

QUALITATIVE ANALYSIS OF THE ESSENTIAL OIL OF *SYZYGIUM AROMATICUM* (L.) (CLOVE) USING GAS CHROMATOGRAPHY-MASS SPECTROMETRY (GC-MS)

Nawal H Mohammed^{1*}, Mohammed H Ahmed² and Mohammed O Hussien¹

¹Central laboratory, Ministry of Science and Technology,
P.O. Box 7099, Khartoum, Sudan.

²King Abdulaziz University, Faculty of Science and Arts,
Chemistry Department, Khulias, Saudi Arabia.

ABSTRACT

This study was conducted to identify qualitatively the chemical composition of essential oil of *Syzygium aromaticum* (clove) samples using gas chromatography-mass spectrometry (GC-MS). Essential oil was isolated using steam distillation method. Seven chemical components were identified in the essential clove oil as follows: 2-Cyclohexen-1-one, 2-methyl-5-(1-methylethenyl), Phenol, 4-(2-propenyl), 3-Allyl-6-methoxyphenol, caryophyllene, Alpha-Caryophyllene, eugenol and 1,2-Benzenedicarboxylic acid, bis(2-methylpropyl) ester. It is suggested that clove may be used as a major source for isolation of natural eugenol, a phenolic compound that has been shown to possess antimicrobial properties.

Keywords: *Syzygium aromaticum*, Clove oil, Steam distillation, GC-MS.

INTRODUCTION

Clove (*Syzygium aromaticum*) is one of the most important herbs in traditional medicine which belongs to the family *Myrtaceae* (Amlaet *et al.*, 2007). Normally the morphology of clove tree is an evergreen that grows to a height ranging from 8-12 m, having large leaves and sanguine flowers in numerous groups of terminal clusters. In the beginning, buds are lighter in colour and gradually change to green, after which they mature into a bright at which time they are ready for harvesting. Clove samples are harvested when 1.5-2 cm long, and consist of a long calyx, terminating in four spreading sepals and four unopened petals which form a small ball in the center (Kim *et al.*, 1998).

Clove is native to Indonesia and used as a spice in virtually all of the world's cuisine. The name derives from French *clou*, a nail, as the buds resemble small irregular nails in shape. Since ancient times, clove has been cultivated in India, Madagascar, Sri Lanka, Indonesia and Southern China. Recently, other countries like Bangladesh, Burma, Thailand and

Malaysia cultivate clove on a small scale (Hossain *et al.*, 2012).

Clove essential oil is used in aromatherapy and to treat toothache in dental emergencies (Kim *et al.*, 1998). Clove oil is composed of different classes and chemical group *viz* mono terpenes, sesquiterpenes and phenolics hydrocarbons compounds. Their derivatives result in biological benefits such as antibacterial, antifungal, insecticidal and antioxidant activities. Recently, other high molecular weight compound such as flavonoid, triglycosides, terpenoid etc have been isolated from clove (Niwano *et al.*, 2011).

Owing to meagre data available on chemical analysis of essential oil of clove samples that were imported from outside of Sudan, this study was conducted to analyze the chemical composition of essential oil of *Syzygium aromaticum* (clove) samples using gas chromatography-mass spectrometry (GC-MS).

MATERIALS AND METHODS

Plant sample

The imported clove samples used in the present study were obtained from industry consultations, Ministry of industry, Khartoum, Sudan during November, 2008. The samples were transported to the laboratory and kept at room temperature.

Extraction of essential oil

Approximately about 100 g of air-dried clove powder was subjected to steam distillation method using an industrial type distiller for 3 h to obtain the essential oil. It was dried over anhydrous sodium sulfate (Na_2SO_4) and stored at -18°C .

GC-MS analysis

Essential clove oil was analyzed using GC-MS electron impact ionization (EI) method on gas chromatography (Shimadzu) coupled to a GC-MS QP2010 plus Mass Spectrometer (Tokyo, Japan) with auto-sampler (AOC-20S) and auto-injector (AOC-20i). A fused silica capillary column HP5-MS (30 m x 0.32 mm, film thickness 0.25 μm) was used. Helium was the carrier gas at constant pressure of 100 Kpa. The temperature at the injection port was 250°C . The components of the clove oil were identified by comparing the spectra with those of known compounds stored in the NIST library (2005) (Fig. 1-8).

RESULTS AND DISCUSSION

Seven chemical components were identified qualitatively in the essential clove oil as follows: 2-Cyclohexen-1-one, 2-methyl-5-(1-methylethenyl), Phenol, 4-(2-propenyl), 3-Allyl-6-methoxyphenol, caryophyllene, Alpha-

Caryophyllene, eugenol and 1,2-Benzenedicarboxylic acid, bis (2-methylpropyl) ester (Table 1). This is in agreement with the previous studies results that showed similar components in the essential clove oil cultivated in Turkey, Bangladesh and Sultanate of Oman (Alma *et al.*, 2007; Bhuijan *et al.*, 2010; Hossain *et al.*, 2012).

