International Journal of Advanced Research in Biological Sciences
ISSN: 2348-8069
www.ijarbs.com
Volume 3, Issue 6 - 2016

Research Article

SOI: http://s-o-i.org/1.15/ijarbs-2016-3-6-7

GC-MS and FT-IR Analysis of *Nigella sativa* L. Seeds

K. Nivetha and G. Prasanna*

P.G and Research Department of Biochemistry, Sengamala Thayaar Educational Trust Women's College, Sundarakkottai, Mannargudi, Thiruvarur Dt, Tamil Nadu, India.
*Corresponding Author: *prasannakeertana@yahoo.in*

Abstract

The present study has been designed to identify the bioactive constituents present in ethanol extract of *Nigella sativa* L. seeds using Gas Chromatography-Mass Spectroscopic (GC-MS) and Fourier Transform Infrared Spectroscopy (FT-IR). Preliminary phytochemical analysis revealed the presence of anthroquinones, alkaloids, amino acid, tannins, saponnins, flavonoids, protein, steroids, terpenoids and absence of carbohydrates, polyphenols, phlobatannins, phytosterol, cardiac glycosides. GC-MS analysis of plant extract was performed using a Perkin-Elmer GC Clarus 436 system and interpretation on mass spectrum GC-MS was conducted using the database of National Institute Standard and Technology (NIST). Totally 28 compounds were identified based on their molecular mass, retention time and peak values, among them, the major phytoconstituents such as n-Hexadecanoic acid (29.42%), 9,12-Octadecadienoic acid (z,z)-,2-hydroxy-1-(hydroxymethyl) ethyl ester (19.11%), Eicosanoic acid (13.39%), Hexadecanoic acid, ethyl ester (11.31%), and 9,12-Octadecadienoic acid (z,z)- (10.39%) were identified by high peak values. The FT-IR spectrum analysis was also carried out and the results confirmed the presence of functional groups such as amines, alkanes, acids, esters, alkyl and alkenes. Thus, the result of our study offers a platform of using *Nigella sativa* seeds as herbal alternatives for various diseases.

Keywords: FT-IR, GC-MS, *Nigella sativa* L. phytochemicals, ethanol extract.

Introduction

Plants have been major source of medicine in all cultures from ancient times. In the traditional system, various indigenous plants are being used in the diagnosis, prevention and elimination of physical, mental or social imbalance (Manjunath, 1990). Medicinal plants are the backbone of the traditional medicine (Farnsworth, 1994) and are of great importance to the health of individuals and communities. The medicinal value of these plants lies in some chemical substances that produce a definite physiological action on the human body (Edeoga *et al*., 2005). The drugs are derived from the whole plant or from different organs, like leaves, stem, bark, root, flower, seed, etc., Some drugs are prepared from excretory plant product such as gum, resins and latex.

Over the years, interest in natural products has acquired a cyclic phenomenon. In many countries, including India and China, thousands of tribal communities still use folklore medicinal plants for the cure of various diseases. The great interest in the use and importance of medicinal plants in many developing countries has led to intensified efforts on the documentation of ethno medical data of medicinal plants (Dhar *et al*., 1968; Waller, 1993).

Phytochemistry is a branch of chemistry with photochemical, i.e. chemicals obtained from the plant source. These compounds are known as secondary plant metabolites and have biological properties such as antioxidant activity, antimicrobial effect,

modulation of detoxification enzymes, stimulation of the immune system, decrease of platelet aggregation and modulation of hormone metabolism and anticancer property (Padma Selvi *et al*., 2016**)**. The most important of these bioactive constituents of plants are alkaloids, tannins, flavanoids and phenolic compounds (Hill, 1952). The phytochemical constituents of the medicinal plants were recorded by a number of workers (Joshi, 2000; Ramasubbu and Chandra Prabha, 2009). Almost every species of medicinal plant contains more than one active compound and it is necessary to know the composition before other studies are being under taken.

Phytochemical study helps in discovering alternative source of therapeutic chemicals of importance. Gas Chromatography Mass Spectrometry (GC-MS) is an instrumental technique, comprising a gas chromatograph (GC) coupled to a mass spectrometer (MS), by which complex mixtures of chemicals may be separated, identified and quantified. This makes it ideal for the analysis of the hundreds of relatively low molecular weight compounds found in environmental materials. In order for a compound to be analyzed by GC/MS it must be sufficiently volatile and thermally stable. The FT-IR has proven to be a valuable tool for characterization and identification of compounds or functional groups (chemical bonds) present in an unknown mixture of plants extract (Aysal *et al*., 2007; Ibrahim *et al*., 2008). It is a rapid, non-destructive technique with minimum sample preparation necessary (Singh *et al*., 2011). It allows the qualitative determination of organic compounds as the appearance of the bands in the infrared spectrum at a specific frequency, which is further influenced by the surrounding functional groups (Schulz *et al*., 2003). Hence, the present study has been designed to evaluate the phytochemicals present in the seeds of *Nigella sativa* through GC-MS and FT-IR spectral analysis

