Chemical Characterization of Vegetable Oils – Lemon, Lavender and Argan

CIPRIAN CHELARU[1]*, MADALINA IGNAT[2], MADALINA ALBU[2], AURELIA MEGHEA[1]

[1] University Politehnica of Bucharest, Department of Inorganic Chemistry, Physical Chemistry and Electrochemistry, 313 Splaiul Independentei, Bucharest Romania

[2] INCDTP-Leather and Footwear Research Institute Division, Bucharest, Romania

The aim of this study is to identify the main component from different vegetable and essential oil contained in some plants whit antibacterial activity. Each oil was obtain using non-industrial devices and brought from different area - lemon essential oil – India, lavender essential oil – Bulgaria, argan oil – Morocco. The oils were analysed using gaz chromatography coupled whit mass spectrometry (GC-MS) and fourier transformer – infra red spectrometer (FT-IR(ATR)).

Keywords: lemon essential oil, lavender essential oil, Morocco

Lemon essential oil (*Citrus Limon*) is a vegetable oil that is obtained from lemon. This oil has multiples applications such perfumery, cosmetic, pharmacy, medicine. This essential oil can be use to treat different type of problems, like fever, infection, insomnia. It has also anti-bacterial and antifungal properties,

Lavender essential oil (*Lavandula Angustifolia*) is a complex mixture, the major compounds are linalool and linalyl acetate . Lavender essential oil is the most versatile essential oil. It has antiseptic, anti repellent (insect removal), relieve pain, eliminate headaches, colds action, etc.

Argan oil (*Argania Spinosa*) is an oil complete the combination of a high concentration of vitamin E, precursors of vitamin A, unsaturated fatty acids (linoleic acid prevails) and essential fatty acids omega-3 and omega-6 that gives skin suppleness and elasticity, prevents dehydration of skin and maintain softening. It is involved in the biosynthesis of prostaglandins, which play an important role in skin permeability. Furthermore, argan oil containing an amount of tocopherol three times higher than any other oil. Tocopherol is one that confers antioxidant properties and action against free radicals, it is effective in preventing sun burns.

Experimental part

Isolation and production of vegetable oils

The lemon essential oil (*Citrus Limon*) was obtained by steam distillation from lemon flower. The origin of lemon flower is India. The lavender essential oil (*Lavandula Angustifolia*) was obtained cold pressing flower parts. The origin of lavender flower is Bulgaria. All the vegetables oils was stored at low temperature for further characterization by GC-MS, FT-IR(ATR). The argan vegetable oils (*Argania Spinosa*) were obtained by cold pressing of the argan seeds. The argan seed was harvested from argan tree that is endemic to Morocco.

Results and discussions

GC-MS technique analysis

The chemical composition was determined by GC-MS using a gas cromatographTermo – GC with DSQ II detector. The column used was TR-5MS, Φ = 0.25 mm, l = 60m, He gas flow = 1 mL/min, injection temperature = 220°C. Oven program temperature: 50 to 220°C whit 3°C/min.

Lemon essential oil (Citrus Limon)

Identification of compounds of Lemon essential oil (*Citrus Limon*) was determinate by using GC-MS technique [8], as is show in the figure 1 and table 1.