Eugenol and caryophyllene that available in the essential clove oil components make it potentially useful for the preparation of both herbal and modern medicines because they exhibit antibacterial, antifungal, anti-inflammatory capacities, insecticidal and antioxidant potential, and are also used traditionally as a flavouring agent and antimicrobial material in food industry (Dorman *et al.*, 2000; Niwano *et al.*, 2011). Clove oil is also used in traditional medicine for the therapeutic treatment, including anti-phlogistic, anti-vomiting, analgesic, anti-spasmodic, anti-carminative, kidney reinforcement, antiseptic, diuretic, odontalgic, stomachic, tonicardiac (Hossain *et al.*, 2012).

CONCLUSIONS

It could be concluded that clove may be used as a major source for the isolation of natural eugenol, a phenolic compound that has been shown to possess antimicrobial properties. Further investigations on essential clove oil regard to its chemical and physical properties as well as its antimicrobial and antioxidant activities are warranted.

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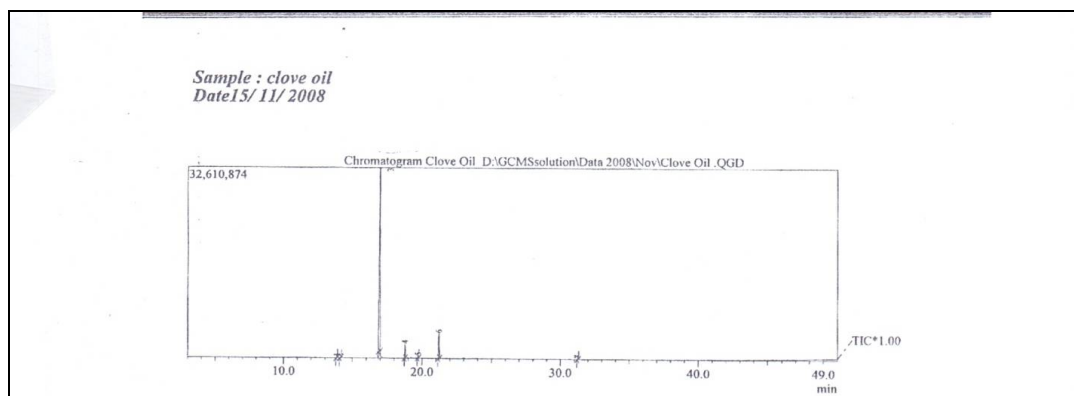


Fig. 1: A typical gas chromatogram of the constituents of essential clove oil

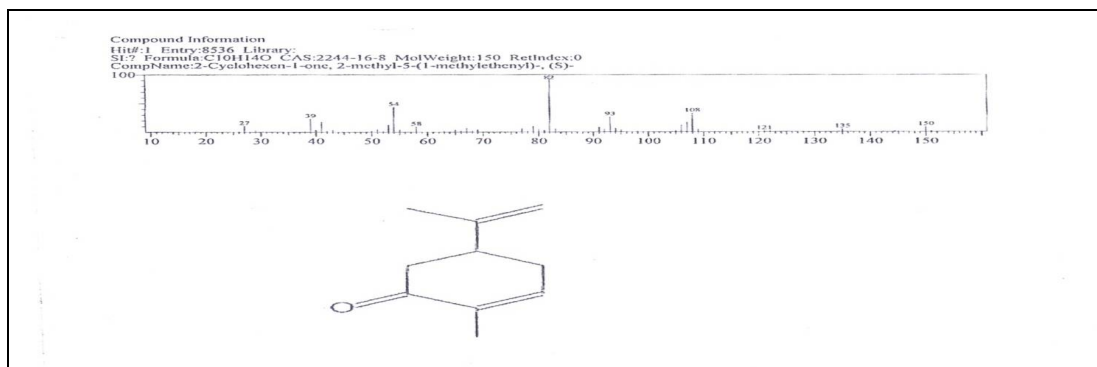


Fig. 2: A typical gas chromatogram of the 2-Cyclohexen-1-one,2-methyl-5-(1-methylethenyl)