*Nigella sativa (*Karunjiragam) is belongs to the family of Ranunculaceae, is cultivated in many countries in the world like Middle Eastern Mediterranean region, South Europe, Saudi Arabia, Turkey, Syria, Pakistan and India (Sharma *et al*., 2005). It is an annual flowering plant with finely divided leaves and 20-90 cm in height. Flowers solitary at end of branches, blue, star-shaped. Shortly clawed; petals are smaller. The fruits are big and exaggerated capsules are made-up of 3-7 united follicles having various seeds. The seeds are small dicotyledonous, trigonus, angular, 2-3.5×1-2 mm, apparent black and internally white, somewhat aromatic odor and bitter in taste (Warrier *et al*., 2004).

Chemical composition

Many active compounds have been isolated, identified and reported so far in different varieties of black seeds. The most important active compounds are thymoquinone (30%-48%), thymohydroquinone, dithymoquinone, p-cymene (7%-15%), carvacrol (6%-12%), 4-terpineol (2%-7%), t-anethol (1%-4%), sesquiterpenelongifolene (1%-8%) α-pinene and thymol*etc*. Black seeds also contain some other compounds in trace amounts. Seeds contain two different types of alkaloids; *i.e.* isoquinoline alkaloids *e.g*. nigellicimine and nigellicimine-N-oxide, and pyrazol alkaloids or indazole ring bearing alkaloids which include nigellidine and nigellicine. Moreover, *Nigella sativa* seeds also contain alpha-hederin, a water soluble penta cyclic triterpene and saponin, a potential anticancer agent (Al-Jassir, 1992).

Traditional and Medicinal uses

The seeds of *N. sativa* and their oil have been widely used for centuries in the treatment of various ailments throughout the world. It is an important drug in the Indian traditional system of medicine like Unani and Ayurveda (Sharma *et al.*, 2005). Among Muslims, it is considered as one of the greatest forms of healing medicine. It is also recommended for use on regular basis in Tibb-e-Nabwi (Prophetic Medicine) (Al-Bukhari, 1976). It is used as liver tonic, digestive, anti-diarrheal, appetite stimulant, emmenagogue, to increase milk production in nursing mothers to fight parasitic infections, and to support immune system (Abel-Salam, 2012). Black seeds are also used in food like flavoring additive in the breads and pickles because it has very low level of toxicity (Al-Ali *et al.*, 2008). Roasted black seeds are given internally to stop the vomiting (Yarnell and Abascal, 2011).

Materials and Methods

Collection of plant materials

The *Nigella sativa* L. seeds were purchased from a local market, Mannargudi, Thiruvarur District, Tamil Nadu, India. The black seeds were thoroughly rinsed with plenty of water to get rid of the adherent impurities. The clean seeds were used for the preparation of extract.

Preparation of the extract

The seeds of *Nigella sativa* were dried below 60°C in an oven, and then powdered. 50gm of dried powdered seeds were subjected to extraction with 250 ml of ethanol in a Soxhlet apparatus. The extracts obtained were filtered and evaporated to dryness by Rota evaporator and stored at low temperature for further studies.

Preliminary phytochemical screening

The seed extract was subjected to preliminary phytochemical investigations to determine the different phytoconstituents using standard methods (Harborne, 1984).

Gas Chromatography - Mass Spectroscopy (GC-MS) analysis

10 g of powdered seed sample is soaked with 30 ml ethanol overnight and filtered through ash less filter paper with sodium sulphate (2 g). The extract is concentrated to 1ml by bubbling nitrogen in to the solution. The extract contained both polar and non-polar phyto components. 2µl of the ethanol extract of *Nigella sativa* was employed for GC-MS analysis. The Clarus 436 GC Bruker used in the analysis employed a fused silica column BR-5MS (5% Diphenyl / 95% Dimethyl poly siloxane), 30m × 0.25mm ID × 0.25µm 2µl df and the components were separated using Helium as carrier gas at a constant flow of 1 ml/min. The sample extract injected into the instrument which was detected by the Turbo gold mass detector (perkin elmer) with the aid of the software MS work station 8. During the 36th minute of GC extraction process, the oven was maintained at a temperature of 110º C with 2 minutes holding. The injector temperature was set at 250ºC (Mass Analyser). The different parameters involved in the operation of the Clarus 436 MS Bruker were also standardized (Inlet line temperature: 200ºC). Mass spectra were taken at 70 eV; a scan interval of 0.5 s and fragments from 45 to 450 Da. The MS detection was completed in 36 minutes (Srinivasan *et al*., 2013).

Identification of components

The relative percentage amount of each component was calculated by comparing its average peak area to the total areas. The detection employed the NIST (National Institute of Standards and Technology) Ver 8-Year 2005 library. The compound prediction is based on Dr. Duke's phytochemical and Ethno botanical Databases by Dr. Jim Duke of the Agricultural Research Service/USDA. Interpretation of GC-MS was conducted using the database of NIST having more than 62.000 patterns. The spectrum of the unknown components was compared with the spectrum of the known components stored in the NIST library. The name, molecular weight and structure of the components of the test materials were ascertained.

