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Comparative analyses of onion (*Allium cepa* L.) and garlic (*Allium sativum* L.) bulbs from Nigeria

Ugbabe Grace Eyinehi[1*], Baba Musa Hassan[2], Fatokun Omolola[1], Adamu Aliyu[1]
[1] Department of Medicinal Plant Research and Traditional Medicine (MPR and TM), National Institute for Pharmaceutical Research and Development (NIPRD), Abuja, Nigeria
[2] Department of Plant Science and Biotechnology, Federal University Lafia. Nassarawa, Nigeria

Abstract
This study was aimed at investigating and comparing the microscopy and chemical constituents of the bulbs of *Allium cepa* L. and *Allium sativum* L. Comparative analyses including chemo-microscopy, High Performance Liquid Chromatography Analysis (HPLC), and Gas Chromatography–Mass Spectrometry (GC- MS) analyses were carried out. The HPLC analysis for *Allium cepa* gave 10 peaks and peak number 4 has the highest. While The HPLC analysis for *Allium sativum* gave 7 peaks and peak number 3 the highest peak, *Allium cepa* Gas Chromatography-Mass Spectrometry (GC-MS) Analysis showed 47 peaks, corresponding to the name of compounds, while that of *Allium sativum* Gas Chromatography- Mass Spectrometry (GC-MS) analysis showed 35 peaks as the total number of compounds. Chemo-microscopic analysis of *Allium cepa* and *Allium sativum* revealed the presence of lignin, cellulose, tannins, starch, oxalate crystal, oil, protein and absence of mucilage and calcium in the tests carried out. The microscopic characters observed can be used for identification and quality control of the crude drug. The Chromatographic profile of the essential oils of *Allium cepa* and *Allium sativum* studied revealed: In *Allium cepa*, the components with the highest percentage compositions were: Caryophyllene (16.54%), Benzene,1,2,3-trimethyl (6.96%), 3(2H)-Furanone, 2-hexyl-5 methyl (5.73%), Disulphide, dipropyl (5.22%), while the components of *Allium sativum* with the highest percentage composition were: Diallyl disulphide (40.14%), Benzene,1,2,3-trimethyl (7.02%), Benzene,1ethyl-3-methyl (4.87%), Benzene,1-(bromethyl)-4-(1-methylethy) (4.81%). The results of this research provided information on the essential oil components found in *Allium cepa* and *Allium sativum* based on the GCMS analyses. The oils of the two plants find applications in flavorings, fragrances, cosmetics, manufacture of chemicals, pesticides and insecticides as well as being anti-inflammatory, anti-bacterial, anti-fungal agents and anti-infective.

Keywords: allium cepa**,** allium sativum

Introduction

Since ancient times Garlic, Allium sativum L., and Onion, Allium cepa L. have been used as common foods and for the treatment of many diseases. The first citation of these plants is found in the Codex Ebers (1550 BC), an Egyptian medical papyrus reporting several therapeutic formulas based on garlic and onions as useful remedy for a variety of diseases such as heart problems, headache, bites, worms and tumours (Martins et al., 2016) [18]. Cloves of garlic have been found in the tomb of Tutankhamen and in the sacred underground temple of the bulls of Saqqara. (Martins et al., 2016) [18].

Allium is the largest and most important representative genus of the Alliaceae family which comprise of about 450 species, widely distributed in the northern hemisphere. Louis Pasteur in 1858 first noted antibacterial properties of garlic. Later on, in 1932 Albert Schweitzer treated amoebic dysentery in Africa with garlic (Tizian Zumthum, 1913-1965) [24]. It was also used for several epidemic diseases e.g. Typhoid, Cholera, Diphtheria, and Tuberculosis (Farag, 2013) [10]. Onion and garlic are beneficial herbs usually grown as annual. More recently, attention has focused on the cancer preventive properties of garlic on the basis of the data obtained from epidemiological studies, conducted in China, showing a decrease of gastric cancer risk proportional to the increase of garlic intake. This evidence has been related to the ability of garlic to reduce the nitrite concentrations in the gastric tract (Kim, 2016) [16].

Onion (Allium cepa) and garlic (A. sativum) are among the oldest cultivated plants, used for culinary purposes in addition to their therapeutic effects. Allium species present a rich source of phytonutrients of potential health benefits for treatment of diabetes type 2, coronary heart disease, obesity, hypercholesterolemia, hypertension, cataract, and disturbances of the gastrointestinal tract. Most of Allium biological effects are related to the sulphur-containing compounds, "thiosulphinates", typical of Allium and responsible for its characteristic pungent aroma and taste (Engeland, 2013) [6]. Nevertheless, these metabolites are relatively unstable which warrants the development of analytical methods with which changes in their structure can be monitored i.e., in response to processing methods. Compared to sulphur compounds, other constituent viz., saponins and flavonoids found in Allium are more stable to cooking and storage conditions. Allium are consumed either as raw vegetable (fresh leaves or dried cloves), or after processing in the form of oil, extract or powder. Pronounced differences in the chemical composition and content of their bioactive compounds are observed during processing. Recently, the impact of processing methods on functional foods chemical composition and quality has been under increasing scrutiny (Engeland, 2013) [6].

