IV Results and Discussion

4.1-Chamomile essential oil

4.1.1 Physicochemical properties of chamomile essential oil.

The Physicochemical properties are usually determined essential oils in order to assess their values and application fore. The Physicochemical examination of oil samples includes several analyses of which the most important ones were the determination of specific gravity, refractive index, solubility, acid number, ester number and ester number after acetylation. Some physicochemical constants of the oil samples of chamomile oil cultivated in El-Fayoum, Bani Sweif and El- Menya governorates of Egypt were determined and results are shown in table (1).

4.1.1.1 Specific gravity

It could be noticed from table (1) that the specific gravity at 15^0c of chamomile oil sample III was 0.9716 which it was the highest sample, while the sample I was the lowest one (0.9473) However ,values for the three samples of chamomile oil are in agreement with those values reported by **Gildemeister and Hoffmann (1952), and Guenther (1952).**

4.1.1.2 Refractive Index

Data in table (1) pointed out that, chamomile oil sample III obtained from El-Menya governorate was the highest value and similar to those obtained by **trease (1961)** while the chamomile oil sample II showed the lowest value and with slightly lower refractive index. value compared with the data mentioned by **Joven (1958) (1959).**

4.1.1.3- Solubility

Data of solubility tabulated in (table 1) indicated that all three samples of chamomile essential oil soluble in 1.2 vol of 90% alcohol are inclose agreement with those recorded by **schimmel and co (1939)**

4.1.1.4- Acid Number

Acid number of chamomile oil from sample III had the highest number while the lowest one was recorded for chamomile oil sample I. However all the values were in agreement with those values reported by **Gildemeister and Hoffmann (1952)**.

4.1.1.5- Ester Number

From the results presented in (table 1), it could be noticed that the chamomile oil sample III (cultivated in El-Menya, Governorate) showed the highest levorotary while chamomile oil sample I (obtained from El-Fayoum Governorate) had the lowest number. These values were in agreement with those recorded by **Gildemeister and Hoffmann (1952), Guenther (1952) and Schimmel and co (1939).**

4.1.1.6-Ester number after acetylation

Data of Ester number after acetylation recorded in table (1) showed that , the values for I , II and III chamomile oil samples were 65.4, 70.6 and 84.3 respectively. All these values are found to be within the range recorded by **Schimmel and co (1939)**.

Table (1) The physicochemical properties of chamomile essential oils obtained from three different locations in Egypt

Properties / Essential oil	Specific Gravity at 15 C°	Refractive index	Solubility	Acid number	Ester Number	Ester Number After acetylation
Chamomile oil I (From El-Fayoum)	0.9473	1.4848	Soluble in 1.2 vol of 90% alcohol	12.3	6.2	65.4
Chamomile oil II (From Bani Sweif)	0.9704	1.4725	Soluble in1.2 vol of 90% alcohol	13.1	7.3	70.6
Chamomile oil III (From El-Menya)	0.9716	1.4950	Soluble in 1.2 vol of 90% alcohol	14.4	9.1	84.3

4.1.2- Chemical composition of chamomile essential oil samples.

Gas liquid chromatography analysis was used to determine the chemical composition of three essential oil samples produced from chamomile plants cultivated in El-Fayoum, Bani Sweif and El-Menya governorate in Egypt . this experiment was carried out to separate and identify the main components of oil.

The chemical composition of oil is listed in table (2) and chromatograms are shown in fig (1) (2) (3) , respectively . These identified components were namely: farnesene, caryophelene, furfural, bisabolol oxide A, α-bisabolol, camazulene and bisabolol oxide b.which represented 65.49 % , 80.55 % and 82.73 % of the total components of the chamomile oil El-Fayoum, Bani Sweif and El-Menya respectively . Bisabolol oxide b (29.02%), (33.40%), (35.81), farnesene (26.80%), (30.26%), (29.23%) and bisabolol oxide A (4.78%), (5.38%),(7.06%) may be considered the main components in chamomile oils of the three governorates respectively. These results are in agreement with those obtained by **Mishra et al (1999).**

It could be revealed that, oils sample III which obtained from chamomile plant cultivated in El-Menya governorate in Egypt had the highest content of identified components and the highest content of the main components (82.73 %) bisabolol oxide b (35.81%) .On the other hand, the oil sample obtained from chamomile plant cultivated in El-Fayoum governorate showed the lowest content valus .

Table (2) Chemical composition of chamomile essential oils obtained from three different locations in Egypt

Components	Chamomile Essential Oil					
	I (from El Fayoum)		II (From Bani Sweif)		III (From El-Menya)	
	RT	Area%	RT	Area%	RT	Area%
Farnesene	19.39	26.80	19.34	30.26	19.68	29.23
Caryophelene	20.66	0.29	20.85	1.08	20.60	1.60
Furfural	31.44	1.16	31.78	6.49	31.46	0.66
Bisabolol oxide A	32.87	4.78	32.82	5.38	32.20	7.06
α Bisabolol	33.66	1.46	33.62	1.68	33.25	5.75
Camazulene	38.01	1.98	37.96	2.26	38.40	2.62
Bisabolol oxide B	38.70	29.02	38.66	33.40	39.11	35.81
		65.49		80.55		82.73