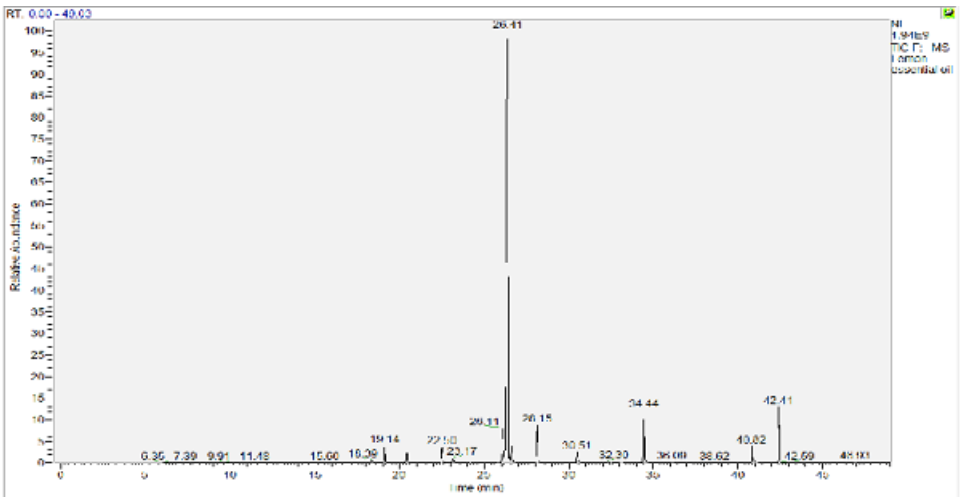

Fig. 1. Lemon essential oil (*Citrus Limon*) chromatogram

* email: cchelaru_cciprian@yahoo.com; Phone: (+40)722405093

Table 1

CHEMICAL COMPOSITION OF LEMON ESSENTIAL OIL

No.	Retention time (min)	Compound	Area (%)	No.	Retention time (min)	Compound	% (area)
1	19.14	α-Pinene	1.77	7	28.15	γ-terpinene	3.35
2	20.44	Camphene	1.33	8	30.51	Linalol L	1.03
3	22.50	2-β-Pinene	1.69	9	34.44	4-Terpineol	4.34
4	26.11	Cymol	3.97	10	40.82	Geranyl acetate	1.54
5	26.41	dl-Limonene	75.53	11	42.41	Caryophyllene	4.06
6	26.66	1.8 Cineole	1.38				

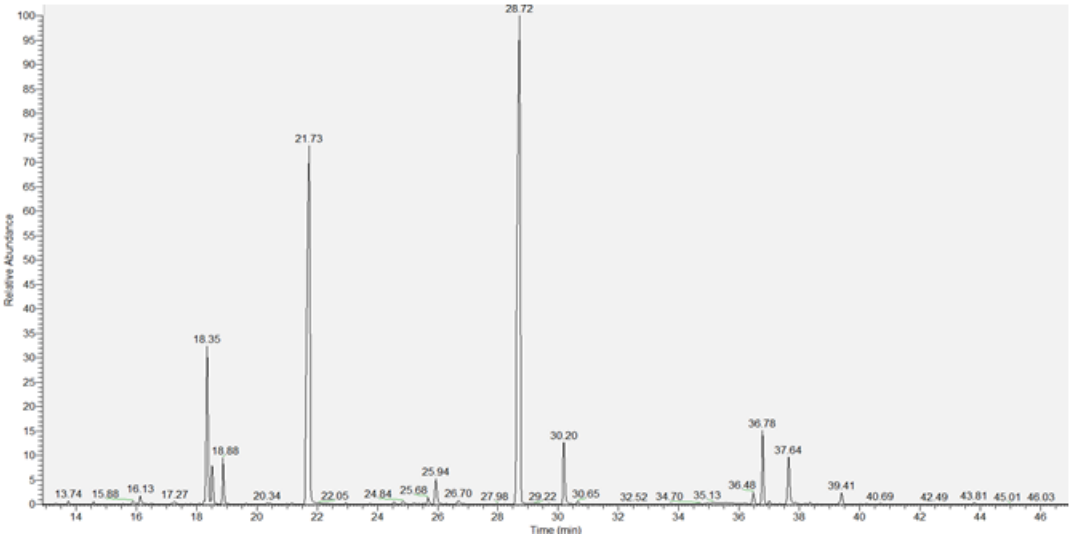

Fig. 2. Lavender essential oil (*Lavandula Angustifolia*) chromatogram

Table 2

CHEMICAL COMPOSITION OF LAVENDER ESSENTIAL OIL

No.	Component	Retention time (min)	Area (%)	No.	Component	Retention time (min)	Area (%)
1	Alpha-pinene	13.74	0.14	12	4-Terpineol	25.94	1.56
2	2 beta Pinene	15.88	0.26	13	Alpha-Terpineol	26.70	0.30
3	Beta-myrcene	16.13	0.46	14	Linalyl Acetate	28.72	40.62
4	Beta Pinene	17.27	0.27	15	Lavandulyl acetate	30.20	3.67
5	Alpha-trans-ocymene	18.35	7.90	16	Alpha-santalene	36.48	0.56
6	1,8 Cineole (Eucalyptol)	18.51	2.09	17	Trans-caryophyllene	36.78	4.08
7	Alpha-cis-ocimene	18.88	2.28	18	Alpha - bergamotene	37.01	0.18
8	Linalool-L	21.59	30.94	19	Beta-farnesene	37.64	2.99
9	Camphor	24.56	0.13	20	Alpha-Humulene	38.37	0.12
10	Lavanduol	24.84	0.25	21	Germacrene-d	39.41	0.69
11	Borneol L	25.68	0.39	22	Caryophylene oxide	43.81	0.10

From the table 1 is possible to see that 91.25% is represented by five components, cymol, dl-limonene, γ-terpinene, 4-terpineol, caryophyllene in which 74.92% is dl-limonene.