All parts of these plants produce a strong odour when crushed. Onion is one of the oldest cultivated herbs and is believed to have originated in Central Asia, possibly in Iran-Pakistan region (Aaron, 1997) [1]. As early as the 6th century, onions were used as medicine in India and were also popular with the ancient Greeks, Romans and Egyptians for seasoning of foods (Engeland, 2013) [6]. The pungency of onions made them popular among poor people throughout the world that could freely use this inexpensive vegetable to spark up their meals. Onion has been used as an herbal remedy for centuries in colds, coughs, bronchitis and influenza. Onions are well-known for their easily assimilable iron content (Gough, 2016) [13]. They are therefore beneficial in treating anemia. Recent researches establish that the Onion as an effective preventive against heart attacks. Onions are highly beneficial in the treatment of the disorders of urinary system and are very effective in bleeding piles. Other uses of this herb are teeth disorders, ear disorders and tuberculosis (Jones, 2010) [15].

Garlic has remained a very popular plant in traditional medicine in addition to its use as a condiment and food, since ancient times. The earliest recorded evidence of garlic consumption dates as far back as 2900 B.C. in the inscription of the Cheops pyramids of Egypt, and the pyramid builders were given rations of garlic to increase their stamina, build their strength, and protect them from disease (Stephens, 2011) [23].

Western medicine system relies on medical practices, which overlooked preventative measures and concentrated on curing established ailments. But since past few decades the medical community has become increasingly aware of the importance of preventative medicine and herbs. The research has been conducted throughout the world on curative and preventative properties of onion and garlic and promising results have been exhibited in prevention and cure of cardiovascular diseases, cancer prevention, inflammation, diabetes, immune system enhancement, antioxidant, detoxification, digestive disorders, anti-bacterial, fungal, and viral, allergies and asthma etc. (Aaron, 1997) [1].

Onions of all colors are good sources of vitamin C, vitamin B6, potassium and folate, while garlic is rich in vitamin C, vitamin B6, thiamin, potassium, calcium, phosphorous, copper and manganese. Onion and garlic are a low-calorie way to add flavor to a dish without resorting to ingredients like butter and salt (Engeland, 2013) [6]. Similar to onion, garlic has also been used as an herbal remedy from time immemorial. It has high food value, low in protein, fat and carbohydrates and rich calcium and riboflavin. The chemical composition of garlic varies from variety to variety, cultural practices and climatic conditions. The active properties of garlic are due to this pungent volatile oil. Garlic bulb comprises of 84.09% water, 13.38 % organic matter, and 1.53 % inorganic matter (Engeland, 2013) [6]. This oil is rich in sulphur, but contains no oxygen. The chief constituents of the oil are diallyl disulfide (60%), diallyl trisulphide (20 %), allyl propyl disulfide (6%), a small quantity of diethyl disulfide and probably diallyl polysulfide. Allicin is the chemically and therapeutically active constituent of garlic. Allicin is released only by crushing or chewing raw garlic and cannot be found in cooked garlic. It is colorless, odorless and water soluble component (Kim, 2016) [16].

The sulfur compounds of garlic metabolize to form allyl methyl sulfide (Farag, 2013) [10]. It directly passes to blood and is excreted in lungs and skin. It is for this reason that odor of garlic is present for the long time. Non-sulfur compound present in the garlic are phytoalexin (allixin), which might be effective in cancer prevention. The fermented product of garlic had a higher content of riboflavin, α-tocopherol, but a lower thiamin level than the unfermented product (Ross, 2011). The oil macerate of garlic contains iso-E-10-devinylajoene, Z-10-devinylajoene, and three or five thiosulfinates, which are effective on Helicobacter pylori bacteria, which causes gastric or duodenal ulcer (Ross, 2011). Other health-promoting compounds present in garlic are enzymes, vitamins (Vit-B1, B2, B3, B5, B6, B9 and C) arginine-rich proteins, minerals (calcium, iron magnesium, manganese, phosphorus, potassium, sodium, zinc, and selenium), saponins, oligosaccharides, dietary fibers and flavonoids (Ross, 2011; Lanzotti, 2016).

Onion and Garlic are closely related and known to be one of the major sources of vegetable and spices for people in many parts of Nigeria. The aim of this study is to investigate and compare the chemo-microscopy and chemical constituents of the bulbs of Allium cepa and Allium sativum.

Materials and Method

Study Area

This work was carried out in the Laboratories of National Institute for Pharmaceutical Research and Development, (NIPRD) Federal Capital Territory Abuja (FCT). Nigeria.

Source of Plant Materials

Allium cepa (Onion) and *Allium sativum* (Garlic) were purchased from Karmo Market, Federal Capital Territory (FCT) Abuja.

Chemo-microscopy

Chemo microscopic studies of the comminuted dried bulb sample was carried out using various reagents and stains such as iodine, sulphuric acid (66 %), concentrated hydrochloric acid, ferric chloride, Sudan III, ruthenium red and phloroglucinolin HCl (1:1) to test for the presence of different metabolites (African Pharmacopoeia, 1986; Evans, 2009) [3, 7]

HPLC Analysis of *Allium cepa* and *Allium sativum* bulb extracts

Extraction Method

0.2g of the samples were weighed into clean and well labeled sample bottles, 10 ml of 70% ethanol was added to each sample bottle and allowed to stand for 24 hours, the mixture was filtered into clean bottle to be fed into the HPLC machine.