Fourier Transform - Infrared Spectroscopy (FT-IR) analysis

Infrared spectroscopy is one of the powerful analytical techniques which offer the possibility of chemical identification. The technique is based on the simple fact that chemical substance shows selective absorption in infrared region. After absorption of IR radiations, the molecules vibrate, giving rise to absorption spectrum. A small amount of powdered seeds was placed directly on the germanium piece of the infrared spectrometer with constant pressure applied and data of infrared absorbance, collected over the wave number ranged from 4000 cm^{-1} to 650 cm^{-1} and computerized for analyses by using the Omnic software (version 5.2). The reference spectra were acquired from the cleaned blank crystal prior to the presentation of each sample replicate. All spectra were collected with a resolution of 4-1 cm (Liu *et al.*, 2006).

Results and Discussion

A large number of medicinal plants and their purified constituents have shown beneficial therapeutic potentials (Khalaf *et al.*, 2007). In order to promote the use of medicinal plants as potential sources for treating various ailments, it is important to thoroughly investigate their composition and activity and thus validate their use (Nair and Chanda, 2006). There is a growing awareness in correlating the phytochemical components and their biological activities (Sumner *et al*., 2003; Robertson, 2005). Phytochemicals or secondary metabolites usually occur in complex mixtures that differ among plant organs and stages of development (Wink, 2004). Understanding of the phytochemical constituents is important for exploration of the authentic effectiveness of the plant. In the present study, phytochemical screening, GC-MS and FT-IR analysis were carried out in ethanol extract of *Nigella sativa* seeds.

Phytochemical analysis

Phytochemicals are bioactive chemicals of plant origin. They are regarded as secondary metabolites

because the plants that manufacture them may have little need for them. They are naturally synthesized in all parts of the plant body; bark, leaves, stem, root, flower, fruits, seeds, etc. i.e. any part of the plant body may contain active components (Tiwari *et al.*, 2011). The quantity and quality of phytochemicals present in plant parts may differ from one part to another. In fact, there is lack of information on the distribution of the biological activity in different plant parts essentially related to the difference in distribution of active compounds (or active principles) which are more frequent in some plant parts than in others (Lahlou, 2004). Following such leads, plant parts are usually screened for phytochemicals that may be present. The presence of a phytochemical of interest may lead to its further isolation, purification and characterization. Then it can be used as the basis for a new pharmaceutical product.

In the present study, seeds extract of *Nigella sativa* was qualitatively examined for the presence of phytoconstituents and the results represented in table1. The results revealed the presence of alkaloids, anthroquinone, amino acid, tannins, saponins, flavonoids, protein, steroids, and terpenoids and absence of carbohydrates, polyphenols, phlobatannins, phytosterol, and cardiac glycosides. Previously it was reported that *Nigella sativa* seeds contain tannins, which was extracted in methanolic extract (Eloff *et al.*, 1998). Alkaloids generally play some metabolic role and control development in living system. They are also involved in protective function in animals and are used as medicine especially the steroidal alkaloids (Lalitha and Jayanthi, 2012). The flavonoids in plant have been reported to exert multiple biological effects including antioxidant, free radical scavenging abilities, anti inflammatory, anti carcinogenic etc., (Lalitha and Jayanthi, 2012). Tannins forms complexes with proteins through forces such as hydrophobic effects, hydrogen bonding and covalent bond formation, thus, tannins act as antibacterial agent by inactivating microbial adhesions, enzymes, cell envelope transport proteins (Hashem and El-Kiey, 1982).

Table 1: Preliminary phytochemical screening of *Nigella sativa* seeds

S.No	Phytochemicals	Results
1.	Alkaloids	+
2.	Anthroquinone	+
3.	Carbohydrates	-
4.	Tannins	+
5.	Amino acids	+
6.	Polyphenols	-
7.	Phlobatannins	-
8.	Saponnins	+
9.	Flavonoids	+
10.	Protein	+
11.	Steroids	+
12.	Phytosterol	-
13.	Terpenoids	+
14.	Cardiac glycosides	-