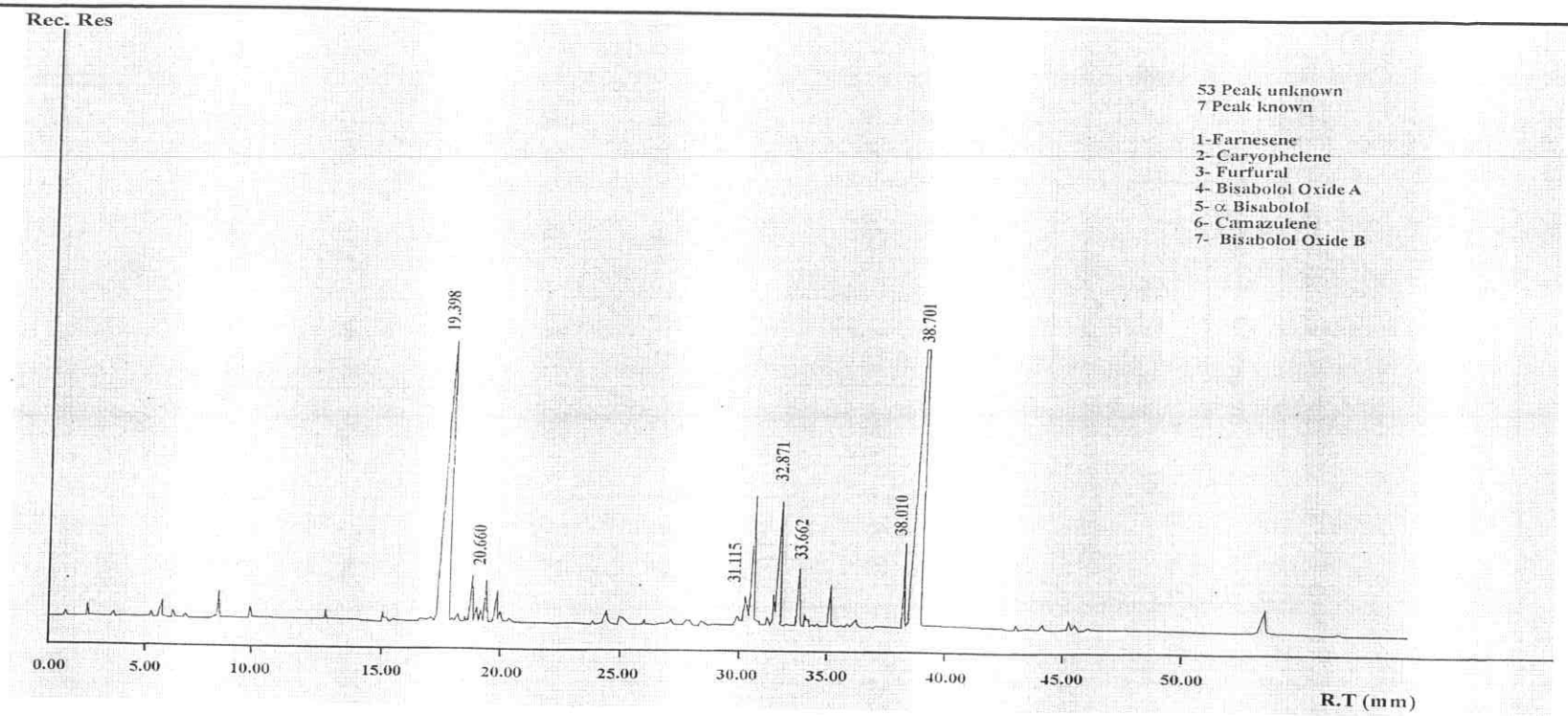

Figure (1) Gas chromatogram of Chamomile oil of El-Fayoum

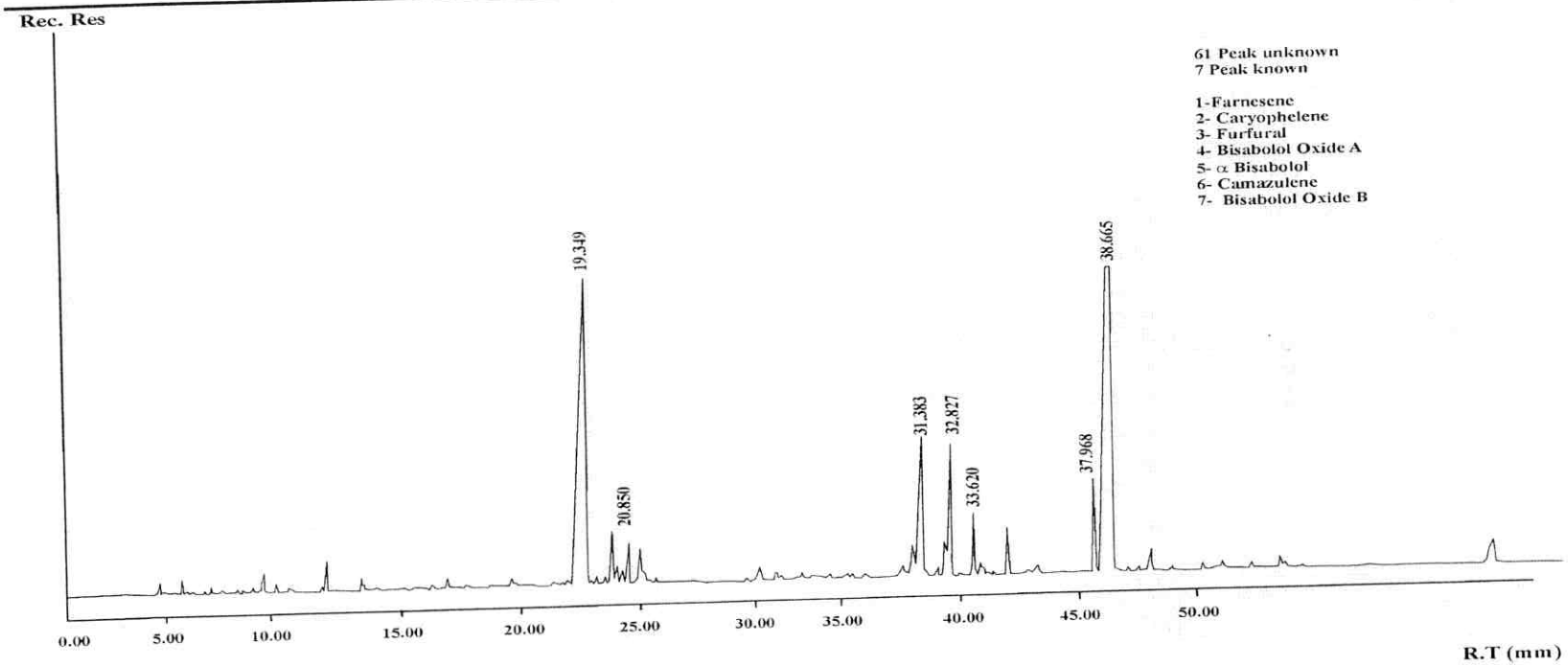

Figure (2) Gas chromatogram of Chamomile oil of Bani Sweif

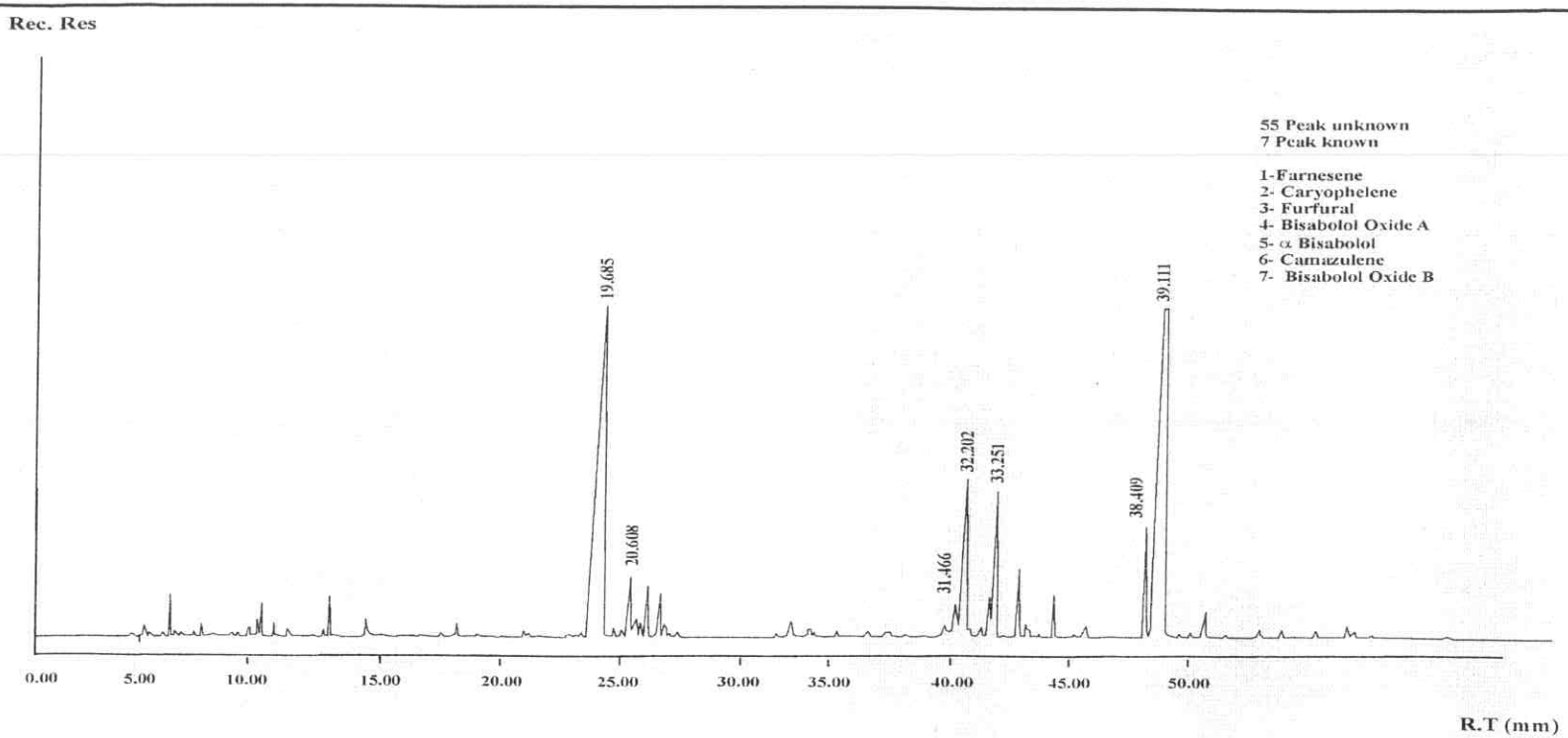

Figure (3) Gas chromatogram of Chamomile oil of El-Menya

4.1.3- Antimicrobial activity of chamomile essential oil .

The results of antimicrobial activity tests for essential oil prepared from three different chamomile plants cultivated in different locations in Egypt' are shown in tables (3,4) and figs (4,5) .Data indicate,the inhibition zones (mm) on various microorganisms.
The obtained data in table (4) and shown in fig (5) indicate the minimum inhibitory concentration (MIC) of chamomile essential oil .

4.1.3.1- Antibacterial activity of chamomile oil

The three mentioned chamomile essential oils had different inhibition zones with gram-negative bacteria (*Escherichia coli, salmonella typhimurium*) and gram – positive bacteria (*bacillus subtitles, staphylococcus aureus*) , while the (MIC) was 125 microgram/disc. Oil of El Fayoum showed the highest inhibition zone in diameter for gram- negative bacteria, (13.5 mm with *Escherichia coli).* On the other side , oil of Bani Sweif had the lowest one (6.5 mm with *E. coli* and S. typhi). With gram-positive bacteria, oil of of Bani Sweif had the highest inhibition zone in diameter (17.00 mm with *B. subtilis)* that of El Fayoum had the lowest one,(12.00 mm with *staphylococcus aureus*)

4.1.3.2- Antifungal activity of chamomile oil samples

The effect of chamomile essential oil on growth of fungi (*Aspergillus flavus* and *Aspergillus Niger*) and yeast (*saccaromyces cervisiae*) was shown as inhibition zone in table (3), MIC in table (4) and their figs (4,5) Data show that all chamomile essential oils had a fungal activity against *A. flavus* and *A. Niger*.

It could be noticed that Bani Sweif chamomile oil obtained the highest inhibition zone (10.0 mm with *A. flavus*) and the lowest with *A*

Niger while the (MIC) was 250 microgram/disc. On the other hand, Chamomile oil of El Fayoum and Bani Sweif the highest valus for A. *Niger* (8.0mm) with MIC 125 microgram/disc.

It could be concluded that oil of El Fayoum was more sensitive than the other two oils .

It could be said that , (Chamomile oil of Bani Sweif showed the highest inhibition zone for *s. cervisiae* (8.5 mm), on the other side, chamomile oil of El Fayoum had the lowest one (6.5 mm) while MIC both of them was 250 microgram /disc

These results are in agreement with that reported by **Soliman and Badeaa (2002).**

Table (3) Inhabitation zones (mm) on various micro-organisms growth by Chamomile oils obtained from three different locationsin Egypt

Strains / Essential Oil	Gram Negative Bacteria		Gram Positive Bacteria		Fungi		Yeast
	E.Coli	*S.Typhi*	*B.Subtilis*	*Stap. Aureus*	*A.Flavus*	*A.Niger*	*S.Cervisiae*
Chamomile Oil I (from El-Fayoum)	13.5	10.0	15.5	12.0	9.5	8.0	6.5
Chamomile Oil II (from Bani Sweif)	9.0	10.5	17.0	13.5	8.5	8.0	8.5
Chamomile Oil III (from El-Menya)	6.5	6.5	14.5	14.5	10.0	7.0	7.0

Table (4) Minimum inhibitory concentration (MIC) of Chamomile oils obtained from three different locationsin Egypt on the growth of different micro-organisms

Strains / Essential oils	Gram Negative Bacteria		Gram Positive Bacteria		Fungi		Yeast
	E.Coli	S.Typhi	B.Subtilis	Stap. Aureus	A.Flavus	A.Niger	S.Cervisiae
Chamomile Oil I (from El-Fayoum)	125	125	125	125	125	125	250
Chamomile Oil II (from Bani Sweif)	125	125	125	125	250	125	250
Chamomile Oil III (from El-Menya)	125	125	125	125	250	250	125