High Performance Liquid Chromatography Analysis (HPLC)

The method described by (Adamu *et al*., 2018) [2], was used with some modifications. An aliquot of each sample was taken with the aid of a 2ml syringe and filtered through a 0.45µm Millipore membrane filter and then transferred into HPLC vial before injecting into the HPLC machine.The chromatographic system used in this study includes Shimadzu HPLC system consisting of Ultra- Fast LC-20AB prominence equipped with SIL-20AC auto sampler; DGU-20A3 degasser; SPD-M20A UVdiode array detector (UV-DAD); column oven CTO-20AC, system controller CBM- 20Alite and Windows LC solution software (Shimadzu Corporation, Kyoto Japan); column, VP-ODS 5µm and dimensions (150 x 4.6 mm). The chromatographic conditions included mobile phase solvent A: 0.2% v/v formic acid in HPLC grade water and solvent B: HPLC grade acetonitrile; mode: isocratic; injection volume 10 µl of extracts solution in the mobile phase; detection was at UV 254 nm wavelength. The HPLC operating conditions were programmed to give the following: solvent B: 20% at a flow rate of 0.6 ml/min; and column oven was set to 40°C temperature. The total run time was 20 minutes.

Gas Chromatography–Mass Spectrometry (GC- MS) Analysis

The methods of Okhale *et al*., 2018 were used where fresh *A. cepa* and *A. sativum* sample was chopped separately into pieces and each subjected to hydro-distillation for 4 hours using Clevenger-type apparatus. The essential oil obtained was dried over anhydrous sodium sulphate and used immediately for GC-MS using Shimadzu QP-2010 GC with QP-2010 mass selective detector [MSD, operated in the EI mode (electron energy =70Ev), scan range = 45400 amu, and scan rate = 3.99 scan/sec], and Shimadzu GCMS solution data system. The GC column was HP-5MS fused silica capillary with a 5% phenylpolymethylIsililoxane stationary phase, length 30 m, internal diameter 0.25 mm and film thickness 0.25 µm. The program used for GC oven temperature was isothermal at 60ºC, increased from 60ºC to 180ºC at rate of 10ºC/min, held at 180ºC for 2 minutes; increased from 180ºC at a rate of 15ºC/min, then held at 280ºC for 4 minutes. The injection port temperature was 250ºC.

The ionization of sample components was performed in the electron impact mode (70eV). Injector temperature was 250ºC. The injection port temperature was 250°C while detector temperature was 280°C. Diluted sample (1/100 in hexane, v/v) of 1.0 µL was injected using auto sampler and in the split mode with ratio of 20:80. Individual constituents were identified by comparing their mass spectra with known compounds and NIST Mass Spectral Library (NIST 11). The percentages of each component were reported as raw percentages based on the total ion current without standard.

Results

The chemo microscopy of the bulbs of *Allium cepa* and *Allium sativum* revealed the presence of lignin, cellulose and tannins, starch, Oxalate crystal, Oil and Proteins while calcium and mucilage were absent (Table 1).

Table 1: Chemo-microscopic Evaluation of *Allium cepa* and *Allium sativum* bulb

Parameter	Inference	
	cepa	*sativum*
Lignin	+	+
Mucilage	-	-
Cellulose	+	+
Tannins	+	+
Starch	+	+
Calcium Oxalate crystal	-	-
Oil	+	+
Proteins	+	+

Key: + = Present, - = Absent

HPLC of *Allium* Species

The HPLC of *Allium cepa* extract gave 10 peaks while that of *Allium sativum* extract gave 7 peaks (Figures 2 & 3: Table 2 & 3). *Allium cepa* has number 4 peak as the highest while *A. sativa* has peak 3 as the highest.

GC-MS Chromatographic Profile of the Essential Oil of *Allium cepa* and *Allium sativum*

The GC-MS of *Allium cepa* revealed 47 compounds (Figure 4 and Table 4), while that of *Allium sativa* revealed 35 compounds (Figure 5 & Table 5). The major compounds in *Allium cepa* were Caryophyllene (16.54%); 3(2H)-Furanone, 2-hexyl-4-methyl- (5.73%); Disulphide, dipropyl (5.22%); Benzene, 1,2,3-trimethyl- (6.90%) and Benzene -ethyl-3-methyl (4.79%), The major compounds in *Allium sativa* were Diallyl disulphide (40.14%);

Benzene, 1,2,3-trimethyl- (7.02%); Benzene, 1-ethyl-3-methyl- (4.8%) Diallyl disulphide (4.40%) and Benzene 1-(bromomethyl)-4-(1-methylethyl) (4.81%).