\+ - indicates presence
\- - indicates absence

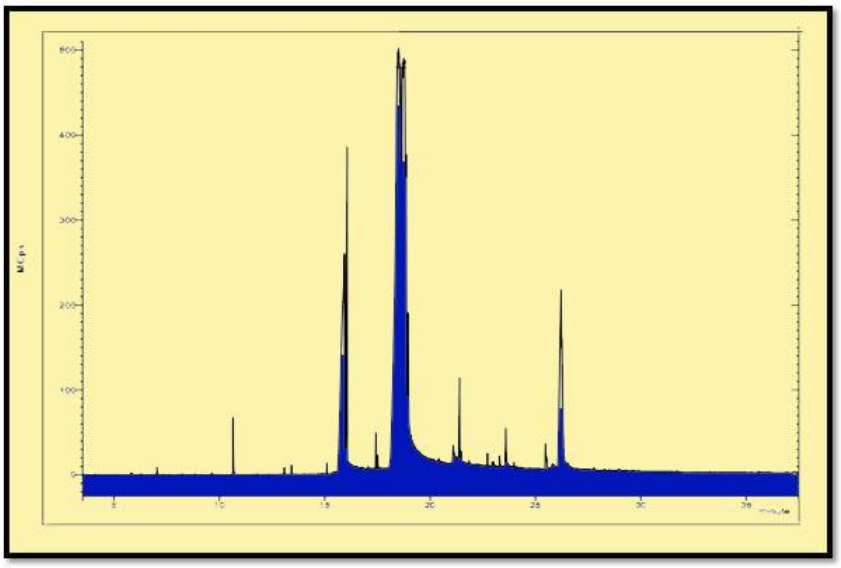
GC-MS analysis

GC-MS is the best technique to identify the bioactive constituents of long chain hydrocarbons, alcohols, acids, esters, alkaloids, steroids, amino acid and nitro compounds (Muthulakshmi *et al*., 2012). In the present study, Gas Chromatography Mass Spectroscopy analysis was carried out in ethanol extract of *Nigella sativa* seeds. (Table 2; Figure 1).

Table 2: GC-MS analysis of *Nigella sativa* seeds

S.No.	RT	Name of the compound	Molecular Formula	Molecular Weight	Peak Area %
1.	5.82	5Hydroxy methyl furfural	$C_6H_6O_3$	126	0.02
2.	6.27	Thymoquinine	$C_{10}H_{12}O_2$	164	0.03
3.	7.05	Thymol	$C_{10}H_{14}O$	150	0.06
4.	8.23	2-Isopropylidene-5-methylhex-4-enal	$C_{10}H_{16}O$	152	0.02
5.	8.84	Longifolene	$C_{15}H_{24}$	204	0.03
6.	9.63	Phenol, 3-(1,1-dimethylethyl)-4-methoxy-	$C_{11}H_{16}O_2$	180	0.02
7.	10.65	p-tert-Butyl catechol	$C_{10}H_{14}O_2$	166	0.52
8.	13.07	Tetradecanoic acid	$C_{14}H_{28}O_2$	228	0.18
9.	13.42	Tetradecanoic acid, ethyl ester	$C_{16}H_{32}O_2$	256	0.15
10.	15.09	Hexadecanoic acid, methyl ester	$C_{17}H_{34}O_2$	270	0.14
11.	15.91	n-Hexadecanoic acid	$C_{16}H_{32}O_2$	256	29.42
12.	16.05	Hexadecanoic acid, ethyl ester	$C_{18}H_{36}O_2$	284	11.31
13.	17.41	9,12-Octadecadienoic acid, methyl Ester	$C_{19}H_{34}O_2$	294	1.03
14.	17.51	Oleic Acid	$C_{18}H_{34}O_2$	282	0.65
15.	18.68	9,12-Octadecadienoic acid (Z,Z)-	$C_{18}H_{32}O_2$	280	10.39
16.	18.95	Eicosanoic acid	$C_{20}H_{40}O_2$	312	13.39
17.	21.11	cis-13,16-Docasadienoic acid	$C_{22}H_{40}O_2$	336	2.55
18.	21.38	cis-11,14-Eicosadienoic acid, methyl ester	$C_{21}H_{38}O_2$	322	3.93
19.	21.84	Methyl 19-hexacosenoate	$C_{27}H_{52}O_2$	408	1.06
20.	23.02	Cholestan-3-ol, 2-methylene-, (3β,5α)-	$C_{28}H_{48}O$	400	0.80
21.	23.31	9,12,15-Octadecatrienoic acid, 2-(acetyloxy)-1-[(acetyloxy)methyl]ethyl ester, (Z,Z,Z)-	$C_{25}H_{40}O_6$	436	0.96
22.	23.60	Palmitic acid β-monoglyceride	$C_{19}H_{38}O_4$	330	2.92