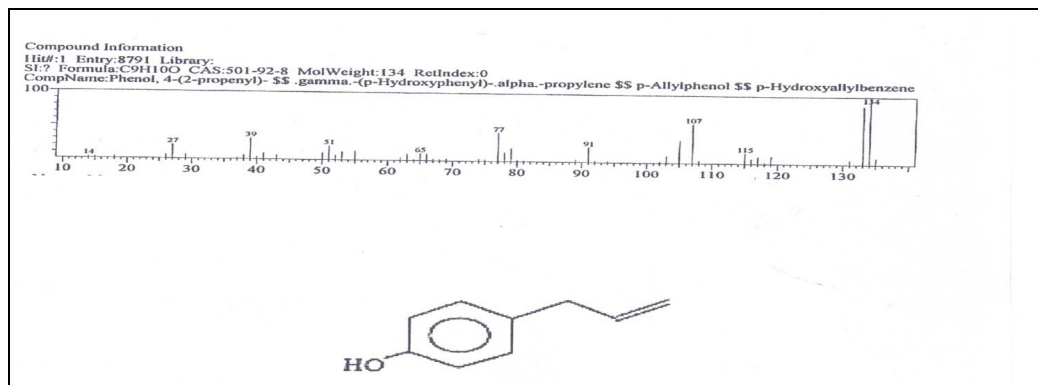


Fig. 3: A typical gas chromatogram of the Phenol, 4-(2-propenyl)

