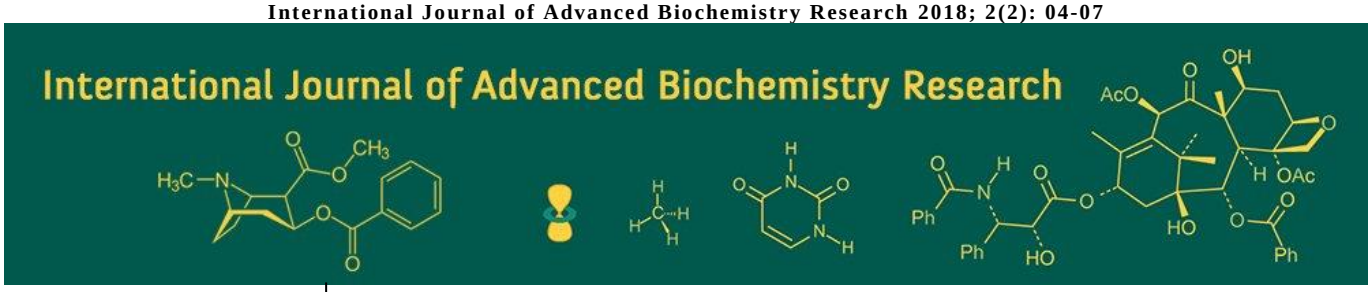

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Gas chromatography analysis and photoluminescence of *Nigella sativa* Oil

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Abstract
Nowadays the liquid lasers play as an important tool and are used in many applications such as spectroscopy, medicine. This research was carried out to study the possibility of using the *Nigella Sativa* oil as a laser gain medium and the chemical composites. For this purpose absorption spectrum was carried out which ranged from 600 to 680 nm, and emission spectrum ranged from 650 nm to 700 nm, this emission range includes the laser wavelengths that used to treat wound healing and wrinkles and 690 nm treat in photodynamic therapy. Totally 7 compounds were identified based on their molecular mass, retention time and peak values, among them, the highest amount was obtained for 9-octadecenoic acid (48.16%) and low peak value was tetradecanoic acid (Myristic acid), isopropyl ester (0.52).

Keywords: Laser gain medium, quantum yield, antimicrobial activity, antifungal activity, black cumin

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 [1]. Medicinal plants are the backbone of the traditional medicine [2] 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 [3]. 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 [4].
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 [5, 6].
The present study has been designed to investigate the possibility of producing laser from this oil using He-Ne laser as an excited source and to identify the bioactive constituents present in components of *Nigella Sativa* oil using Gas Chromatography-Mass Spectroscopy.

Materials and Methods
Cumin (*Nigella Sativa*) Oil sample of black seed oil were taken from Saudi companies, Hemani black seed oil (100% natural pomegranate seed), *i.e.* natural oils, free of chemicals and preservatives, extracted from anew black seed ensure that active substances do not volatilize.
Optical absorbance measurement of N. Sativa oil was carried out by placed in a transparent plastic tube then placed inside the UV-Vis spectrometer to record the optical absorbance.
For the photoluminescence process the sample was placed in a transparent plastic between two sensors to amplify the emitted light then it was excited using He-Ne laser beam λ= 633 nm. The emission was collected using a USB detector and recording the results.
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.

Results

Figure 4.1 showed the optical absorbance result of *N. Sativa* oil from UV-Vis spectrometer; it was found that the absorption spectrum ranged from 600 to 680 nm contained a broad peak in the UV range and two peaks at about 450 and 650 nm.