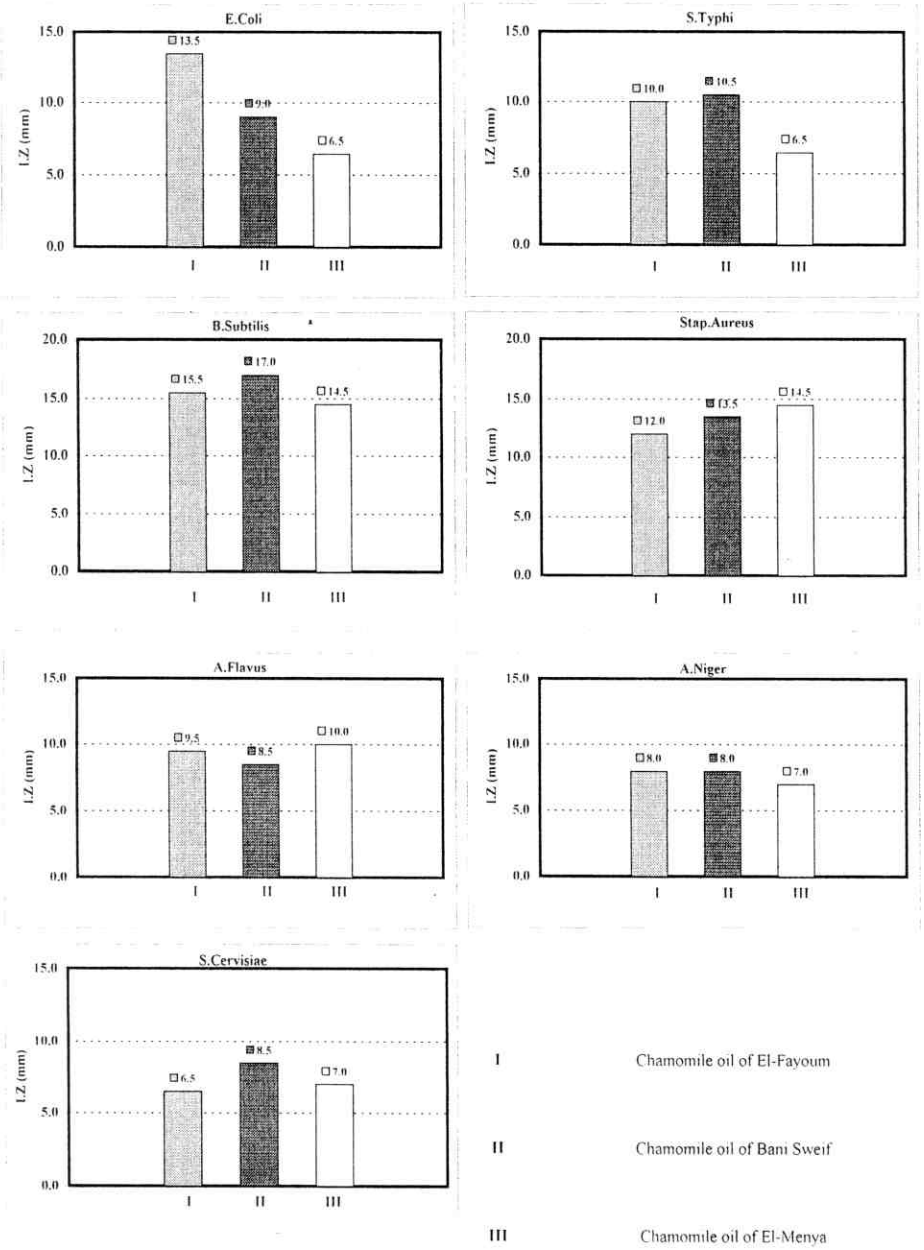

Figure (4) Inhibitation zones (mm) on various micro-organisms growth inducat Chamomile oils from three different locations in Egypt.

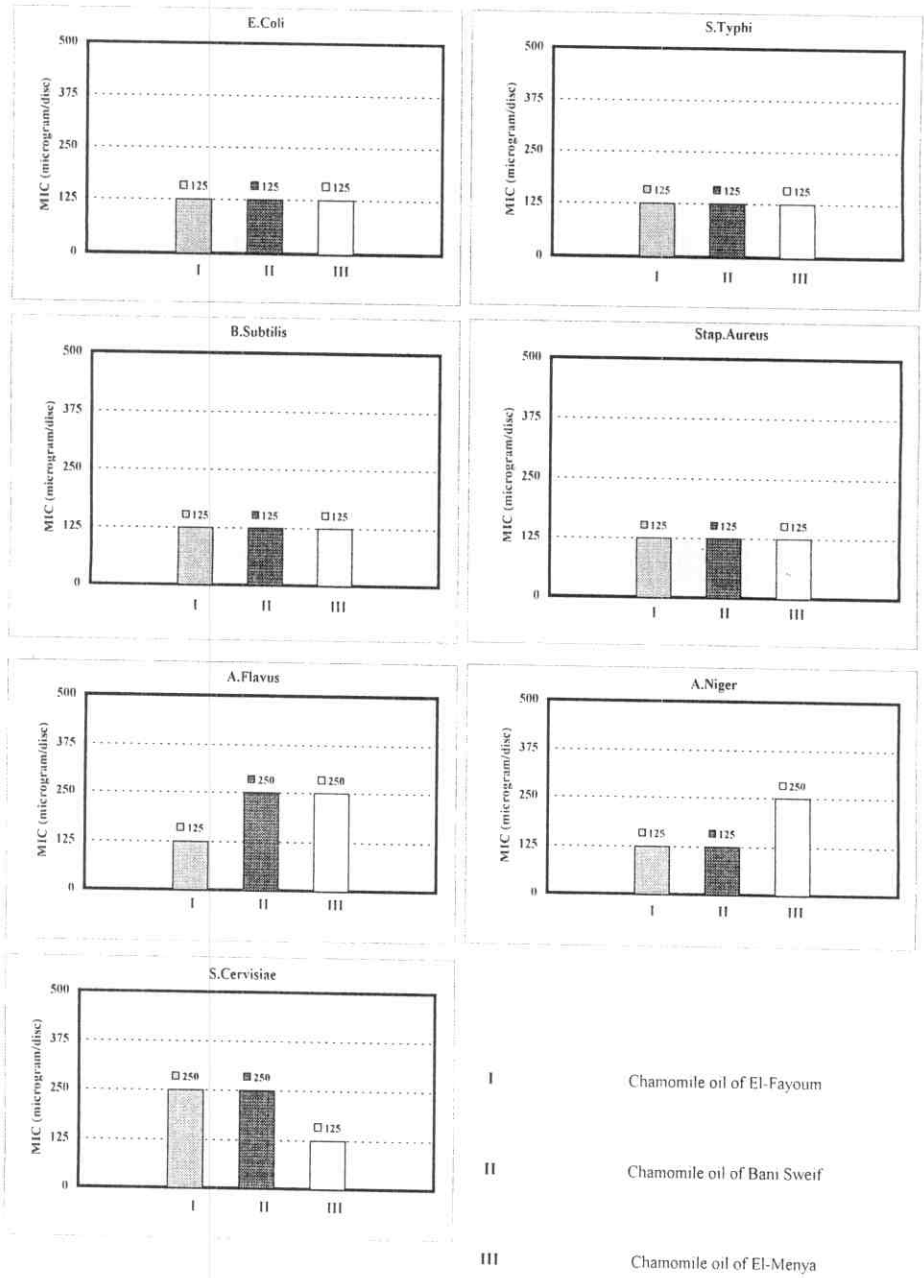

Figure (5) MIC of Chamomile oils obtaind from three different locations in Egypt on the growth of different microorganisms.

4.2- Cumin essential oil

4.2.1- Determination of the physicochemical properties of cumin essential oils .

The most important physicochemical characterisaties of cumin essential oil were determined and results obtained are shown in table (5).

4.2.1.1 -Specific gravity

Cumin oil from Assiut had the highest value while cumin oil from El- Menya had lowest one. These results are in agreement with those reported by, **Guenther (1961) and Soliman (2001)**

4.2.1.2- Refractive index

The refractive index of cumin from El- Menya was 1.5035 which was the highest value, while the refractive index of cumin oil sample II was 1.5017 which was the lowest value. However these results are in agreement with those, recorded by, **Guenther (1961) and Soliman (2001).**

4.2.1.3- Optical rotation

Optical rotation tabulated in table (5) showed that, values varied from $+4^0$ $40^{\backslash}$ for to $+5^0$ $15^{\backslash}$ for the cumin oil from Sohag. However, all these obtained values are found to be within the standard reported by, **Guenther (1961), Fenaroli (1971), Karim et al (1976)**

4.2.1.4- Solubility

Data in table (5) pointed out that all oil samples producted from cumin plants cultivated in El-Menya, Assiut and Sohag governorates were soluble in 1.8 vol of 80% ethyl alcohol this

findings were similar those results obtained by **Wahid and Ikram (1961), Badei (1980), Bandoni et al (1991) and Soliman (2001)**

4.2.1.5- Acid number

The acid values of the cumin oil from El- Menya , Assiut and Sohag were 1.41, 1.37 and 1.50,respectively. Cumin oil from Sohag had the highest number (1.50) while cumin oil from Assiut had the lowest value. Most of the values are in agreement of those found by, **Karim at al (1976), Bandoni et al (1991)**

4.2.1.6- Ester number

Cumin oil from sohag had the highest ester number while the lowest value was founding cumin oil from Assiut. It could be noticed, from data in table (5) that all the values are slightly lower than the standard range, mentioned by **Badei (1980) and Naglaa (1998)**

4.2.1.7- Aldehydes

From the results presented in table (5) it could be noticed that, there were variation in aldehyde content of values found in value was found the highest in cumin oil from Assiut (48.3%) and lowest value was for cumin oil from El- Menya (45.6%) However the found values are in agreement with data reported by **Guenther (1961), Fenaroli (1971), Karim et al (1976), Masada (1976) and Soliman (2001)**

Table (5) the physicochemical properties of cumin essential oil obtained from three different locations in Egypt

Properties / Essential oils	Specific gravity at 20^0 c	Refractive index at 20^0 c	Optical rotation	Solubility	Acid number	Ester number	Total aldehyed content
Cumin oil I (from El-Menya)	0.9175	1.5035	$+4^0$ 40\	Soluble in 1.8 vol of 80% a lochol	1.41	25.25	45.6%
Cumin oil II (From Assiut)	0.9206	1.5017	$+4^0$ 95\	Soluble in 1.8 vol of 80% a lochol	1.37	27.4	48.3%
Cumin oil III From (Sohag)	0.9201	1.5018	$+5^0$ 15\	Soluble in 1.8 vol of 80% a lochol	1.50	29.3	47.1%

4.2.2- Determination of the chemical composition of cumin essential oil samples

Gas liquid chromatography was used to determine the chemical composition of oil samples (I, II, III) which produced from cumin plants cultivated in El-Menya, Assiut and Sohag governorates in Egypt, respectively. The chemical composition of these oil samples was listed in table, (6) and while the chromatograms are presented in figures 6 , 7 , 8, respectively.

Gas chromatograms showed 20, 21 and 21 peaks for cumin oil samples I, II and III, respectively, of which anly , 8 of this peaks were identified.

These identified components represented 94.98%, 94.74% and 94.57% of the total components of cumin oil samples I,II and III, respectively.

It could be noticed from data tabulated in table (6) that (P menthene 3-al-7, cu,inic aldehyde, gamma Terpinene and p. menthadiene 1.3al-7) the main. Components were in cumin oil samples I, II, and III p menthene 3-al-7 and reached (27.26%), (27.27%) and (25.46%), respectively cuminic aldehyde and reached (19.81%), (19.33%) and (17.83%), respectively gamma terpinene and reached (15.13%), (16.06%) and (15.41%) respectively and p-menthadiene 1, 3-al-7 and reached (13.99%), (12.99%) and (15.23%) respectively, It could be revealed that, cumin oil sample I which produced from cumin plant cultivated in El Menya governorate was slightly higher than the two other oil samples. While the cumin oil sample III which produced from cumin plant cultivated in Sohag governorate in Egypt was slightly lower one.

The most of chemical composition of cumin oil samples in this study was found to be in agreement with results obtained by **Beis et al (2000), Soliman (2001) and Jirovetz et al (2005)** but the amount of each component showed some differenences .

Table (6) Chemical composition of cumin essential oil obtained from three different locations in Egypt .

