analysis of the methanolic extract of the leaf of C. adansonii include: n-Hexadecanoic acid; 9,12-Octadecadienoic acid (Z,Z); 9-Octadecenoic acid; (Z,E)-2,13-Octadecadien-1-ol; 9,17-Octadecadienal; cis-9-Hexadecenal; cis-Vaccenic acid; Z,Z-10,12-Hexadecadienal; 13-Octadecenal; Hexadecanoic acid 2-hydroxy-1-(hydroxymethyl)ethyl ester; E-11-Hexadecenal. From table 1, the retention time, peak area, molecular weight and the molecular formula constituted the parameters by which each compound was identified. Compounds identified in this study show similarity
with earlier studies on the chromatographic analysis of *C. religiosa* [15]. From Table 1, the compound identified with the least retention time is n-Hexadecanoic acid (25.61 min) while E-11-Hexadecenal, was the last compound identified with the longest retention time (40.30 min). Figure 1, shows the chromatogram of the methanolic extract of the leaf of CA. The figure shows the various compounds identified alongside their retention times. Nature of compounds identified from the table can be categorized as fatty acids, long chain unsaturated aldehyde, fatty acid esters and polyunsaturated fatty acids (PUFA).

Fats are known to be vital sources of energy however, fats, as dietary intakes has more roles to the physiological system. Earlier studies have shown that unsaturated fatty acids have more health benefits than saturated fatty acids [16][17] and [18]. Observations made on intake of dietary fats have shown a steady relationship between polyunsaturated fatty acids and reduced risk of heart disease [19]. The compounds identified in Table 1 have common bioactive properties which include: antioxidant, anti-inflammatory [20], hypocholesterolemic, cancer preventive, antifungal, antibacterial, anti-acne, anti-coronary, anti-eczemic, insecticidal properties [21]. Unsaturated fatty acids can be obtained from fish, vegetables, olive oil, cotton seed oil, canola oil, or lean meat [22][23].

Table 1: Compounds identified in the methanolic leaf extract of *Crateva adansonii* in GC-MS

| Ret time (min) | Peak area (%) | Compound Description | Mol. Wt. (g/mol) | Mol. formula | Nature of compound |
|---------------|---------------|----------------------|------------------|-------------|-------------------|
| 25.61         | 19.92         | n-Hexadecanoic acid (palmitic acid) | 256.42 | C_{16}H_{32}O_{2} | Fatty acid |
| 28.03         | 47.56         | 9,12-Octadecadienoic acid (Z,Z) | 280.45 | C_{18}H_{32}O_{2} | Polyunsaturated Fatty acid |
| 29.45         | 0.31          | 9-Octadecenoic acid (Z,E)-2,13-Octadecadien-1-ol | 282.10 | C_{18}H_{34}O_{2} | Fatty acid pheromone |
| 29.53         | 0.28          | 9,17-Octadecadienal | 266.469 | C_{18}H_{32}O | Long chain unsaturated aldehyde |
| 31.99         | 0.91          | cis-9-Hexadecenal | 238.415 | C_{16}H_{30}O | Long chain unsaturated aldehyde |
| 32.81         | 2.03          | cis-Vaccenic acid (Z,Z)-10,12-Hexadecadienal | 236.399 | C_{16}H_{30}O | Long chain unsaturated aldehyde |
| 33.22         | 0.27          | cis-Vaccenic acid (Z,Z)-10,12-Hexadecadienal | 282.468 | C_{18}H_{34}O_{2} | Long chain unsaturated aldehyde |
| 33.93         | 0.81          | 13-Octadecenal | 236.399 | C_{18}H_{34}O_{2} | Long chain unsaturated aldehyde |
| 36.12         | 0.86          | 13-Octadecenal | 266.469 | C_{18}H_{34}O | Long chain unsaturated aldehyde |
CONCLUSION

The search for lead compounds as a cure to numerous microbial issues from natural source is endless, so the importance of this study is the identification of some of the volatile bioactive compounds in the leaves of the plant. Further work on the pharmacological activity of this plant can be considered.

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**Conflict of Interest:** The authors hereby declare that there is no conflict of interest

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