Figure 1: GC-MS analysis of ethanol extract of *Nigella sativa* seeds



The compounds were identified through mass spectrometry attached with GC with respect to their peak area and retention time. Totally 28 compounds were identified namely 5-Hydroxymethylfurfural (0.02%), Thymoquinone (0.03%), Thymol (0.06%), 2-Isopropylidene-5-methylhex-4-enal (0.02%), Longifolene (0.03%), Phenol, 3-(1,1-dimethylethyl)-4-methoxy- (0.02%), P-tert-Butyl catechol (0.52%), Tetradecanoic acid (0.18%), Tetradecanoic acid, ethyl ester (0.15%), Hexadecanoic acid, methyl ester (0.14%), n-Hexadecanoic acid (29.42%), Hexadecanoic acid, ethyl ester (11.31%), 9,12-Octadecadienoic acid, methyl ester (1.03%), Oleic Acid (0.65%), 9,12-Octadecadienoic acid (Z,Z)-(10.39%), Eicosanoic acid (13.39%), cis-13,16-Docasadienoic acid (2.55%), cis-11,14-Eicosadienoic acid, methyl ester (3.93%) methyl 19 –hexacosenoate (1.06%), Chelestan-3-ol, 2-methylene-, (3β,5α)-(0.08%), 9,12,15-Octadecatrienoic acid, 2-(acetyloxy)-1-[(acetyloxy) methyl] ethyl ester, (Z,Z,Z)-(0.96%), Palmitic acid β-monoglyceride (2.92%), 5,8,11,14-Eicosatetraenoic acid, methyl ester, (all-Z)-(0.79%),9,12-Octadecadienoic acid(z-z)-,2-hydroxy-1-(hydroxymethyl)ethyl ester (19.11%), Supraene (0.08%), Campesterol (0.13%), Stigmasterol (0.14%), β-Sitsosterol (0.40%).

Among the 28 compounds, major peak values were obtained for the compounds such as n-Hexadecanoic acid (29.42%), 9.12- Otadecadienoic acid (z,z)-, 2-hydroxy-1-(hydroxymethyl) ethyl ester (19.11%), Eicosanoic acid (13.39%), Hexadecanoic acid, ethyl ester (11.31%), 9,12-Octadecadienoic acid (Z,Z)-(10.39%).

According to Duke's Ethno botanical and phytochemistry database, the identified compounds possess many biological properties (table 3). Among the identified phytochemicals hexadecanoic acid is suggested to be a fatty acid ester and it may employed as antioxidant, antimicrobial, flavor, hypocholesterolemic agent and larvicidal activities (Bodoprost and Rosemeyer, 2007; Falodun *et al*., 2009). 9,12,15-octadecatrienoic acid is unsaturated fatty acid and have the property of antimicrobial, antioxidant, hypocholesterolemic, anti-inflammatory, cancer preventive, hepatoprotective, anti-arthritic, anti-histimic, anti-enzemic and anti-coronary. Methyl octadecanoate exhibits antifungal and anti-cancer activities (Gross and Shah, 2009). The compound 9, 12-octadecadienoic acid (Z, Z)-ethyl, is a fatty acid ester and it may be employed as antioxidant, antimicrobial, flavor, hypocholesterolemic agent and larvicidal activities.

Stigmasterol is a steroidal compound used as the precursor of vitamin D3 and it may be employed as antimicrobial, anticancer, anti-arthritic, antiasthma, diuretic and anti-inflammatory and also useful in prevention of certain cancers, including ovarian, prostate, breast and colon cancers (Kametani and Furuyama, 1987). It also exhibits potent antioxidant, hypoglycemic and thyroid inhibiting properties (Panda *et al*., 2009) as well as inhibits several pro-inflammatory and matrix degradation mediators typically involved in osteoarthritis-induced cartilage degradation (Gabay *et al*., 2010). Tetradecanoic acid is alcoholic compounds and it may use as antimicrobial agent, antiviral, candidicide and hypocholesterolemic agent (Saravana, 2013).

FT-IR analysis

FT-IR is one of the most widely used methods to identify the chemical constituents and elucidate the compounds structures and has been used as a requisite method to identify Medicines in Pharmacopoeia of many countries. Owing to the fingerprint characters and extensive applicability to the samples, FT-IR has played an important role in pharmaceutical analysis in recent years (Vlachos *et al*., 2006; Gough *et al*., 2003). In the present study FT-IR analysis was performed in *Nigella sativa* seeds. The results of FT-IR peak values and functional groups were represented in figure 2 and table 4. The result profile showed the presence of functional groups like amines (3378.8), alkanes (2927.80, 2854.20, and 1464.50), acids (1713.00, 1244.00), ester (1185.30), alky1 (1046.52), and alkenes (720.75-918.43).

The alkanes are found in the plant cuticle and epicuticular wax of many species. They protect the plant against water loss, prevent the leaching of important minerals by rain and protect against micro-organisms and harmful insects (Baker, 1982). Alkenes are important in the manufacture of plastics, e.g. polythene and as fuel and illuminant. They serve as raw materials for the manufacture of alcohols and aldehydes. They are used for artificial ripening of fruits, a general anaesthetic, making poisonous mustard gas and ethylene-oxygen flame. Amines and amides are the main groups of protein synthesis (Prasanna and Anuradha, 2016).