Components	Cumin essential oil samples					
	I (From El-Menya)		II (From Assiut)		III (From Sohag)	
	RT	Amount	RT	amount	RT	amount
α -pinene	-4.55	1.06	-4.54	1.17	-4.55	1.05
gamma terpinene	-5.57	15.13	-5.57	16.06	-5.58	15.41
cuminic aldehyde	-8.05	19.81	-8.05	1933	-8.07	17.83
p-cymene	-8.60	7.09	-8.60	8.01	-8.64	8.14
b-phellanderene	-16.93	2.48	-16.91	2.16	-17.03	1.38
p-menthene-3-al-7	-23.35	27.26	-23.35	27.27	-23.45	25.46
p- menthadiene-1.3-al-7	-23.65	13.99	-23.66	12.99	-23.75	15.23
p-menthadiene-1.4-al-7	-23.75	8.16	-23.76	7.75	-23.86	10.07
		94.98		94.74		94.57

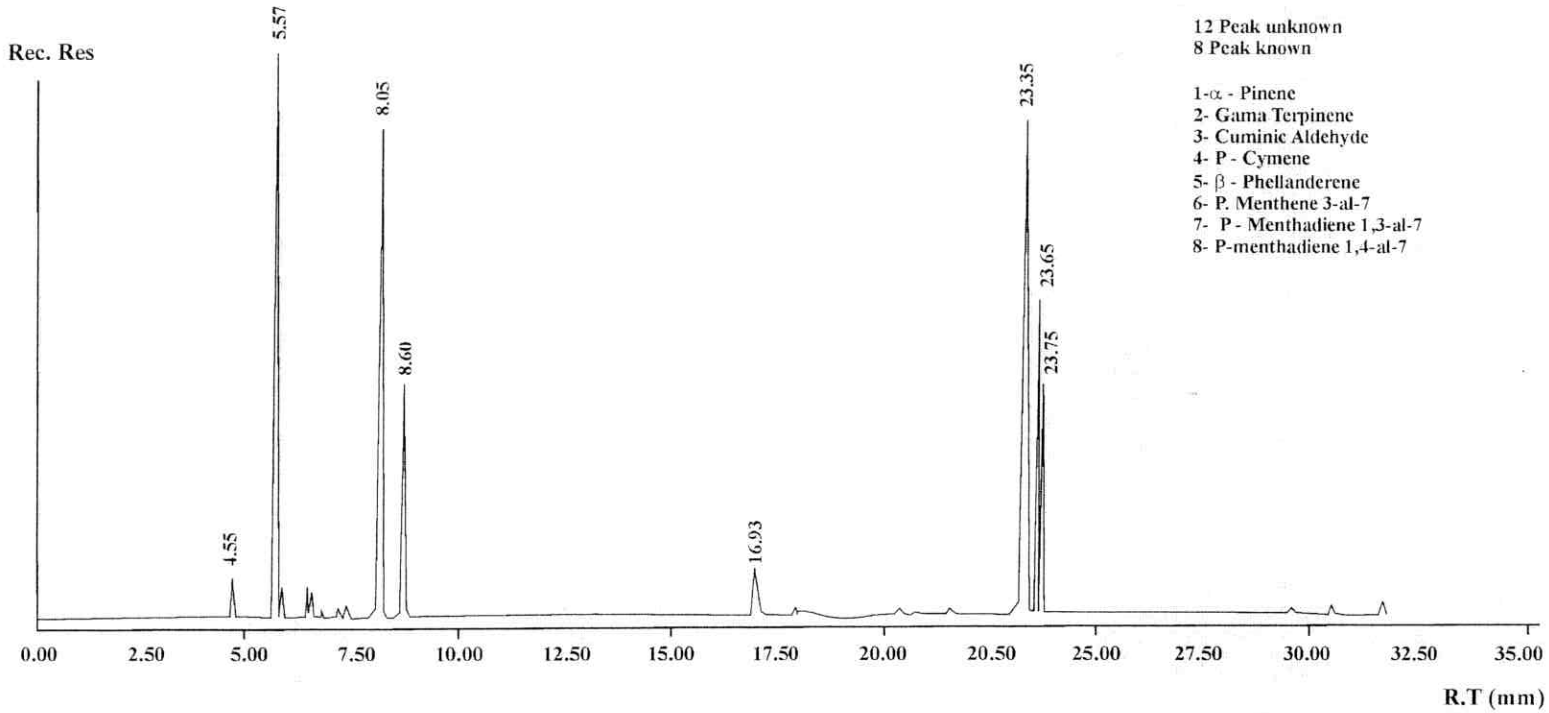

Figure (6) Gas chromatogram of Cumin oil from El-Menya

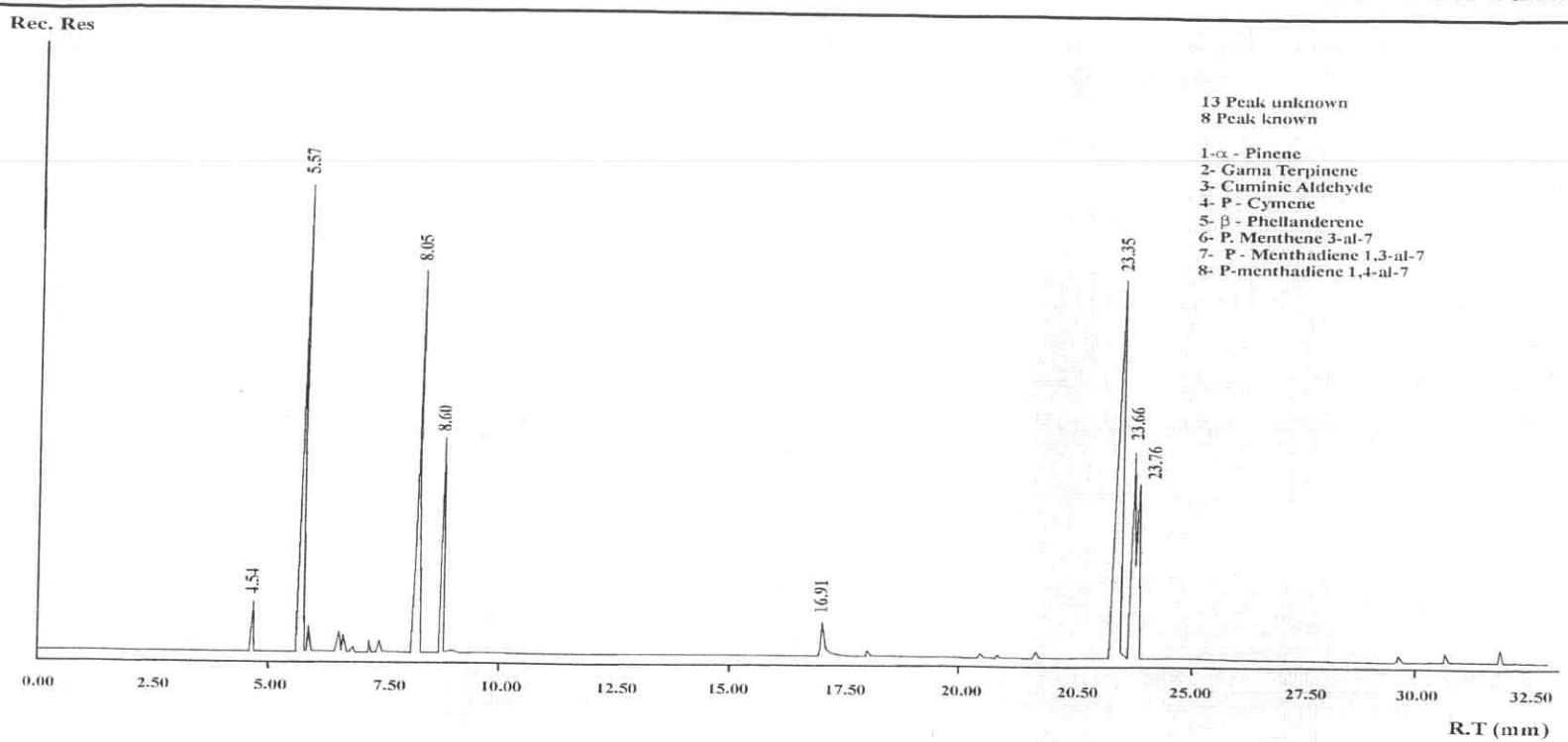

Figure (7) Gas chromatogram of Cumin oil from Assiut

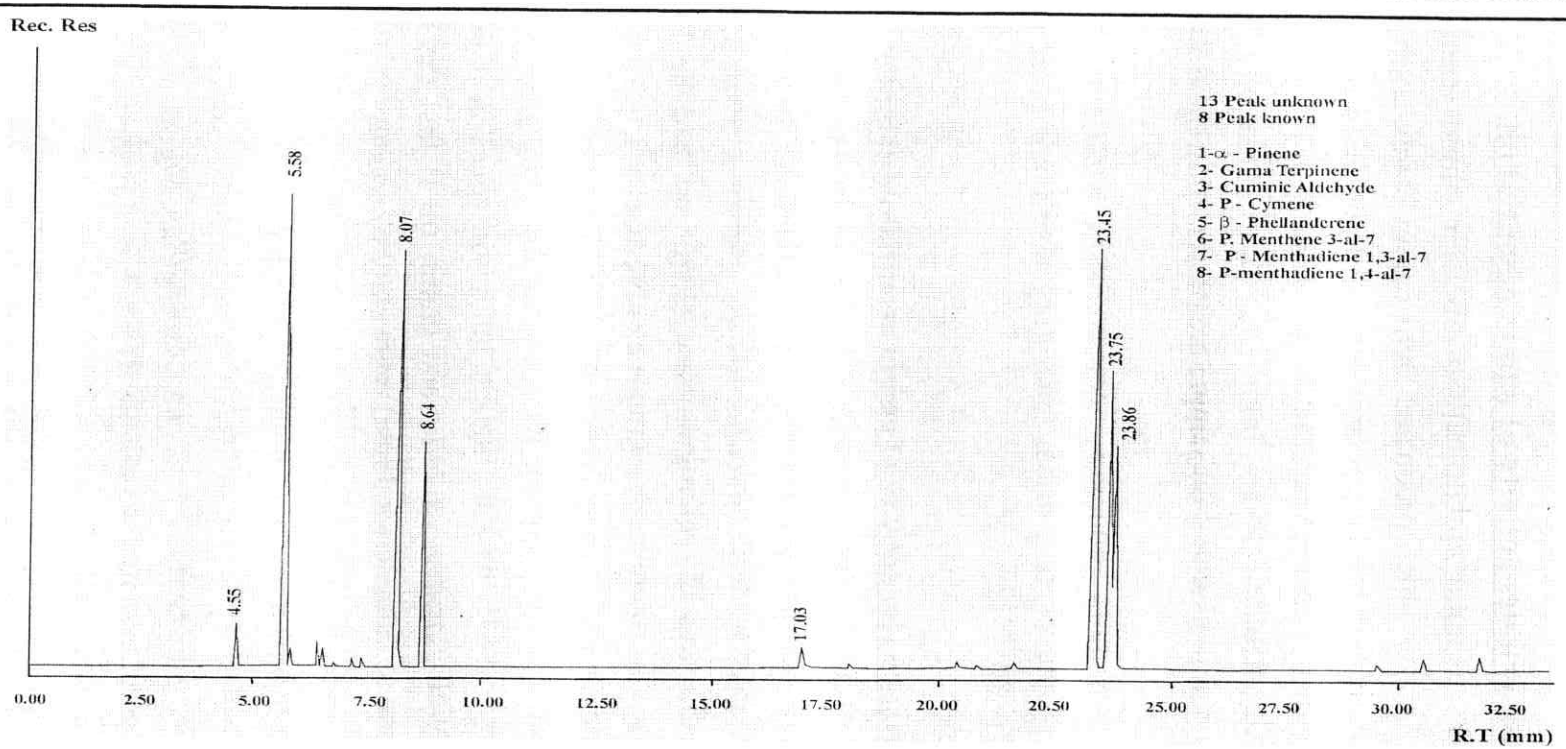

Figure (8) Gas chromatogram of Cumin oil from Sohag

4.2.3- Antimicrobial activity of cumin essential oil.