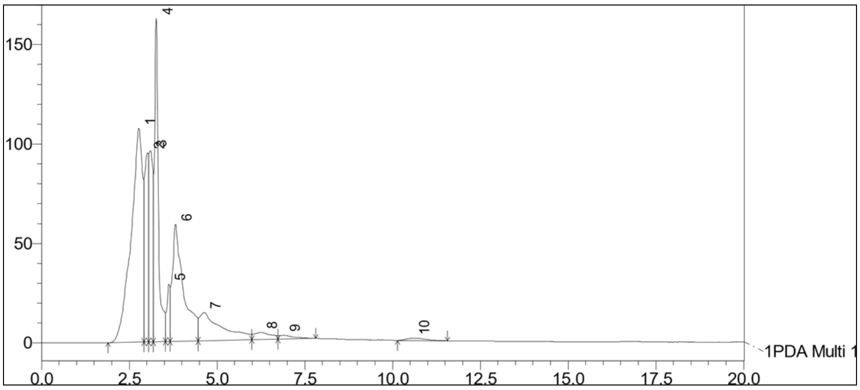

Fig 1: The HPLC analysis for *Allium cepa* bulb

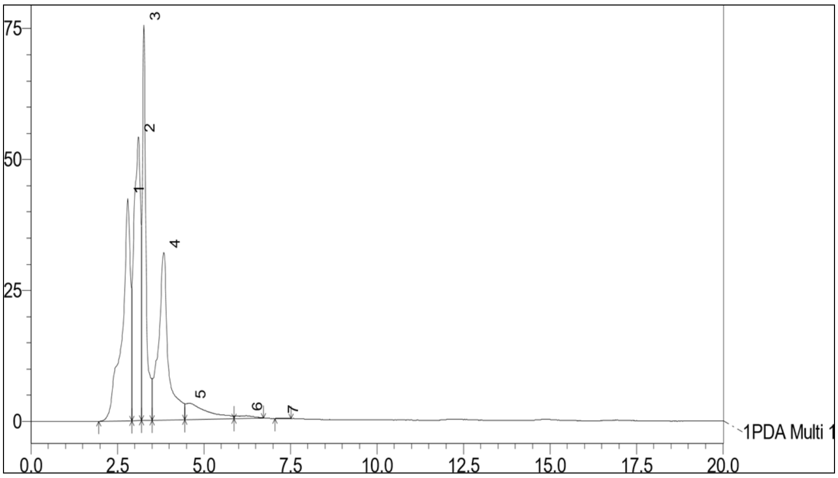

Fig 2: The HPLC analysis of *Allium sativum* bulb

Table 2: HPLC Chromatogram of *A. cepa* bulb extracts

Peak No.	1	2	3	4	5	6	7	8	9	10
Retention Time	2.768	3.019	3.096	3.261	3.624	3.809	4.629	6.239	6.892	10.577
Area	2470436	755197	767221	1272594	190473	1302088	638836	124899	59514	46873

Table 3: HPLC Chromatogram of *A. sativum* bulb extracts

Peak No.	1	2	3	4	5	6	7
Retention Time	2.975	3.102	3.260	3.836	4.584	6.222	7.253
Area	716946	741968	549772	634802	138651	21330	1875