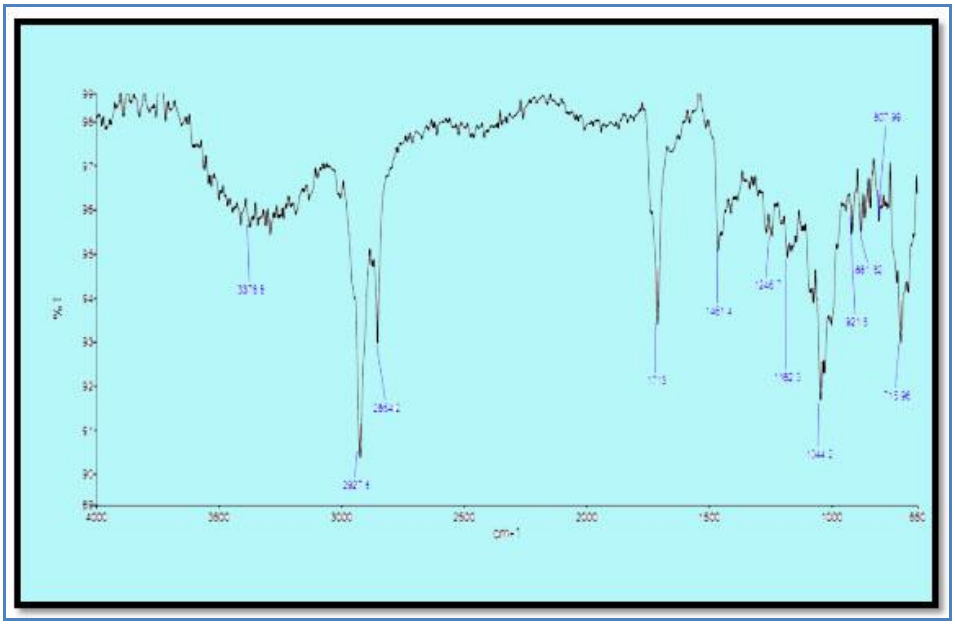
Table 3: GC-MS analysis of *Nigella sativa* seeds based on Dr. Duke's ethnobotanical and phytochemistry database

S.No	RT	Name of the Compound	Compound Nature	Activity
1	13.07	Tetradecanoic acid	Myristic acid	Antioxidant, Lubricant, Hypercholesterolemic, Cancer-Preventive, Cosmetic
2	18.68	9,12-Octadecadienoic acid,(z,z)	Linoleic acid	Antiinflammatory, Nematicide, Insectifuge, Hypocholesterolemic,Cancer preventive,Hepatoprotective, Antihistaminic, Antiacne, Antiarthritic, Antieczemic
3	23.31	9,12,15-Octadecatrienoic acid,	(z,z,z)-Linolenic acid	Antiinflammatory, Insectifuge, Hypocholesterolemic, Cancer preventive, Nematicide, Hepatoprotective, Insectifuge, Antihistaminic, Antieczemic, Antiacne, Antiandrogenic, Antiarthritic, Anticoronary.
4	15.09	Hexadecanoic acid methyl ester	Fatty acid ester	Antioxidant, Flavor, Hypocholesterolemic pesticide, 5-Alpha reductase inhibitor
5	16.05	Hexadecanoic acid	Palmitic acid	Antioxidant ,HypocholesterolemicNematicide, pesticide, Lubricant, Antiandrogenic, Flavor, Hemolytic 5- Alpha reductase inhibitor.
6	6.27	Thymoquinone	(2-isopropyl-5-methyl-benzoquinone)	Anticancer activity
7	7.05	Thymol	Biocides	Antimicrobial activity, Antitumor properties.
8	27.80	Supraene	Triterpene	Antibacterial, Antioxidant, pesticide, Antitumour, Cancer, preventive, Immunostimulent, Chemo preventive, Lipoxygenase-inhibito
9	34.95	Campesterol	Phytosterol	Hypocholesterolemic, Anticancer sactivity, Antibacterial activity and mutagenicity, anti inflammatory.
10	35.61	Stigmasterol	Phytosterol	Antioxidant activity, Anticancer activity, Hypoglycemic and thyroid inhibitors.
11	37.21	Bete-Sitosterol	Plant sterol ester	Anti inflammatory, Hypocholesterolemic and anti allergic, anti cancer activity.
12	17.51	Oleic Acid	Palmitic acid	Monoacylglycerol, Antioxidant, antiatheroselerotic and protein glycation inhibitory activities.
13	23.60	Palmitic acid	Nematicide	Antioxidant

Table 4: FT-IR analysis of ethanol extract of *Nigella sativa* L. seeds

S.No	Peak Value	Bond	Functional group
1.	3378.8	NH-Stretch	Amine
2.	2927.80	C-H Stretch	Alkane
3.	2854.20	C-H Stretch	Alkane
4.	1713.00	C=O Stretch	Acid
5.	1464.50	C-H bending	Alkane
6.	1244.00	C-O Stretch	Acid
7.	1185.30	C-O Stretch	Ester
8.	1046.52	C-F Stretch	Alkyl
9.	918.43	=CH bending	Alkene
10.	884.64	=C-H bending	Alkene
11.	804.92	=C-H bending	Alkene
12.	720.75	=C-H bending	Alkene

Figure 2: FT-IR analysis of ethanol extract of *Nigella sativa* L. seeds



Conclusion

From our study, it could be concluded that *Nigella sativa* seeds contains various bioactive compounds. The presence of these bioactive compounds justifies the use of the seeds for various ailments by traditional practitioners. However isolation of individual phytochemical constituents and subjecting it to biological activity will definitely give fruitful results.