Results of antimicrobial activity tests for cumin essential oil samples (I, II, III) which producted from cumin plants cultivated in El-Menya, Assiut and Sohag governorates in Egypt, respectively are presented in tables (7)and (8) and and Figs (9)and (10).

The inhabitation zones (mm) on various micro-organisms growth with cumin essential oil sample are presented in table 7 and fig 9 .

The minimum inhibitory concentration (MIC) of cumin essential oil samples on various micro-organisms are presented in table 8 and fig 10

4.2.3.1- Antibacterial activity of cumin essential oil samples

Cumin oil samples showed different inhibition zones with gram-negative bacteria (*Escherichia coli, salmonella typhimurium*) and gram-positive bacteria (*Bacillus subtilis, staphylococcus aureus*), while the (MIC) was 125 microgram/disc. Cumin oil had the highest inhibition zone in diameter for gram-negative bacteria, (13.0 mm) with Escherichia coli while cumin oil I had the lowest inhibition zone, (9.0 mm) with salmonella typhimuriom , in gram-positive bacteria, cumin oil III had the highest inhibition zones in diameter (18.5 mm) with *Basillus . subtilis* and cumin oil II had the lowest inhibition zone in diameter(8.5 mm) with *staphylococcus . Aureus.*

4.2.3.2 - Antifungal activity of cumin oil samples

All cumin essential oil samples under study had a fungal activity against *Aspergillus . flavus* and *Aspergillus. Niger.*

The cumin essential oil sample III producted from cumin plants cultivated in Sohag governorate had the highest sample inhibition

zone (11.0 mm) with *Aspergillus flavus* but sample oil II produceded from cumin plant cultivated in Assiut governorates was lower than sample oil I produceded from cumin plant cultivated in El-Menya governorate. With *Aspergillus. Niger* while the minimum inhibitory concentration (MIC) of cumin oil samples was 250 microgram / disc.

Cumin essential oil sample II had slightly higher than the other oil samples inhibition zones(7.00 mm)while the MIC was the lowest one, (125 microgram / disc) with yeast (*saccharomyces. cervisiae*).

This results are agreement with these reported by: **Rasheed and Choudhri (1974), Kalemba (1999), El-Sherbieny et al (2002), Singh et al (2002) and Jirovetz et al (2005)**

Table (7) Inhabitation zones (mm) on various micro-organisms growth by Cumin oils obtaind from three different locationsin Egypt .

Strains / Essential Oil	Gram Negative Bacteria		Gram Positive Bacteria		Fungi		Yeast
	E.Coli	*S.Typhi*	*B.Subtilis*	*Stap. Aureus*	*A.Flavus*	*A.Niger*	*S.Cervisiae*
Cumin Oil I (from El-Menya)	9.5	9.0	16.7	10.0	7.5	6.5	6.5
Cumin Oil II (from Assiut)	13.0	11.0	12.5	8.5	7.0	6.0	7.0
Cumin Oil III (From Sohag)	10.5	9.0	18.5	15.0	11.0	6.0	6.5

Table (8) Minimum inhibitory concentration (MIC) of Cumin oil obtaind from three different locations in Egypt on the growth of different micro-organisms .

Strains / Essential Oil	Gram Negative Bacteria		Gram Positive Bacteria		Fungi		Yeast
	E.Coli	*S.Typhi*	*B.Subtilis*	*Stap. Aureus*	*A.Flavus*	*A.Niger*	*S.Cervisiae*
Cumin Oil I (from El-Menya)	125	125	125	125	250	250	250
Cumin Oil II (from Assiut)	125	125	125	125	250	250	125
Cumin Oil III (From Sohag)	125	125	125	125	250	250	250

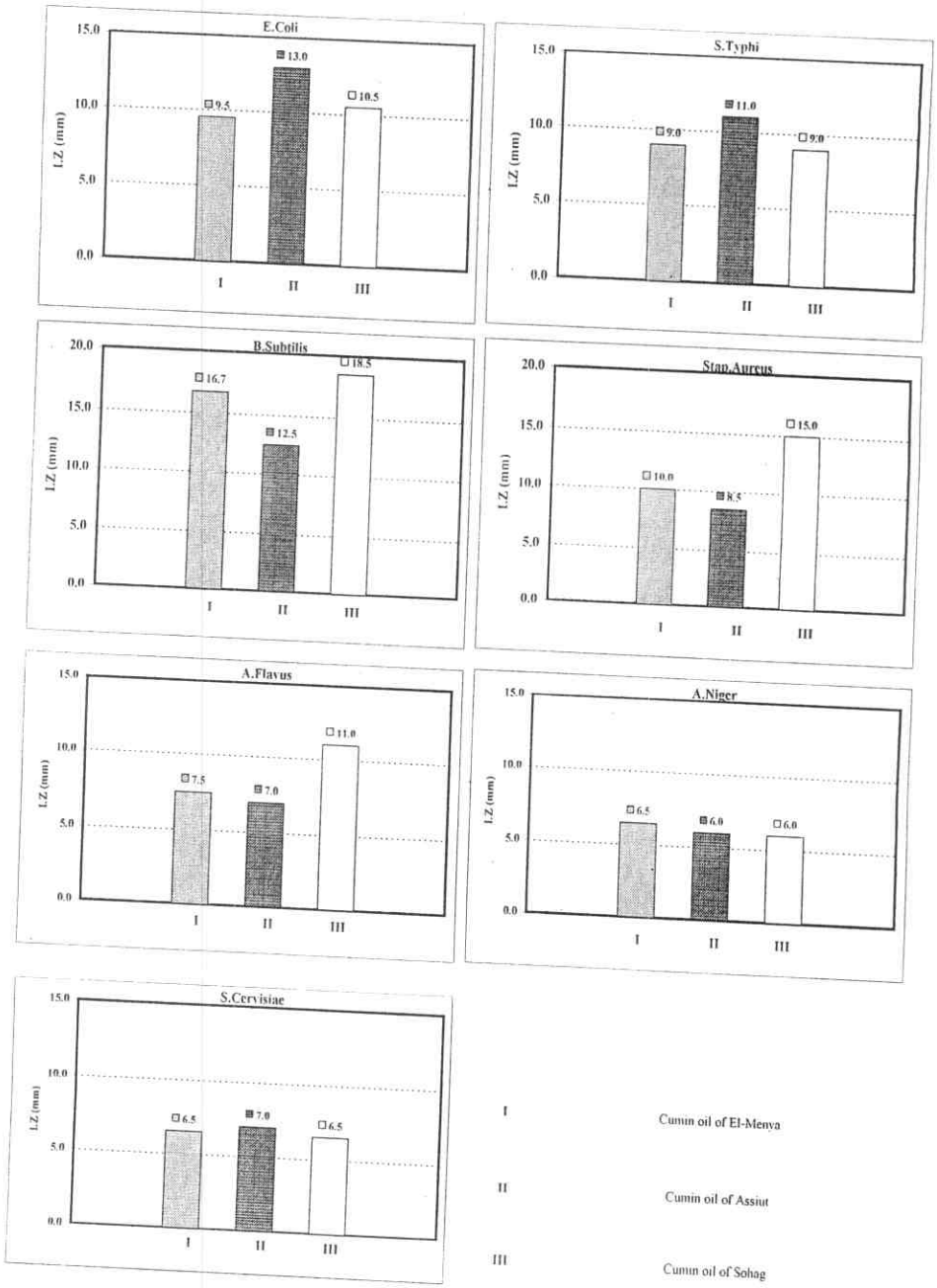

Figure (9) Inhibitation zones (mm) on various micro-organisms growth inducat Cumin oils from three different locations in Egypt.