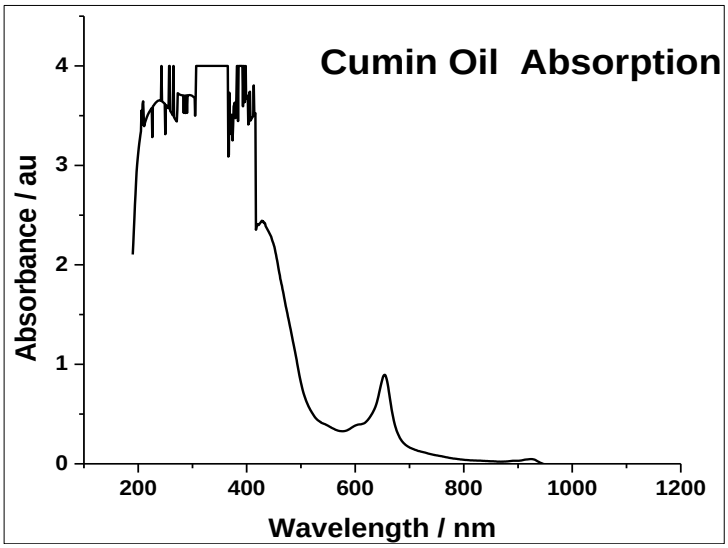

Fig 1: *N. Sativa* Oil Absorption

Photoluminescence spectrum of *N. Sativa* oil excited by He-Ne laser (632.8 nm) in figure 2 showed abroad peak of emission from 650 to 720 nm.

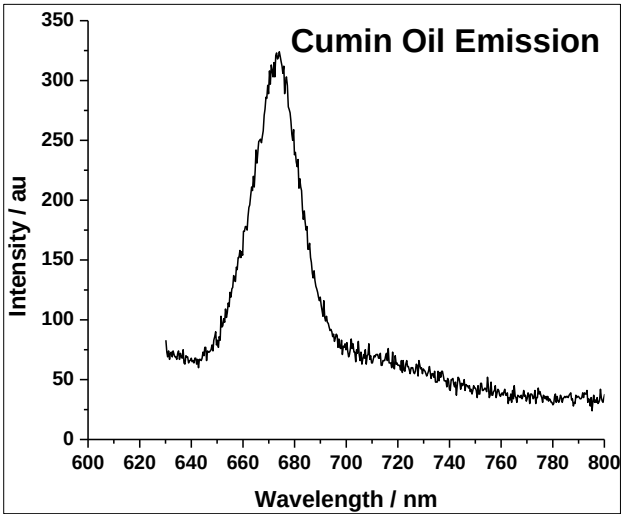

Fig 2: *N. Sativa* Oil Emission excited by He-Ne Laser (632.8 nm)

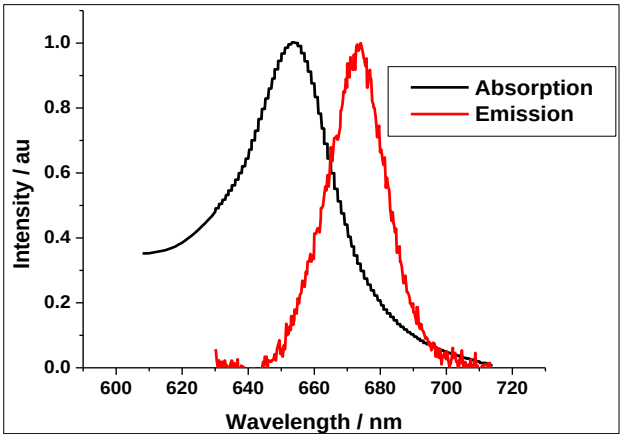

Fig 3: *N. Sativa* Oil Absorption and Emission

Figure 3 showed the absorption and emission of cumin oil using Origin Lab program and it covered wavelengths from 600 nm up to 720 nm.

Discussion

Figure 4 shows the absorption and emission of cumin oil, it was found that the absorption spectrum ranged from 600 nm to 680 nm, while the emission spectrum ranged from 650 nm to 700 nm.

The fluorescence quantum yield of a fluorophore is the ratio of fluorescence photons emitted to photons absorbed.

The fluorescence quantum yield is an intrinsic property of a fluorophore and is important for the characterization of novel fluorescent probes. The fluorescence quantum yield is the ratio of photons absorbed to photons emitted through fluorescence. The quantum yield Q can also be described by the relative rates of the radiative kr and non-radiative knr relaxation pathways, which deactivate the excited state.

The fluorescence quantum yield= Number of photons emitted / Number of photons absorbed.

=7858.7/1230.5

= 6.38659.

The difference between positions of the band maxima of absorption and fluorescence of the same electronic transition is known as Stokes shift. Stokes shift is important for practical applications of fluorescence because it allows separating strong excitation light from weak emitted fluorescence using appropriate optics.

The importance of the Stokes shift is not only a practical one, but it can also give you insight on what happens to the fluorescing system in the excited state. Small stokes shift means small geometrical relaxation and small solvation effects once the chromophore is excited. Large stokes shift means large geometrical relaxation and/or solvation effects.