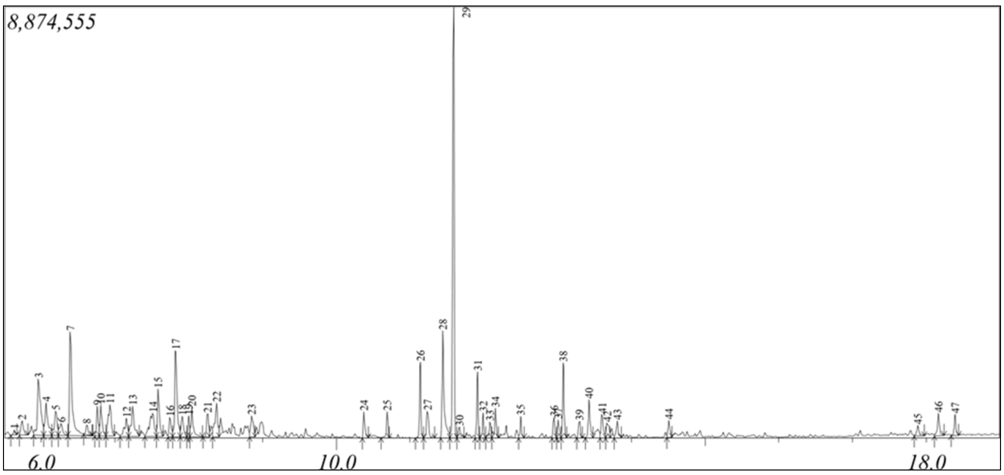

Fig 3: GC-MS Chromatographic Profile of the Essential Oil of *Allium cepa* bulb

Table 4: Chromatographic Profile of the Essential Oil of *Allium cepa* bulb

Peak No.	Name of compound	Retention time	Molecular formula	% composition
1	(IR)-2,6,6-Trimethylbicyclo [3,1,1] hept-2-e	5.638	$C_{10}H_{16}$	0.26
2	(IR)-2,6,6-Trimethylbicyclo [3,1,1] hept-2-e	5.738	$C_{10}H_{16}$	0.95
3	Benzene, 1-ethyl-3-methyl-	5.960	C_9H_{12}	4.79
4	Benzene, 1,2,3-trimethyl-	6.065	C_9H_{12}	2.40
5	Benzene, 1-ethyl-3-methyl-	6.195	C_9H_{12}	1.72
6	Cyclohexane, 1-methylene-4-(1-methylethenyl	6.270	$C_{10}H_{16}$	0.90
7	Benzene, 1,2,3-trimethyl-	6.394	C_9H_{12}	6.96
8	2,2-di-n-Propylacetyl chloride	6.618	$C_8H_{15}C_lO$	0.55
9	Benzene, 1,2,3-trimethyl-	6.759	C_9H_{12}	1.43
10	Benzene, 2-ethyl-1,4-dimethyl-	6.808	$C_{10}H_{14}$	1.73
11	D-Limonene	6.933	$C_{10}H_{16}$	2.63
12	2-Tolyloxirane	7.154	$C_9H_{10}O$	1.45
13	Benzene, 2-ethyl-1,4-dimethyl-	7.240	$C_{10}H_{14}$	2.41
14	Benzene, 1-ethyly-2,3-dimethyl-	7.511	$C_{10}H_{14}$	2.80
15	Benzene, 1-ethyly-2,3-dimethyl-	7.585	$C_{10}H_{14}$	2.59
16	1,6-Octadien-3-ol, 3,7-dimethyl	7.744	$C_{10}H_{18}O$	1.09
17	Disulphide, dipropyl	7.821	$C_6H_{14}S_2$	5.22
18	1,3-Dithiane, 2,2-dimethyl-	7.911	$C_6H_{12}S_2$	1.43
19	Benzene, 1,2,4,5-tetramethyl-	7.998	$C_{10}H_{14}$	0.94
20	Benzene, 1,2,4,5-tetramethyl-	8.041	$C_{10}H_{14}$	1.76
21	Benzene, 1-methyl-2-(2-propenyl)-	8.255	$C_{10}H_{12}$	1.26
22	1H-Indene, 2,3-dihydro-5-methyl-	8.376	$C_{10}H_{12}$	2.31
23	1H-Indene, 2,3-dihydro-5-dimethyl-	8.852	$C_{10}H_{12}$	1.41
24	Trisulphide, dipropyl	10.375	$C_6H_{14}S_3$	1.15
25	Cyclohexene, 4-ethenyl-4-methyl-3-(1 methylenthenyl)	10.691	$C_{15}H_{24}$	1.06
26	.alfa.-Copaene	11.138	$C_{15}H_{24}$	2.99
27	(-)-.beta.-Bourbonene	11.235	$C_{15}H_{24}$	1.60
28	3(2H)-Furanone, 2-hexyl-5-methyl-	11.444	$C_{11}H_{18}O_2$	5.73
29	Caryophyllene	11.589	$C_{15}H_{24}$	16.54
30	beta.-copaene	11.667	$C_{15}H_{24}$	0.65
31	Humulene	11.914	$C_{15}H_{24}$	2.50
32	Alloaromadendrene	11.990	$C_{15}H_{24}$	0.97
33	.gamma.-Murolene	12,085	$C_{15}H_{24}$	0.76
34	.beta.-copaene	12.159	$C_{15}H_{24}$	1.34
35	Naphthalene, 1,2,4a,5,8,8a-hexahydro-4,7-dimethyl-1	12.502	$C_{15}H_{24}$	0.84
36	Cyclopentene, 3-methyl-3-(trimethylsily)acetyl	12.950	$C_{11}H_{20}OS$	0.93
37	1H-Cycloprop[e]azulen-7-ol, decahydro-1,1	13.009	$C_{15}H_{24}O$	0.90
38	Caryophyllene oxide	13.079	$C_{15}H_{24}O$	3.02
39	Cis-Z-.alpha.-Bisabolene epoxide	13.298	$C_{15}H_{24}O$	0.81
40	14,15,16-Trinor-8-.xi.—labd-5-ene,8,13-epoxy	13.427	$C_{17}H_{28}O$	1.94
41	Ar-tumerone	13.603	$C_{15}H_{20}O$	1.31
42	Cis-(-)-2.4a,5,6,9a-Hexahydro-3,5,5,9-tetrarmethyl	13.670	$C_{15}H_{24}$	1.14
43	Cis-Z-.alpha.-Bisabolene epoxide	13.809	$C_{15}H_{24}O$	0.98
44	3-Isopropyl-4-methyl-decen-4-ol	14.509	$C_{14}H_{28}O$	0.88
45	Pentacyclo[9.1.0.0(2,4).0(5,78,10)] dodecane	17.886	$C_{20}H_{32}$	0.69
46	Podocarp-7-en-3-one, 13.beta.-methyl-13-vinyl	18.166	$C_{20}H_{30}O$	1.25
47	Cis-(-)-2,4a,5,6,9a-Hexahydro-3,5,5,9-tetrarmethyl	18.390	$C_{15}H_{24}$	1.04

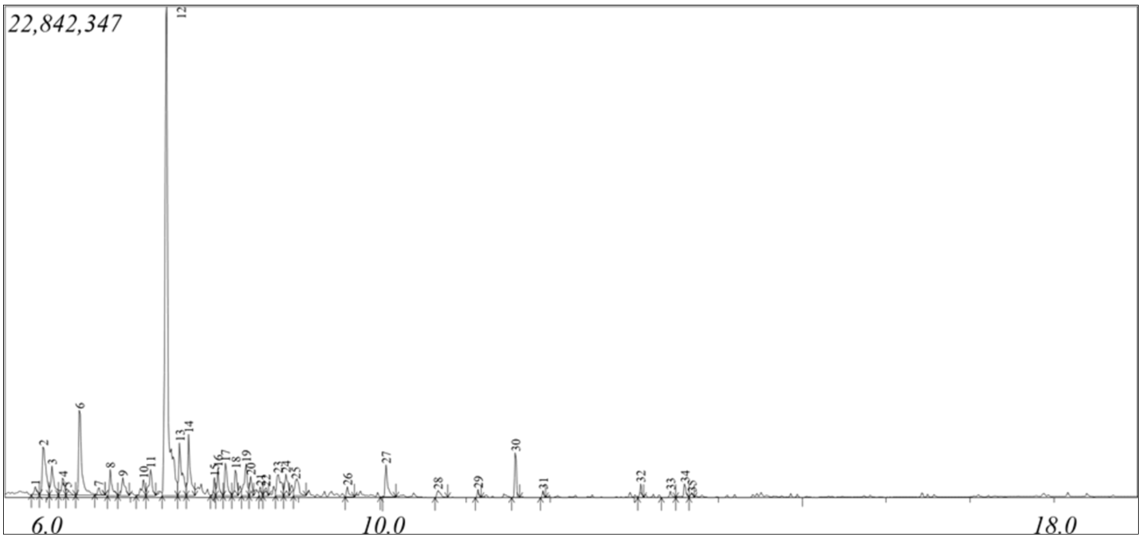

Fig 4: Gas Chromatography- Mass Spectrometry (GC-MS) Analysis of *Allium sativa* bulb