Lavender essential oil (*Lavandula Angustifolia)*

With GC-MS analysis was able to identify a total of 22 compounds in the essential oil which are presented in figure 2.

From the table 2 is possible to see that 83.54% is represented by four components, Alpha-trans-ocymene, Linalool-L, Linalyl Acetate, Trans-caryophyllene, in which 30.94% is Linalool-L and 40.62% is Linalyl Acetate.

Argan oil (*Argania Spinosa)*

Argan oil chromatogram characterization was made by using GC-MS technique [8], as is show in the figure 3 and table 3.

From the table 3 is possible to see that 96% is represented by four components, palmitic acid, linoleic acid, oeic acid, in which 72.01 % is Linoleic acid.

FT-IR(ATR) analysis

FT-IR(ATR) spectra compounds identification were recorded using a Jasco FT-IR 4200 series spectrometer fitted with ATR accessory/diamond crystal.

IR spectroscopy was used to identify the characteristic bands from vegetables oils chemical structure (νC=O, νC–OH, νHC=CH, ν–OH etc.).

Lemon essential oil

The FT-IR(ATR) analysis was used in order to identify the main functional groups present in the lemon essential oil as is show in the figure 4 and table 4.

In figure 4 is presented the FT-IR(ATR) spectra of lemon essential oil with the following assessment:

- strong band identified at 3076 cm^{-1} is a symmetric stretching of =C-O-C bonds;
- band identified at 2727 cm^{-1} is assed to H-C=O bonds from aldehydes;
- band identified at 1742 cm^{-1} is assed to C=O bonds from aldehydes;
- band identified at 1375 cm^{-1} is assed to CH3C-H bonds from alkanes and alkyls;

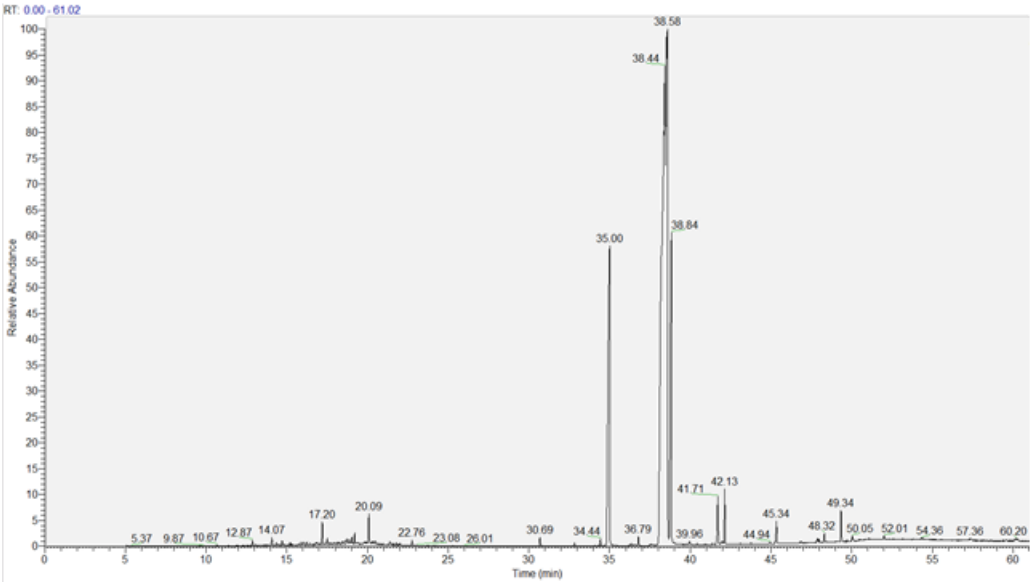

Fig. 3. Argan oil (*Argania Spinosa*) chromatogram

Nr.	Compound	Retention time (min)	% (area)
1	Palmitic acid	35	14.69
2	Linoleic acid	38.58	72.01
3	Oleic acid	38.84	9.3
5	Eicosanoic acid	41.71	1.3
6	Arachidic acid	42.13	1.2
7	Behenic acid	45.34	0.7
8	Qavalen	49.34	0.8