The stokes shifts = the spectrum emission maxima – the spectrum absorption maxima.

= 674.54 – 653.99
= 20.55 nm.

The range 650 nm to 700 nm includes the laser wavelengths that used to treat some diseases such as 660 nm and 670 nm which used treat to wound healing and wrinkles and 690 nm used in PDT [7, 8].

Chemical Analysis

Table 1: GC/MS analysis of *N. Sativa* oil

S. No.	RT	Name of the compound	Molecular Formula	Area %	Molecular Weight
1	8.127	Butylated Hydroxytoluene (phenol)	$C_{15}H_{24}O$	0.77	220
2	10.856	Tetradecanoic acid (Myristic acid), Isopropyl ester	$C_{17}H_{34}O_2$	0.52	270
3	11.877	Hexadecanoic acid (palmitic acid), Methyl ester	$C_{17}H_{34}O_2$	8.15	270
4	13.587	9-12Octadecadienoic (Linoleic acid), Methyl ester	$C_{19}H_{34}O_2$	39.24	294
5	13.633	9-Octadecenoic acid (Oleic acid), Methyl ester	$C_{19}H_{36}O_2$	48.16	296
6	13.857	Methyl stearate (Stearic acid), Methyl ester	$C_{19}H_{38}O_2$	1.89	298
7	15.479	Oxacycloheptadec-8-en-2-one, (8Z), Musk ambrette	$C_{16}H_{28}O_2$	1.28	252