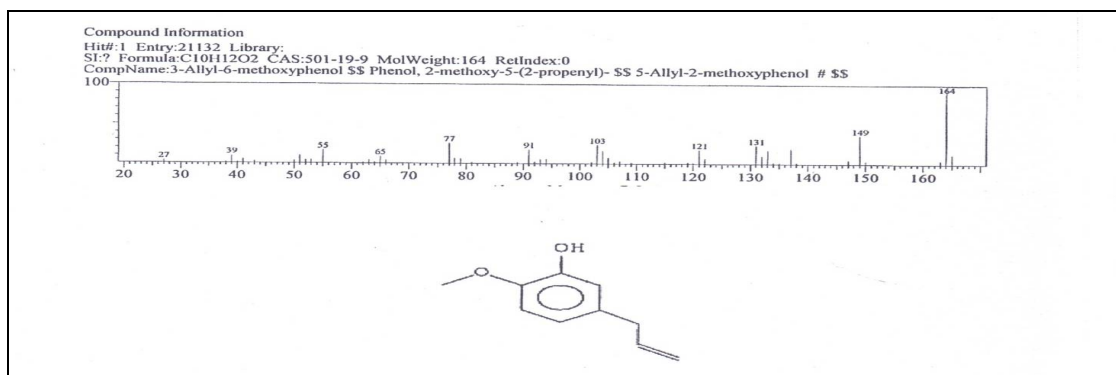


Fig. 4: A typical gas chromatogram of the 3-Allyl-6-methoxyphenol

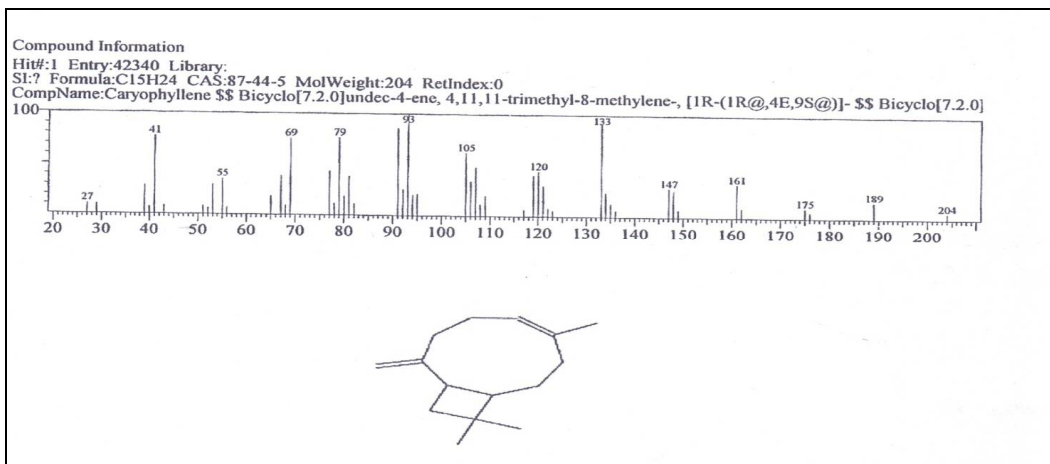


Fig. 5: A typical gas chromatogram of the Caryophyllene

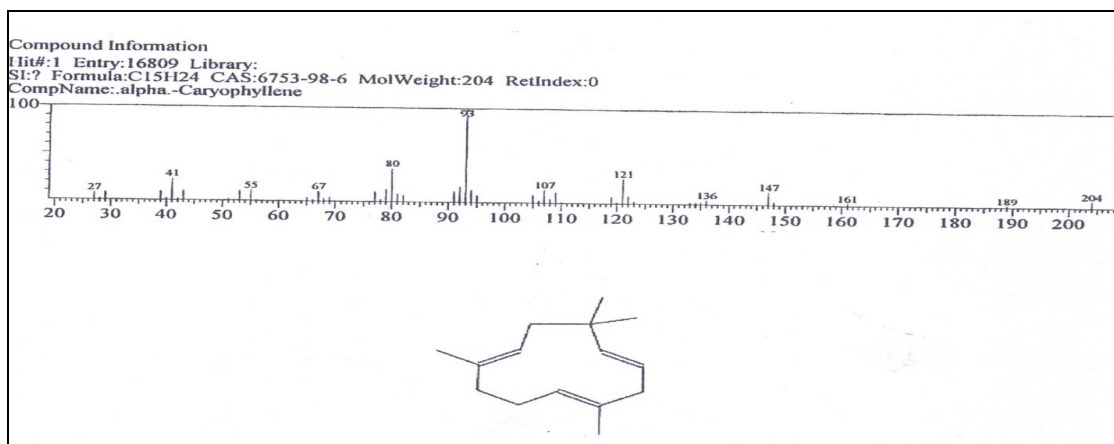


Fig. 6: A typical gas chromatogram of the Alpha-Caryophyllene

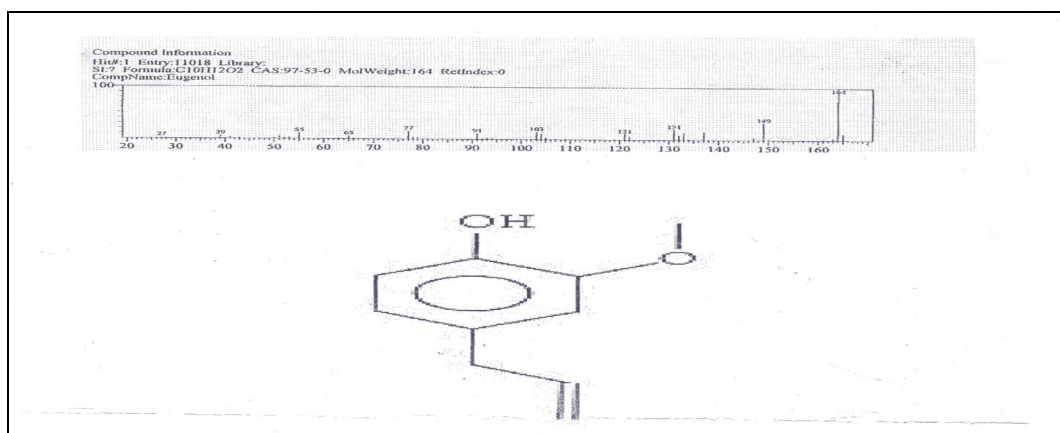


Fig. 7: A typical gas chromatogram of the Eugenol

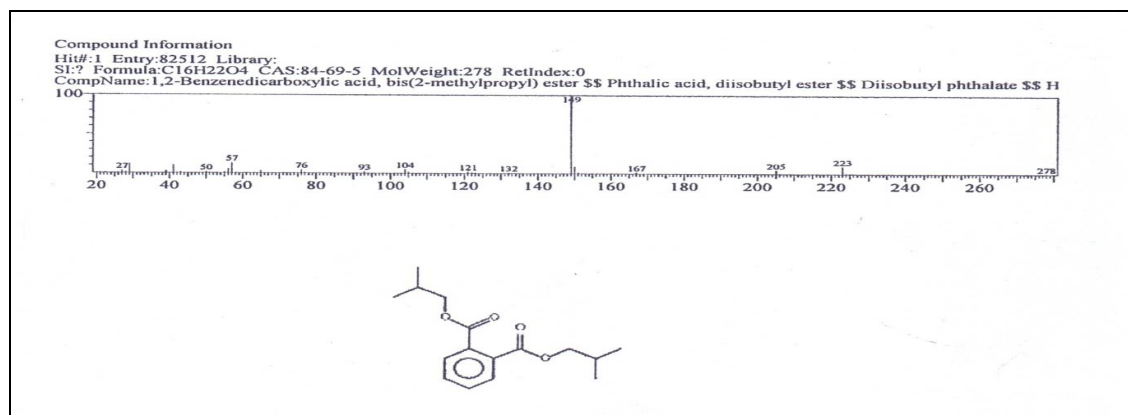


Fig. 8: A typical gas chromatogram of the 1,2-Benzenedicarboxylic acid, bis(2-methylpropyl) ester

Table 1: Chemical composition of the essential clove oil

Peak	R. Time	Area %	Compound
1	13.857	0.20	2-Cyclohexen-1-one,2-methyl-5-(1-methylethenyl)
2	14.111	0.17	Phenol, 4-(2-propenyl)
3	16.968	87.98	3-Allyl-6-methoxyphenol
4	18.761	3.58	Caryophyllene
5	19.716	0.55	Alpha-Caryophyllene
6	21.214	7.38	Eugenol
7	31.254	0.14	1,2-Benzenedicarboxylic acid, bis(2-methylpropyl) ester

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