Table 3
CHEMICAL COMPOSITION OF ARGAN OIL

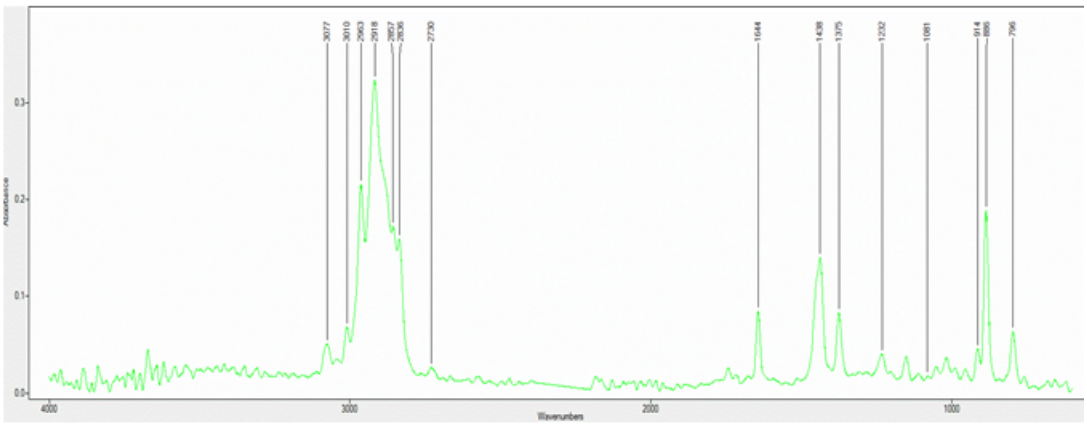

Fig. 4. FT-IR (ATR) spectrum of lemon essential oil

- band identified at 1231 cm^{-1} is assed to asymmetric stretch =C-O-C bonds and band identified at 1081 cm^{-1} is assed to =C-O-C stretch, both present in ethers.

Lavender essential oil (*Lavandula Angustifolia)*

The FT-IR(ATR) analysis was used in order to identify the main functional groups present in the argan oil as is show in the figure 5 and table 5.

Assign peaks identified by FT-IR(ATR) spectrophotometry lavender essential oil are shown in figure 5.

This peak at 3490 cm^{-1} is the Attributes OH group of linalool and its low intensity indicates the small number of OH groups. Peak at 1170 cm^{-1} is a confirmation that structure are alcohols [5].

Essential oils are a mixture of compounds containing saturated group, evidenced by the presence of asymmetric vibrations from 2969 cm^{-1} and 2920 cm^{-1}, assigned to CH_3 CH_2 groups respectively. This CH_2 group is confirmed by the appearance in the footprint of the peaks of 1450 cm^{-1} and 1370cm^{-1}, respectively asymmetric symmetric stretching assigned to the group CH_2.

This linalil and ethyl acetate lavandulil are highlighted in FT-IR spectrum (ATR) by the appearance peak at 1738 cm^{-1} specific carbonyl ester group. Its intensity is consistent with the percentage of 43.89% of GC-MS cumulative percentage for the two compounds.

This eucalyptol is confirmed by existence of the peak occurring at 1111 cm^{-1} and 1019 cm^{-1}, attributed to bond COC and the presence of peak at 1370 cm^{-1}, attributed to the connection O = C-CH_3, in conjunction with this peak to 1019 cm^{-1}.

FT-IR spectrum (ATR) this peak can be seen at 3086 cm^{-1} specific aromatic CH bonds, confirmation was made by the prevailing peak at 832 cm^{-1} specific aromatic.

Argan oil (*Argania Spinosa)*

Argan oil chromatogram characterization was made by using GC-MS technique [8], as is show in the figure 6.

According spectrum FT-IR argan oil present in figure 6 , one can see that it shows the absorption pick from 1743 cm^{-1} is attributed bond -C = O; Pick from 721 cm^{-1}, assigned