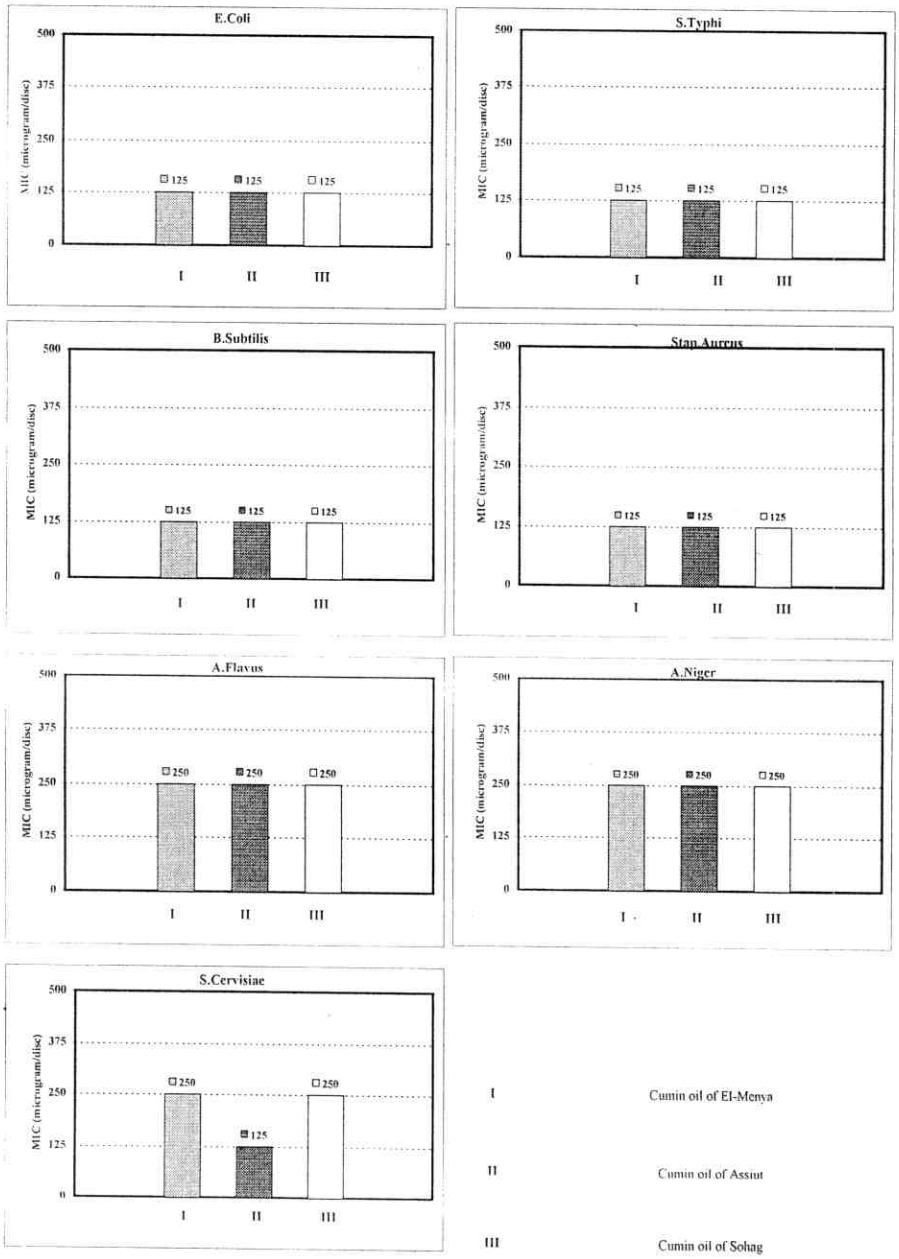

Figure (10) MIC of Cumin oils obtaind from three different locations in Egypt on the growth of different microorganisms.

4.3- Lemongrass essential oil:

4.3.1- Determintion of the physicochemical properties of lemongrass essential oil samples.

The most important physicochemical characteristics of lemongrass essential oil were determined and results are shows in table (9).

4.3.1.1- specific gravity:

The specific gravity of lemongrass oil obtained from plants cultivated in El Kaluobia , El Fayoum and Bani sweif were 0.8564, 0.8812, and 0.8900, respectively, It could be noticed that, oil of Bani sweif had the highest value and sample I was the lowest one but most of the values are found to be in agreement by these recorded by **Guenther (1961) and Masada (1976)**

4.3.1.2- Refractive index:

Data of Refractive index tabulated in table (9) indicated that, Lemongrass oil in El Kaluobia was the highest refractive index while the oil in El Fayoum had the lowest one. However, are values of three lemongrass essential oil samples are found to be within the range reported **by Masada (1976) and El-Zahwey et al (1992).**

4.3.1.3- Optical rotation:

From the results presented in table (9),it could be noticed that, lemongrass oil were characterized by levorotary El Fayoum oil had the highest levorotary while El Kaluobia oil had the lowest one. These values are in agreement with those recorded by **Masada (1976).**

4.3.1.4- Solubility:

Lemongrass essential oil producted from plants cultivated in El kaluobia, El Fayoum and Bani Swief governorates in Egypt, were found soluble in 0.5 vol of 80 % alcohol , These observations are in agreement with those recorded by **Gabr (1994).**

4.3.1.5- Acid number:

Lemongrass oil of Bani Swief showed the highest acid number sample while El kaluobia oil sample had the lowest one. However, all the obtained values are found to be within the range reported **by Soad (1995).**

4.3.1.6- Ester number:

Ester number of lemongrass essential oil are presented in table 9. Bani Swief oil was the highest (35.08) one while El kaluobia oil was the lowest (21.30) However, all results are found to be within the standard range, which mentioned by **Abo zayad (1988) and Soad (1995)**

4.3.1.7- Ester number after acetylation:

Values for ester number after acetylation recorded were 212.16, 201.24 and 217.3 for oil isolated from lemongrass plants cultivated in El kaluobia, El Fayoum and Bani Sweif governorates respectively. It could be noticed that,The highest value was recorded in Bani Swief while El Fayoum showed the lowest value. However, all results are in agreement with data reported literatures by **Ibrahim (1965) and Gabr (1994).**

Table (9) Physicochemical properties of lemongrass essential oil obtaind from three different locations in Egypt .

Properties / Essential oil	Specific gravity at 15 C°	Refractive index at 20^0 C	Optical rotation	Solubility	Acid number	Ester number	Ester number after acetylation
Lemongrass oil I (from El Kaluobia)	0.8564	1.4863	- 10.58	Soluble in 0.5 vol. of 80 % alcohol	2.5	21.30	212.16
Lemongrass oil II (from El Fayoum)	0.8812	1.4822	-2.12	Soluble in 0.5 vol. of 80 % alcohol	3.1	25.14	201.24
Lemongrass oil III (from Bani sweif)	0.8900	1.4854	- 8.14	Soluble in 0.5 vol. of 80 % alcohol	3.4	35.08	217.3

4.3.2- Determination of the Chemical Composition of Lemongrass Essential oil.

Gas liquid chromatography was used to determine the chemical composition of lemongrass oil producted from lemongrass plants cultivated in El Kaluobia, El Fayoum and Bani Sweif governorates in Egypt..

The chemical composition of these oil was listed in table (10) and their chromatograms in figures (11), (12), (13), respectively. The gas chromatograms revealed 29, 31, and 34 peaks in El Kaluobia, El Fayoum and Bani Sweif lemongrass essential oil , respectively Chromatographic analysis indicated that Olney 9 of this peaks were identified, These identified components represented 88.03%, 89.08 % and 87.46% of the total components of lemongrass oil obtained from plants growin in El Kaluobia, El Fayoum and Bani Sweif governorates, respectively .

The main components in the three lemongrass oils were citral a and reachd (44.87%, 44.55% and 44.50%), citral b (31.38%), (31.05%) and (30.95%), respectively.

These results are in harmony with those obtained by **Manzoor et al (1984) and Mona (2000).**

The lemongrass oil produced from lemongrass plant cultivated in El Kaluobia governorate was slightly higher than oil El Fayoum and Bani Sweif in main components, while oil which producted from lemongrass plants cultivated in Bani Sweif governorate was slightly the lowest one.

Table (10) Chemical composition of lemongrass essential oils obtaind from three different locations in Egypt .

Components	Lemongrass essential oil samples					
	I (from El Kaluobia)		II (from El Fayoum)		III (from Bani sweif)	
	Rt	Area %	Rt	Area %	Rt	Area %
Limonene	5.82	3.14	5.82	2.79	5.82	3.17
5 methyl heptenne	9.59	1.66	9.59	1.65	9.59	1.65
linalool	15.37	1.19	15.37	1.18	15.36	1.22
B.caryophyllene	16.1	0.99	16.1	0.94	16.09	0.99
Citral b	19.84	31.38	19.84	31.05	19.84	30.95
Citral a	21.42	44.87	21.41	44.55	21.42	44.50
α . terpenial	21.53	1.20	21.55	1.21	21.53	1.20
Geranyl acetate	24.07	1.99	24.06	1.97	24.06	2.12
Geraniol	36.30	1.61	36.29	1.74	36.29	1.66
		88.03		87.08		87.46