References

Abel-Salma, BK. (2012). Immunomodulatory effects of black seeds and garlic on alloxan-induced diabetes in albino rat. *Allergol Immunopathol*, 40(6), 336-340.

Al-Ali, A., Alkhawajah, AA., Randhawa, MA., Shaikh, NA. (2008). Oral and intra peritoneal LD of thymoquinone an active principle of *Nigella sativa* in mice and rats. *J Environ Sci Heal*, 20(2), 25-27.

Al-Bukhari, MI., Sahi Al-Bukhari, (1976). The collection of authentic sayings of Prophet Mohammad 2nd ed. Ankara, Turkey, Hilal Yayinlari, Division (71) on medicine.

Al-Jassir, MS. (1992). Chemical composition and microflora of black cumin *Nigella sativa* L. seeds growing in Saudi Arabia. *Food Chem*, 45, 239-242.

Aysal, P., Ambrus, A., Lehotay, SJ., Cannavan, A. (2007). Validation of an efficient method for the determination of pesticide residues in fruits and vegetables using ethyl acetate for extraction. *J Environ Sci Health B*, 42(5), 481-90.

Baker, EA., Cutler, DF., Alvin, KL., Price, CE. (1982). Chemistry and morphology of plant epicuticular waxes. The plant cuticle. *J Academic Press London*, 139-165.

Bodoprost, J., Rosemeyar, H. (2007). Analysis of phenacylester derivatives of fatty acids from human skin surface sebum by reversed phase HPTLC: chromatigaphic mobility as functions of physic-chemical properties. *International journal of Mol. Sci*, 8, 1111-1124.

Dhar, ML., Dhar, BN., Dhawan, BN., Mehrotra, BN., Ray, C. (1968). Screening of Indian plants for biological activity. *Indian J Eep Biol*, 6, 232-247.

Edeoga, HO., Okwu, DE., Mbaebie, BO. (2005). Phytochemical constituents of some Nigerian medicinal plants. *J Biotechnol*, 4(7), 685-688.

Eloff, J.N. (1998).Which extractant should be used for the screening and isolation of antimicrobial components from plant. *J Ethnopharmacol*, 60:1-8.

Enomoto, S., Asano, R., Iwahori, Y., Narui, T., Okada, Y., Singab, AN., Okuyama, T. (2001). Hematological studies on black cumin oil from the seeds of *Nigella sativa* L. *Biol pharmaceut Bull*, 24, 307-310.

Falodun, A., Usitoh, CO. (2009). Isolation and charcraterisation of 3- carbomathoxypyridine from the leaves of *Pyrenacantha staudtil* (Hutch and Dalz). *Act pol pharm Drug Res*, 63(3), 2335-237.

Farnsworth, NR. (1994). Ethnopharmacology and drug development. *Ciba foundation Symposium,* 185, 42-59.

Gabay, S., Henik, A. (2010). Temporal expectancy modulates inhibition of return in a discrimination tast. *Psychonomic Bulletin and Review,* 17(1), 47-51.

Gough, KM., Zelinski, D., Wiens, R., Rak, M., Dixon. (2003). Fourier transform infrared evaluation of microscopic scarring in the cardiomyopathic heart effect of chronic AT Suppression. *Anal Bioche,* 316,232-242.

Gross., Shah, BT. (2009). Cotton in india. A rewiew of Adoption Govermment invervations and investment initiatives. *Indian Journal of Agricultural Enononics*, 67(3), 464-475.

Harborne, JB. (1973). Phytochemicals Methods. *Chapman* and *Hall Ltd London,* 2,480-484.

Hashem, FM., El-kiey, MA. (1982). *Nigella sativa* seeds of Egypt. *J pharm sci united Arab Repubic,* 121-133.

Hill, AF. (1952). Economic Botany. A text book of useful plants and plant products 2nd edn. MC *Garw-Hill Book company Inc, New York,*1-12.

Ibrahim, M., Hameed, AJ., Jalbou,t A. (2008). Molecular spectroscopic study of river nile sediment in the greater cairo region. Appl Spectrosc, 62(3), 306-11.

Jayanthi, P., Lalitha, P. (2012). DPPH scavenging assay of the solvent extracts and fractionates of *Eichhornia crassipes* (Mart.) Solms. *Journal of Pharmacy Research,* 5(2), 946-948

Josh,i SC.(2000). Medicinal plants. *Oxford and IBH publishing CO. Ltd New Delhi*, 21- 24.

Kametani, T., Furuyama, H. (1987). Synthesis of vitamin D3 and related compounds. *Medicinal Research Reviews*, 7(2), 147-171.