Table 5: Chromatographic Profile of the Essential oil of *Allium sativum* bulb

Peak No.	Name of Compound	Retention Time	Molecular formula	% Composition
1	6-Methyl-1-(phenylmethyl)-1,2,3,6-tetrahydropyridin-3-ol	5.865	$C_{13}H_{17}NO$	0.65
2	Benzene, 1-ethyl-3-methyl-	5.962	C_9H_{12}	4.87
3	Benzene, 1,2,3-trimethyl-	6.066	C_9H_{12}	2.52
4	Benzene, 1-ethyl-3-methyl-	6.194	C_9H_{12}	1.45
5	Heptane, 5-ethyl-2-methyl	6.242	$C_{10}H_{22}$	0.52
6	Benzene, 1,2,3-trimethyl-	6.395	C_9H_{12}	7.02
7	Oxalic acid, isobutyl undecyl ester	6.622	$C_{17}H_{32}O_4$	0.46
8	Benzene, 1,2,3-trimethyl-	6.760	C_9H_{12}	1.84
9	Indane	6.908	C_9H_{10}	1.59
10	Benzene, 1-methyl-3-propyl-	7.155	$C_{10}H_{14}$	1.40
11	Benzene, 1-ethyl-2,3-dimethyl-	7.241	$C_{10}H_{14}$	2.25
12	Diallyl disulphide	7.429	$C_6H_{10}S_2$	40.14
13	Benzene, 1-(bromomethly)-4- (1-methylethy)	7.585	$C_{10}H_{13}Br$	4.81
14	Diallyl disulphite	7.693	$C_6H_{10}S_2$	4.40
15	Benzene, 1,2,4,5-tetramethyl-	7.998	$C_{10}H_{14}$	0.94
16	Benzene, 1,2,4,5-tetramethyl-	8.041	$C_{10}H_{14}$	1.55
17	2-TrimethylIsilyl-1,3-dithiane	8.133	$C_7H_{16}S_2S$	2.28
18	Benzene, 1-methyl-2-(2-propeny)-	8.252	$C_{10}H_{12}$	1.65
19	1H-Indene, 2,3-dihydro-5-methyl-	8.375	$C_{10}H_{12}$	2.49
20	6,7-Dimethyl-3,5,8,8a-tetrahydro-1H-2-benzopyran	8.432	$C_{11}H_{16}O$	1.23
21	Benzene, 1,3-diethyl-5-methyl	8.546	$C_{11}H_{16}$	0.50
22	Benzaldehyde, 4-(1-methylethyl)-	8.614	$C_{10}H_{12}O$	0.61
23	Naphthalene	8.757	$C_{10}H_8$	2.56
24	1H-Indene, 2,3-dihydro-1,6-dimethyl-	8.851	$C_{11}H_{14}$	1.71
25	Benzene, pentamethyl-	8.970	$C_{11}H_{16}$	1.87
26	1H-Indene, 2,3-dihydro-4,7-dimethyl	9.582	$C_{11}H_{14}$	0.68
27	Trisulfide, di-2-propenyl	10.044	$C_6H_{10}S_3$	2.24
28	7-Amino-6-methyl-7H-S-triazolo[5,1-c]-S-triazole-3-thiol	10.662	$C_4H_6N_6S$	0.67
29	Copaene	11.138	$C_{15}H_{24}$	0.35
30	Caryophyllene	11.586	$C_{15}H_{24}$	2.02
31	Humulene	11.914	$C_{15}H_{24}$	0.34
32	Caryophyllene oxide	13.077	$C_{15}H_{24}O$	0.65
33	14,15,16-Trinor-8-.xi.-labd-5ene, 8,13-epoxy-,	13.430	$C_{17}H_{28}O$	0.41
34	Ar-tumerone	13.601	$C_{15}H_{20}O$	0.97
35	Turmerone	13.690	$C_{15}H_{22}O$	0.35