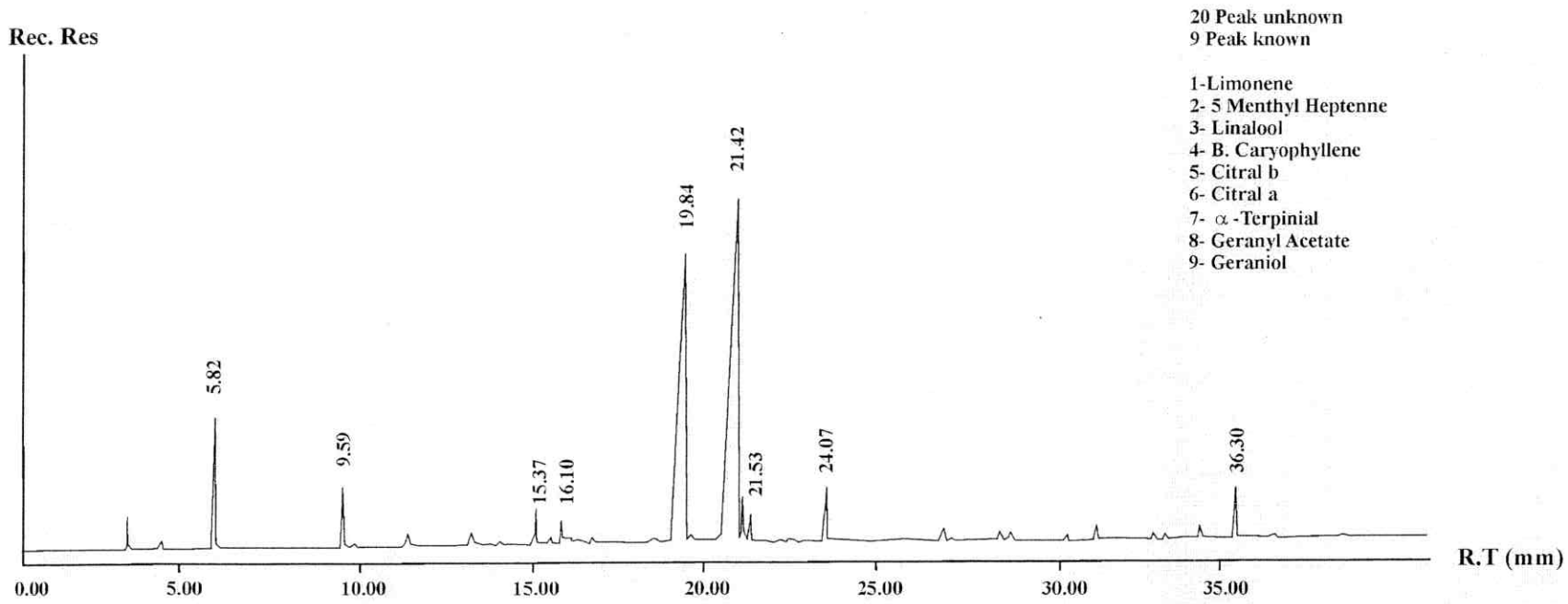

Figure (11) Gas chromatogram of Lemongrass oil from El-Qaluobia

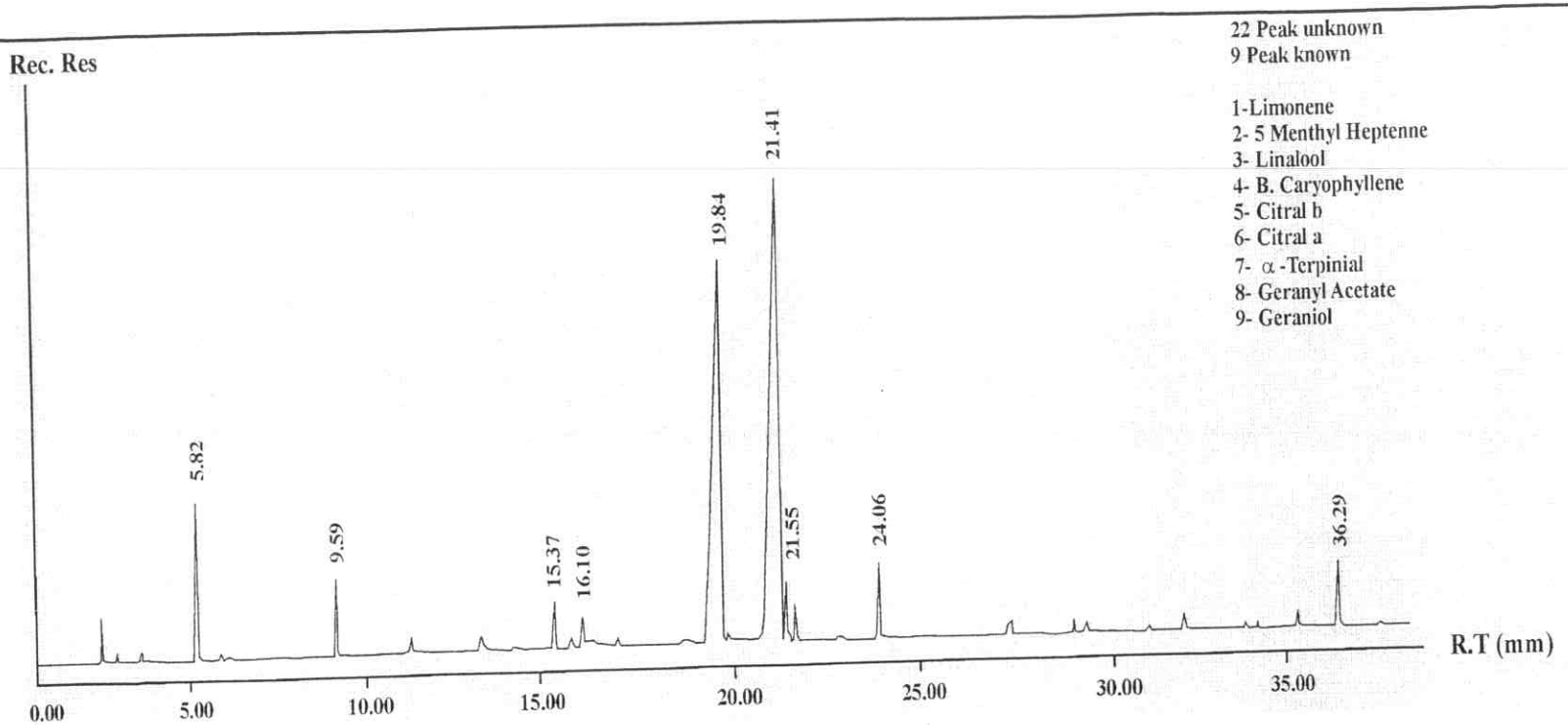

Figure (12) Gas chromatogram of Lemongrass oil from El-Fayoum

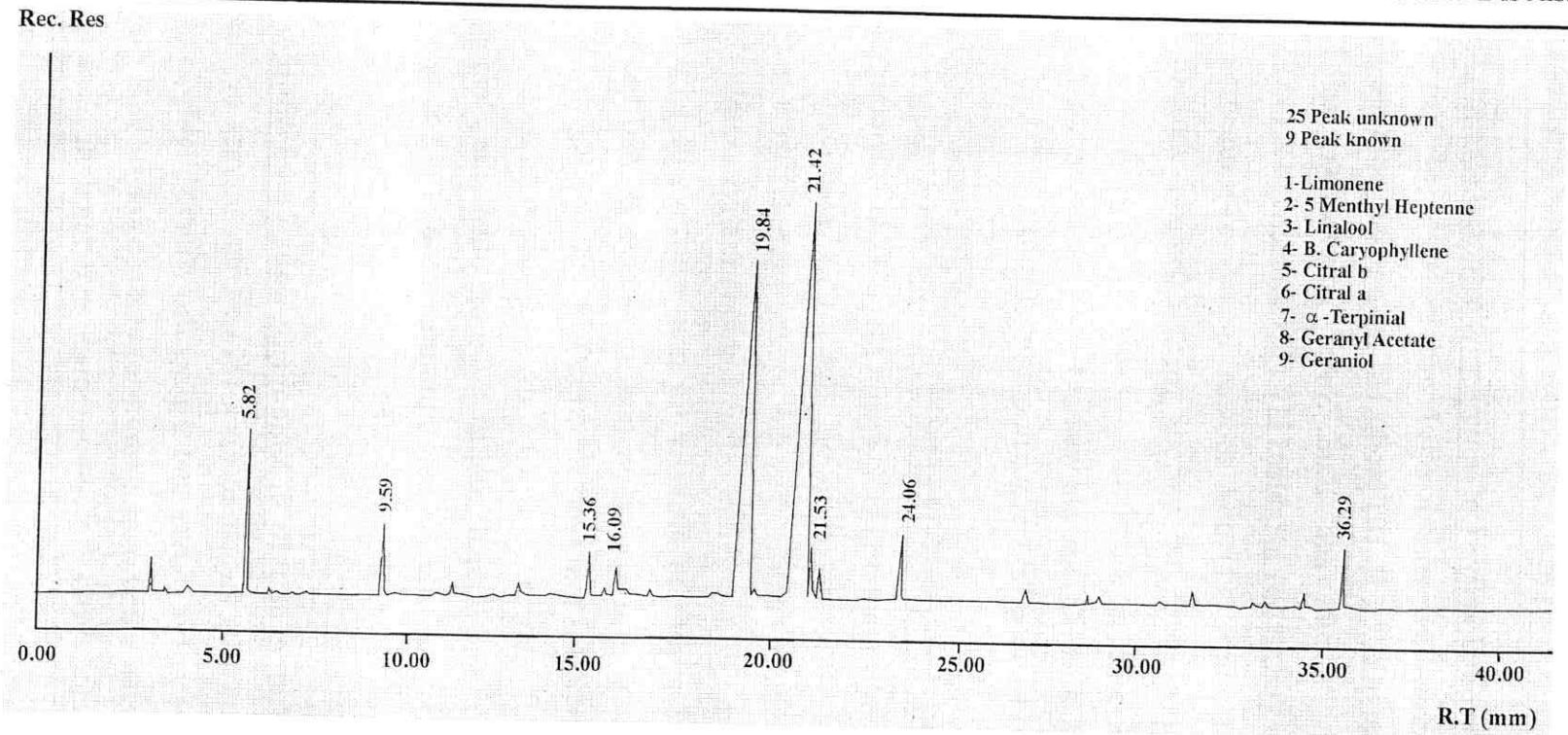

Figure (13) Gas chromatogram of Lemongrass oil from Bani Sweif

4.3.3- Antimicrobial activity of lemongrass essential oil samples:

The results of antimicrobial activity tests of lemongrass essential oil samples (I, II, III) producted from plants cultivated in El Kaluobia, El Fayoum and Bani Sweif governorates of Egypt respectively are presented in tables (11), (12) showen (14) , (15).

Data in table (11) and showen in fig (14) illustrate the inhibition zones (mm) on various micro-organisms growth with lemongrass essential oil samples.

Data in table (12) and showed in fig (15) illustrate the (MIC) of lemongrass oil samples on various micro-organisms.

4.3.3.1- Antibacterial activity of lemongrass essential oil samples

As shown in tables (11), (12) and figs (14), (15) lemongrass oil samples have different inhibition zones with gram-negative and positive bacteria. In contrast they did not show any different in (MIC) which reached 125 microgram / disc. Lemongrass oil sample II have highly inhibition zone in diameter for gram-negative bacteria (21.5 mm with *E. coli*) ,while lemongrass oil sample III had the lowest inhibition zone (7.5 mm with *s. typhi*,) whit gram-positive bacteria, lemongrass oil sample II showed the highest inhibition zone in diameter (19.5 mm with *B. subtilis*). On the other side , lemongrass oil sample III had the lowest inhibition zone, (11.5 mm with *staphylococcus . Aureus*) .

4.3.3.2- Antifungal activity of lemongrass essential oil samples

As shown in the tables (11), (12) all lemongrass oil samples inhibited *Aspergillus flavus* and *Aspergillus Niger*. Highly inhibition zone in diameter (250 microgram/disc) was recorded for oil sample I which producted from lemongrass plant cultivated in El Kaluobia

governorate in Egypt(7.5 mm with *Aspergillus flavus*) On the other hand, lemongrass oil sample II producted from lemongrass plants cultivated in El Fayoum governorate of Egypt showed the highest sample inhibition zone in diamete which was 7.5 mm with *Aspergillus Niger*. All oil samples had (MIC) 250 with *Aspergillus Niger*.

Also, lemongrass oil sample II had the highest inhibition zone in diameter. (9.00 mm) with yeast *Saccharomyes cervisiae* when the concentration was 125 microgram / disc of oil and it was MIC of lemongrass oil sample II on the growth of *Saccharomyes cervisiae*. While the oil sample III was the lowest one inhibition zone in diameter, it was 6.0 mm when (MIC) was 250 microgram/disc.