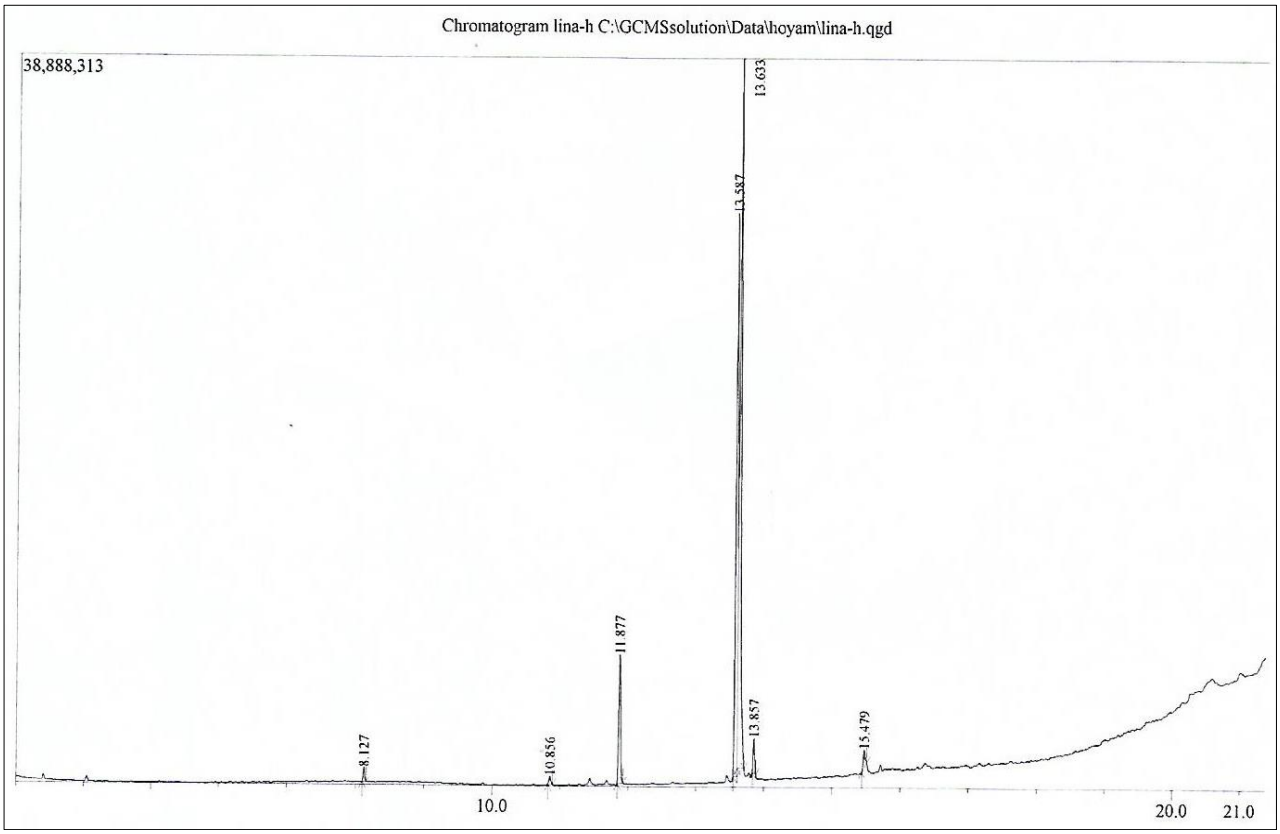

Fig 4: GC/MS analysis compounds of *N. Sativa* oil

Table 2: GC/MS analysis of *N. Sativa* oil

Peak Report TIC

Peak#	R.Time	I.Time	F.Time	Area	Area%	Height	Height%	A/H	Mark	Nar
1	8.127	8.100	8.158	1182646	0.77	752318	0.95	1.57	MI	
2	10.856	10.825	10.892	799092	0.52	443958	0.56	1.80	MI	
3	11.877	11.842	11.925	12521284	8.15	6898187	8.75	1.82	MI	
4	13.587	13.550	13.608	60316905	39.24	30051448	38.13	2.01	MI	
5	13.633	13.608	13.708	74020404	48.16	37875190	48.06	1.95	MI	
6	13.857	13.833	13.883	2903608	1.89	1860273	2.36	1.56	MI	
7	15.479	15.442	15.517	1960940	1.28	923218	1.17	2.12	MI	
				153704879	100.00	78804592	100.00			

The compounds were identified through mass spectrometry attached with GC with respect to their peak area and retention time. Totally 7 compounds were identified namely butylated hydroxytoluene (phenol) (0.77%),tetradecanoic acid (Myristic acid) (0.52%),Isopropyl ester, hexadecanoic acid (palmitic acid) (8.15%),methyl ester,9-octadecenoic acid (Elaidic acid) (48.16%), 9-12Octadecadienoic, methyl ester (39.24%), methyl stearate (Stearic acid) (1.89%),

methyl ester, oxacycloheptadec-8-en-2-one, (8Z), musk ambrette (1.28%), (these compounds are very important in medical application as we mentioned earlier), besides there is a new compound not previously reported: (oxacycloheptadec-8-en-2-one, (8Z)), musk ambrette.

Among the seven compounds, major peak values were obtained for the compounds such as 9-octadecenoic acid (Elaidic acid) (48.16%), 9-12octadecadienoic, methyl ester (39.24%), hexadecanoic acid (palmitic acid) (8.15%).

Table 3: GC-MS analysis of *N. Sativa* oil based on Dr. Duke's ethnobotanical and phytochemistry database

S. No	RT	Name of the Compound	Compound Nature	Activity
1	10.856	Tetradecanoic acid	Myristic acid	Antioxidant, Lubricant, Hypercholesterolemic, Cancer-Preventive, Cosmetic
2	13.587	9, 12- Octadecadienoic acid,(z,z)	Linoleic acid	Antiinflammatory, Nematicide, Insectifuge, Hypocholesterolemic, Cancer preventive, Hepatoprotective, Antihistaminic, Antiacne, Antiarthritic, Antieczemic
3	11.877	Hexadecanoic acid methyl ester	Fatty acid ester	Antioxidant, Hypocholesterolemic, Nematicide, pesticide, Lubricant, Antiandrogenic, Flavor, Hemolytic 5- Alpha reductase inhibitor
4	13.633	Oleic Acid	Palmitic acid	Monoacylglycerol, Antioxidant, antiatheroselerotic and protein glycation inhibitory activities

Conclusions

From this study, it could be concluded that Cumin oil can give fluorescents by excited with He-Ne laser in the range of 650 nm to 700 nm and this could be used in a liquid laser system to treat some diseases. Cumin oil also contains various bioactive compounds such as antioxidant, anti-inflammatory, pesticide, cancer preventive, insectifuge, hypocholesterolemic, antiarthritic, anti-inflammatory, Cosmetic, or protein glycation inhibitory activities. The presence of these bioactive compounds justifies the use of the oil for various ailments by traditional practitioners.

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