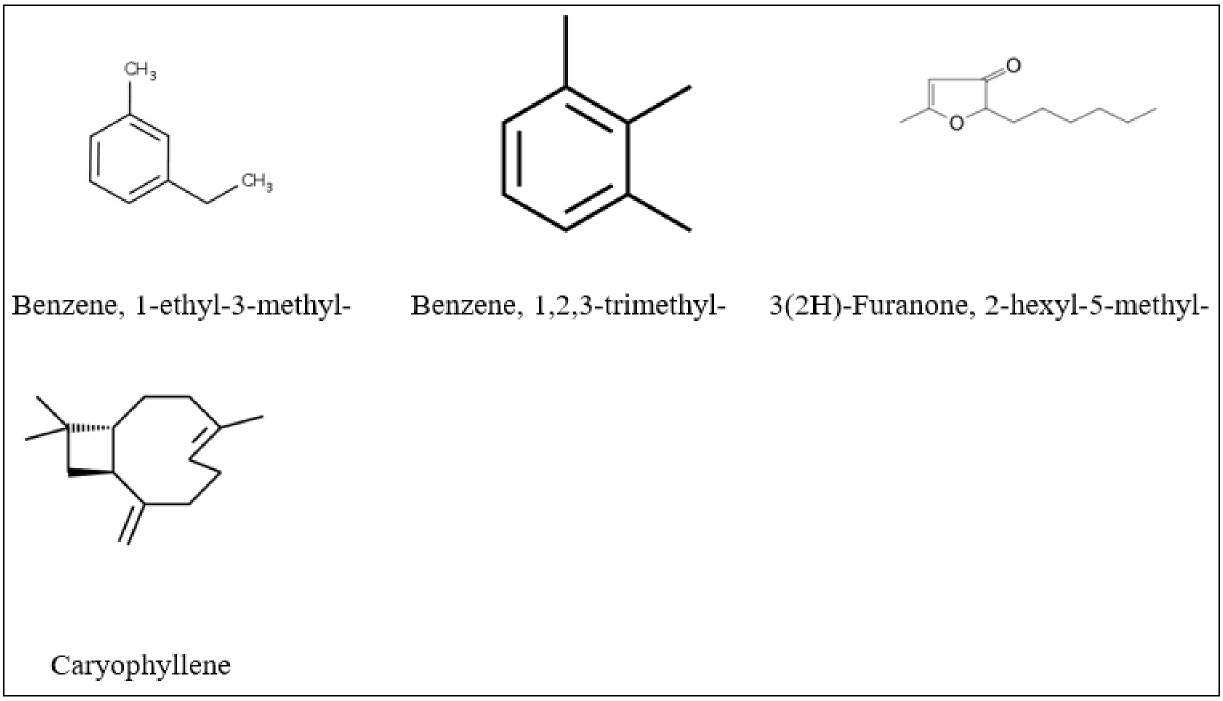

Fig 5: Chemical structures of some compounds in A. cepa bulb oil

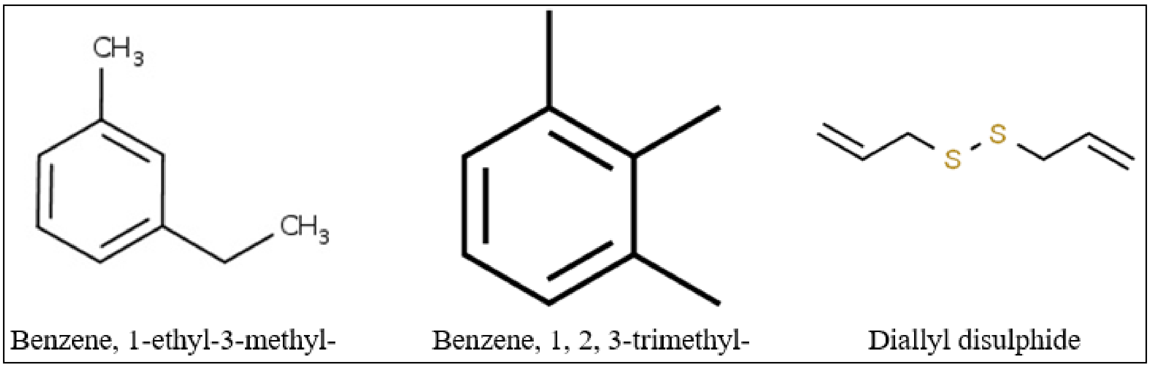

Fig 6: Chemical structures of some compounds in A. sativum bulb oil

Table 6: Compounds common to *A. cepa* and *A. sativum* bulb oils

Compound	% composition (*A. cepa*)	% composition (*A. sativum*)
Benzene,1-ethyl 3-metyl	4.79	4.87
Benzene, 1,2,3-trimethyl-	2.40	2.52
Benzene, 1-ehtyl 3-methyl-	1.72	1.45
Benzene, 1,2,3-triethyl-	6.96	1.84
Cryophyllene	16.54	2.02
Humulene	2.50	0.34
Cryophyllene oxide	3.02	0.65
Ar-tumerone	1.31	0.97

Discussion and Conclusion

Discussion

Chemo-microscopic analysis of *Allium cepa* and *Allium sativum* revealed the presence of lignin, cellulose, tannins, starch, oil, protein and absence of mucilage and calcium oxalate crystals in the tests carried out. The chemo-microscopic characters can be used for identification and quality control of the crude drug. The chemo-microscopic analyses of the two plants were found to be the same in the analysis carried out.

The HPLC analysis of the essential oil of *Allium cepa* had 10 peaks, while that of *Allium sativum* gave 7 peaks. The GC-MS of *Allium cepa* revealed 47 compounds (Figure 4 and Table 3), while that of *Allium sativa* revealed 35 compounds (Figure 5 & Table 4). The GC-MS analysis revealed the major compounds in *Allium cepa* were Caryophyllene (16.54%); 3(2H)-Furanone, 2-hexyl-4-methyl- (5.73%); Disulphide, dipropyl (5.22); Benzene, 1,2,3-trimethyl- (6.90%) and Benzene (-ethyl-3-methyl) (). (Figure 5 and Table 3). The major compounds in *Allium sativa* were Diallyl disulphide (40.14%); Benzene, 1,2,3-trimethyl- (7.02%); Benzene, 1-ethyl-3-methyl- (4.8%) Diallyl disulphide (4.40%) and Benzene 1-(bromomethyl)-4-(1-methylethyl) 4.81% (Figure 6 & Table 4).