These results were in agreement with those reported by **Onawunmi and Ogunalana (1986), Alam et al (1994), Pattnaik et al (1996) and chalchat et al (1997).**

Table (11) Inhabitation zones (mm) on various micro-organisms growth by Lemongrass oil obtaind from three different locations in Egypt

Strains / Essential Oil	Gram Negative Bacteria		Gram Positive Bacteria		Fungi		Yeast
	E.Coli	*S.Typhi*	*B.Subtilis*	*Stap. Aureus*	*A.Flavus*	*A.Niger*	*S.Cervisiae*
Lemongrass Oil I (from El Kaluobia)	9.5	9.0	18.0	13.5	7.5	6.2	6.5
Lemongrass Oil II (from El-Fayoum)	12.5	10.0	19.5	16.0	6.5	7.5	9.0
Lemongrass Oil III (from Bani Sweif)	8.5	7.5	15.0	11.5	6.0	7.0	6.0

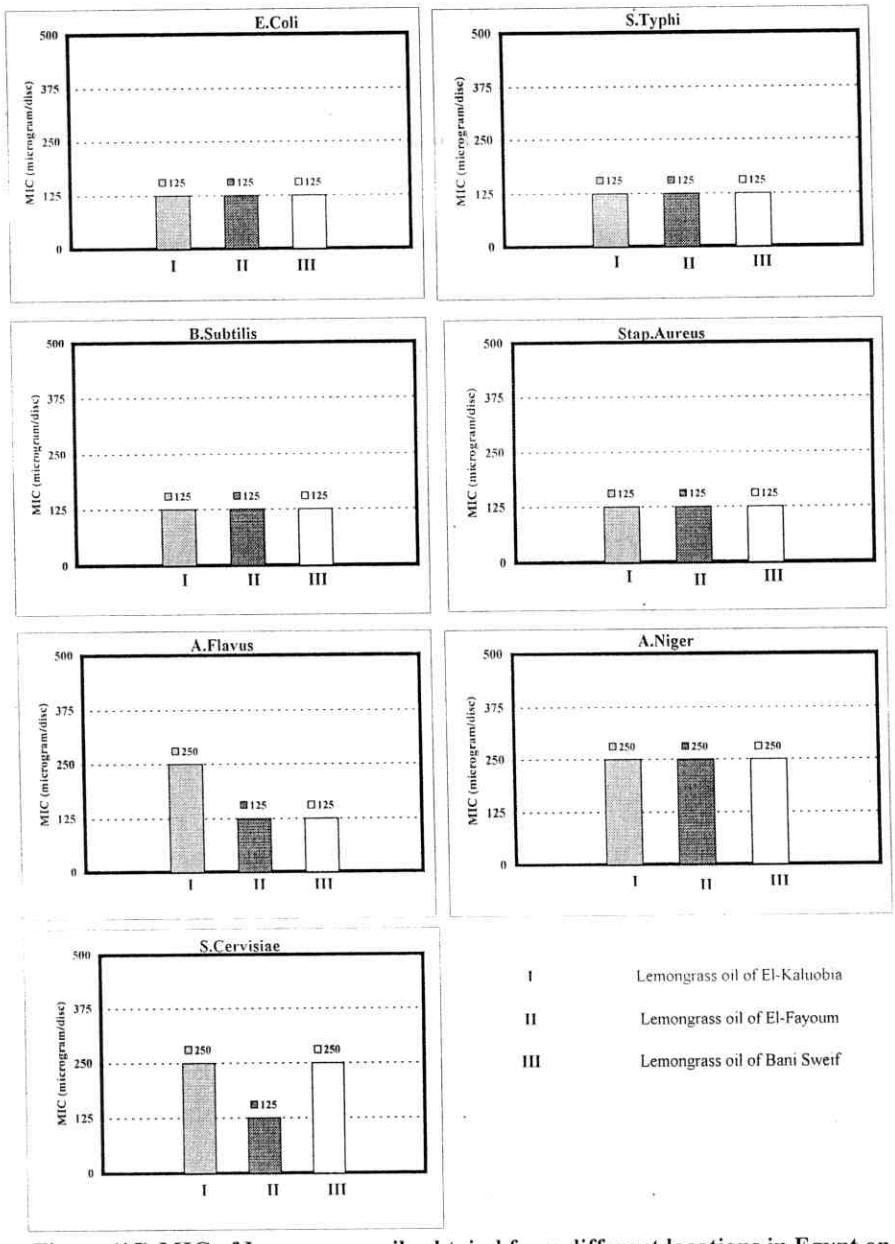

Figure (15) MIC of Lemongrass oils obtaind from different locations in Egypt on the growth of different microorganisms.

4.4 -Conclusion on antimicrobial activity of Chamomile oil samples, Cumin oil samples and Lemongrass oil samples

From antimicrobial activity results in chamomile oil, cumin oil and lemongrass oil it could be noticed from figs (16), and (17) the highest oil sample from each oil inhibition zone in diameter with all microorganisms under study and lowest one.

On the other hand, it could be noticed the minimum inhibitory concentration (MIC) of all oil samples on the growth of different microorganisms.

- It could be revealed that, the highest inhibition zone with *Escherichia. coli* was chamomile oil sample I producted from plants cultivated in El Fayoum governorate of Egypt
- The highest inhibition zone with *Salmonella typhi* was cumin oil sample II producted from plant cultivated in Assiut governorate of Egypt.
- The highest inhibition zone with *Bacillus subtilis*, *Stap. aureus* and *S. Cervisiae* was lemongrass oil sample II productd from plants cultivated in El Fayoum governorate of Egypt.
- The highest inhibition zone with *Aspergillus flavus* was cumin oil sample III producted from plants cultivated in Sohag governorate of Egypt
- The highest inhibition zone with *Aspergillus niger* was chamomile oil samples I, and II producted from plants cultivated in El Fayoum and Bani Sweif governorates of Egypt respectively.

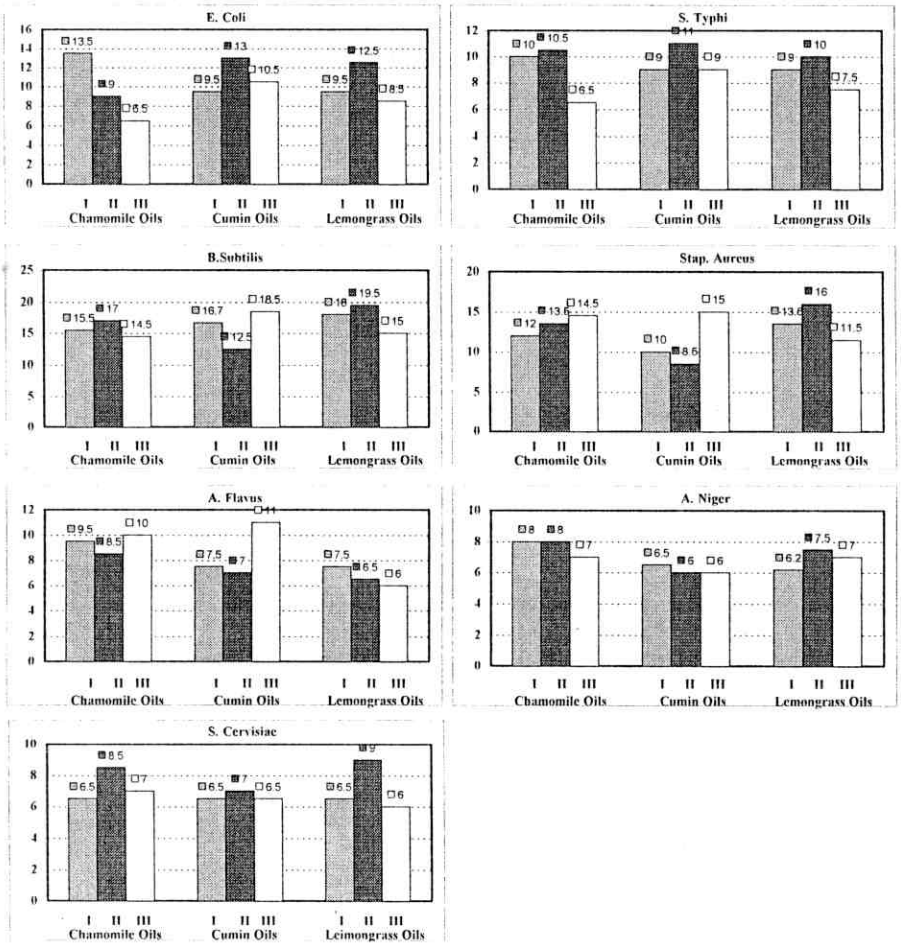

Figure (16) Inhibitation zones (mm) of Chamomile, Cumin and Lemongrass essential oils from three different locations in Egypt on various microorganisms growth.

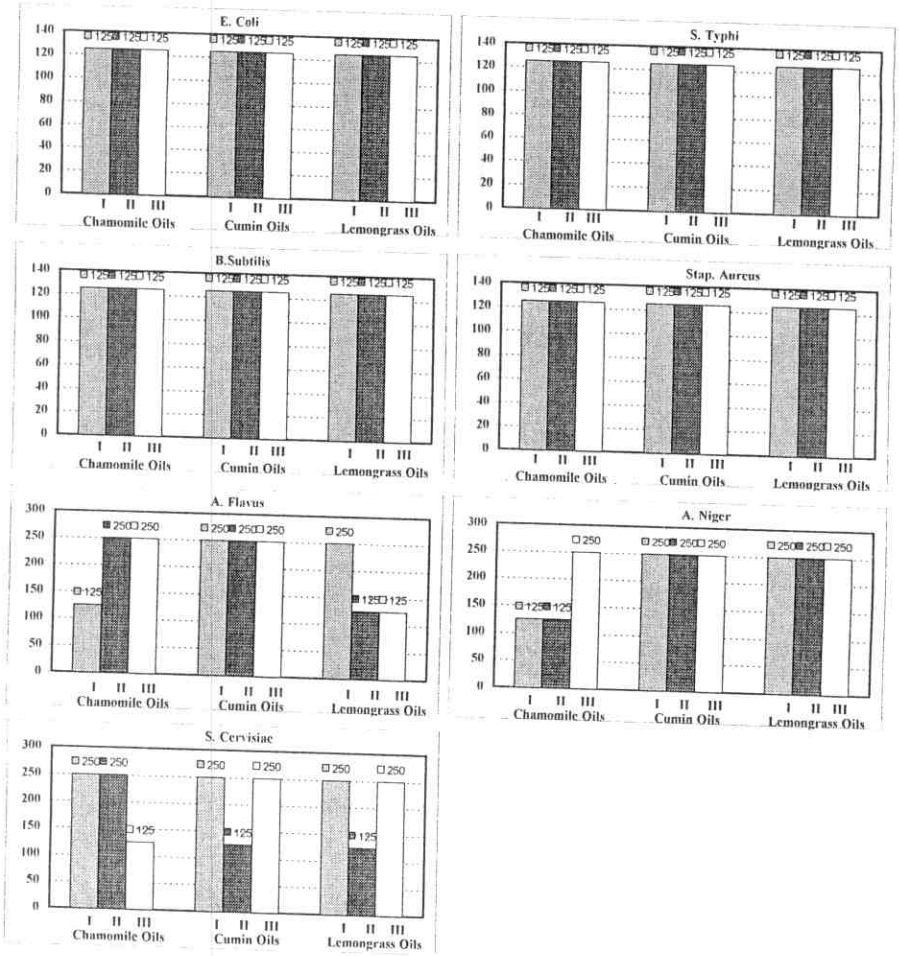

Figure (17) MIC of Chamomile, Cumin and Lemongrass essential oils obtaind from three different locations in Egypt on the growth of different microorganisms.