Karapinar M., Aktug, SE. (1987). Inhibition of food borne pathogens by thymol eugenol menthol and anethole. *Int J Food Microbiol,* 4,161-166.

Khalaf, NA., Shakya, AK., Al-othman, A., Ahbar, Z., Farah, H. (2007). Antioxdidant activity of some common plants. *Turk J Biol*, 31,1-5.

Lahlou, M. (2004). Methods to study the phytochemistry and bioactivity of essential oils. *Phytother. Res*, 18, 435-445.

Liu, H., Sun, S., LV, G., Chan, KKC. (2006). Study on Angelica and its different extracts by Fourier transform infrared spectroscopy and two-dimensional correlation IR spectroscopy. *Spectrochimica Acta Part A,* 64,321-326.

Manjunath, BL., Munjyappa, TV. (1990). Integrated weed management in drill sown finger millet. *Indian Journal of weed science,* 22(34),83-85.

Muthulakshmi, A., Margret, JR., Mohan, VR. (2012). GC-MS Analysis of Bioactive components of *Feronia elephantum* Correa (Rutaceae). *J App Pharm Sci,* 2,69-74.

Nair, R., Chanda S. (2006). Activity of some medicinal plants against certain pathogenic bacterial strains. *Indian J. Pharmacol*, 38,142-144.

Padma Selvi, B., Prasanna, G., Anuradha, R. (2016). Physicochemical and phytochemical analysis of the rhizome of *Drynaria quercifolia* L. *International Journal of Phytopharmacy Research,* 7(1), 18-22

Panda, S., Jafri, M., Kar, A., Meheta, BK. Thyroid inhibitory, antiperoxidative and hypoglycaemic effect of stigmosterol isolated from *Butea monosperma. Fitoterapia*, 80(2), 123-126.

Prasanna, G., Anuradha, R. (2016). Ultraviolet - visible and Fourier Transform-infrared spectroscopic studies on *Drynaria quercifolia* L. rhizome. *Asian J Pharm Clin Res*, 9 (3), 1-4

Ramasubbu, R., Chandra prabha, A. (2009). Medicinal plant diversity of Virudhunagar district, Tamil Nadu. *Current Biotica,* 3(3), 373-385.

Robertson, DG. (2005). Metabonomics in toxicology: A review. *Toxicol Sci*, 85, 809-822

Saravana, P. (2013). GC-MS analysis of bioactive components of *Odina wodier* L. (*Anacardiaceae*). *Intenational Journal of Pharmaceutical Research and Development*, 5(05), 046-069.

Schulz, H., Schrader, B., Quilitzsch, R., Pfeffer, S., Krüger, H. (2003). Rapid classification of basil chemotypes by various vibrational spectroscopy methods. *J Agric Food Chem* , 51(9), 2475-81.

Sharma, PC., Yelne, MB., Dennis, TJ. (2005). Database on medicinal plants used in Ayurveda. *J Sci*, 3, 420-440.

Singh, P., Andola, HC., Rawat, MS., Pant, GJ., Purohit, VK. (2011). Fourier Transform Infraed (FT-IR) Spectroscopy in an overview. *Res J Med Plant*, 5,127-35.

Srinivasan, K., Sivasubramanian, S., Kumarave,l S. (2013). Phytochemical profiling and GC-MS study of *Adhatoda vasica* leaves. *Int J Pharm Bio Sci*, 5(1), 714-720

Sumner, LW., Duran, A.L., Huhman, DH., Smith, JT. (2003). Metabolomics a developing and integral component in functional genomics studies of *Medicago truncatula*. *Recent advances in phytochemistry,* 36, 31-61.

Tiwari,. P., Kumar, B., Kaur, M., Kaur, G., and Kaur, H. (2011). Phytochemical screening and Extraction. *Int. Pharma. Sciencia*, 1, 98-106.

Vlachos, N., Skopelitis, Y., Psaroudaki, M., Konstantinidou, V., Chatzilazarou, A., Tegou, E. (2006). Application of fourier transform infrared

Spectroscopy to edible oils. *Analyt chim Acta*, 573,459-465.

Waller, DP. (1993). Methods in ethnopharmacology. *Journal of Ethnopharmacology*, 38, 189–195.

Warrier, PK., Nambiar, VPK., Ramankutty. (2004). Indian medicinal plants a compendium of 500 species. *Orient Longman Pvt Ltd*, 3,139-142.

Wink M. (2004). Phytochemical diversity of secondary metabolites. *Encyclopedia of plant and crop science*, 915-919.

Yarnell, E., Abascal, K. (2011). *Nigella sativa* holy herb of the Middle East. *Alter Compl Therap*, 17(2), 99-105.

Access this Article in Online	
Quick Response Code	Website: www.ijarbs.com
	Subject: Phytochemistry

How to cite this article:
K. Nivetha and G. Prasanna. (2016). GC-MS and FT-IR Analysis of *Nigella sativa* L. Seeds. Int. J. Adv. Res. Biol. Sci. 3(6): 45-54.