Different studies on the composition of garlic essential oil showed that diallyl disulfide and diallyl trisulfide were the two major compounds (Douiri et al., (2013). Allium sativum essential oil obtained by Clevenger hydro distillation was dominated by diallyl trisulfide (46.5%), followed by diallyl disulfide (16.0%), allyl methyl trisulfide (10.9%) and diallyl disulfide (7.0%). Similarly, Rao et al., (1999) had analyzed six geographical varieties of Allium sativum grown in India. These investigators found diallyl disulfide (27.1-46.8%) and diallyl trisulfide (19.9-34.1%) to be the dominant components, followed by allyl methyl trisulfide (8.3-18.2%), and allyl methyl disulfide (4.4-12.0%). In the present study: Allium cepa had Caryophyllene (16.54%); 3(2H)-Furanone, 2-hexyl- 4-methyl- (5.73%); Disulphide, dipropyl (5.22); Benzene, 1,2,3-trimethyl- (6.90%) and Benzene (-ethyl-3-methyl); while in Allium sativa had Diallyl disulphide (40.14%); Benzene, 1,2,3-trimethyl- (7.02%); Benzene, 1-ethyl-3-methyl- (4.8%) Diallyl disulphide (4.40%) and Benzene 1-(bromomethyl)-4-(1-methylethyl) 4.81%. Caryophyllene has the highest percentage composition in A. cepa (16.54%); while Diallyl disulphide has the highest composition in A. sativum (40.14%) bulb oil.

The major component common to both Allium cepa and Allium sativum in the study were Benzene,1, 2,3-trimethyl, Benzene,1-ethyl 3-metyl, Benzene, 1-ehtyl 3-methyl- , Cryophyllene, Humulene, Cryophyllene oxide and Ar-tumerone but had different percentage conpositions (Table 6).

Caryophyllene is found in large amounts in essential oils of many different spice and food plants, such as Allium sp. It is commercially used as food addictive and its cosmetics. The essential oils found in Disulfide dipropyl is used as pesticides in preventing, destroying or mitigating pests, it is also used in general flavoring agents used in foods, including condiments and seasonings. And it is also used in the manufacturing of chemicals. Also, essential oil found Benzene trimethyl is commonly used in our daily diet and has also been used as a folk remedy for its anti-infective properties and other beneficial effects. It has been studied for therapeutic use as an antioxidant and anti-cancer agent.

Humulene, formerly known as alpha-humulene or alpha-caryophyllene was first identified in the essential oils of Humulus lupulus, commonly called hops. Hops is a species of plant in the Cannabaceae family, which also features both hemp and marijuana plants. Humulene gives it a distinctive bitter "hoppy" taste. Depending on the other terpenes present in a strain, humulene can provide a beer-like scent to cannabis as well. Humulene is a versatile terpene, but its most notable health benefits include antibacterial, anti-inflammatory, and antitumor effects, Fernandes, et al., 2007. Unlike most strains, cannabis that contains a high level of humulene is also anorectic, so that it does not produce such a pronounced appetite boost. A 2007 study published in the European Journal of Pharmacology found that humulene reduced inflammation in rodent models. The same study compared the potency of humulene's anti-inflammatory effects to the ones provided by the potent corticosteroid dexamethasone Fernandes, et al., 2007. In combination with phytocannabinoids and additional terpenes, Humulene has demonstrated the ability to kill cancer cells, preventing their proliferation and reducing tumor growth.

Cryophyllene oxide, an oxygenated terpenoid, well known as preservative in food, drugs and cosmetics, has been tested in vitro as an antifungal against dermatophytes. Its antifungal activity has been compared to ciclopiroxolamine and sulconazole, commonly used in onychomycosis treatment and chosen because of their very different chemical structures, (Yang et al., 1999). Caryophyllene oxide, (Yang et al., 1999) in which the alkene group of caryophyllene has become an epoxide, is the component responsible for cannabis identification by drug-sniffing dogs (Stahl and Kunde, (1973) and is also an approved food additive, often as flavoring. Aromatic (ar-) turmerone is a major bioactive compound of the herb Curcuma longa. It has been suggested that ar-turmerone inhibits microglia activation, a property that may be useful in treating neurodegenerative disease (Joerg et al., 2014). Although ar-turmerone inhibited the proliferation of various cancer cell lines, it enhanced proliferation of peripheral blood mononuclear cells, Yue et al., 2010.

1,2,3-Trimethyl-benzene or Hemimellitene, also known as hemellitol, belongs to the class of organic compounds known as benzenes and substituted benzene derivatives. These are aromatic compounds containing one monocyclic ring system consisting of benzene. It is nearly insoluble in water but soluble in organic solvents. It occurs naturally in coal tar and petroleum. There are three isomers of trimethylbenzene, mesitylene, pseudocumene, and hemimellitene, with hemimellitene being more toxic due to its relatively slow metabolism in mammals (PMID: 1129786). Hemimellitene is found naturally in a number of fruits, essential oils and nuts, including carrot leaf oil, plum fruit, corn, sweet charries, plumcot fruit, and black walnuts (and black walnut essential oils) (Bernalte et al., 1999) [4].

Conclusion

In conclusion, the essential oil components found in *Allium cepa* and *Allium sativum* based on the GCMS analysis find applications in flavorings, fragrances, cosmetics, manufacture of chemicals, pesticides and insecticides as well as anti-inflammatory, anti-bacterial, anti-fungal agents, anti-infective and other beneficial effects.

The isolation of the various components detected by the GCMS analysis can be used for the formulation of drugs which will be used to treat ailments like: respiratory diseases, useful therapeutic agent due to its anti-oxidative and anti-inflammatory agent, anti-cancer, anti-infective, anti-ulcer anti-hypertensive, and anti-nociceptive, anti-fungal and anti-microbial drugs.

Recommendations

Future studies, besides the comparative analysis approach, should focus on the relationship between their chemical structure and activity of the onion and garlic compounds and also on clinical tests to evaluate the potential effects of both the crude extracts.

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