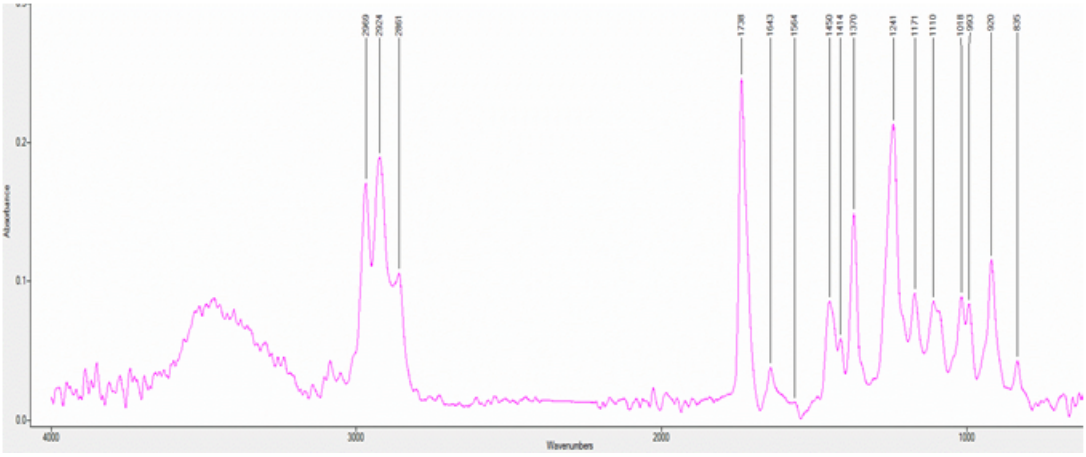

Fig. 5. FT-IR (ATR) spectrum of lemon essential oil

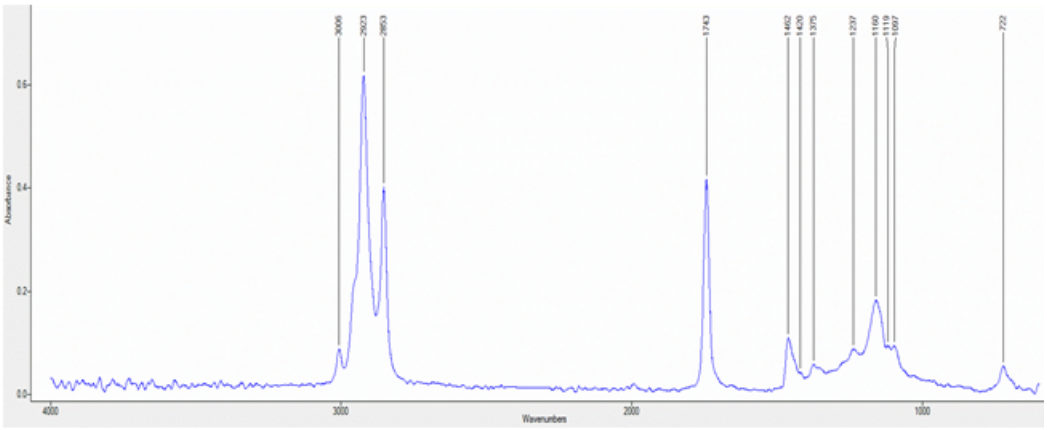

Fig. 6. FT-IR (ATR) spectrum of argan oil

CH_2 -CH_2 -CH_2 bond , thus demonstrating a high degree of saturation compounds of argan oil .

The peaks occurring at a wavelength of 2921 cm^{-1} and 2852 cm^{-1} is CH_2 bond vibration. The link is confirmed by the presence of CH_2 peak at 1461 cm^{-1}. The peaks at 1234, 1160 1120, 1098 cm^{-1} are assigned to COC bond.

Conclusions

The main component of lemon essential oil is over 75% (dl-Limonene).

The main components of argan oil are palmitic and linoleic acid, acids that have a emollient and hydration proprieties for skin.

The approximate similar amount of Lavender essential oil (40.62%) Linalyl Acetate and (30.94%) Linalool-L is possible because the chemical structure is very similar.

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References

1. JONES F.A., Herbs – Useful plants. Their role in history and today. European Journal of Gastroenterology and Hepatology, 8, 1227-1231, 1996.

2. MISHRA, A.K., DUBEY, N.K., Evaluation of some essential oils for their toxicity against fungi causing deterioration of stored food commodities. Applied and Environmental Microbiology, 60, 1101–1105, 1994.

3.JUNG KUN SONG, HO CHUN KANG, KWANG SOK KIM, In-Joo Chin, Microcapsules by Complex Coacervation for Electronic Ink, Molecular Crystals and Liquid Crystals, Vol. 464, pp. 263[845]–269[851], 2007.

4. P. KANMANI, E. DHIVYA, J. ARAVIND, K. KUMARESAN, Extraction and Analysis of Pectin from Citrus Peels: Augmenting Yield from Citrus limon using Statistical Experimental Design, Iranica Journal of Energy & Environment 5 (3): 303-312, 2014.

5. IHUOMA ONYEYIRICHI, NKEOYE, OGECHI, OKPE OCHE, UKAH JERRY, MOHAMMED GERO, Evaluation of chemical constituent of Citrus Medica Limonum Leaf Essential Oil, Journal of Pharmaceutical and Scientific Innovation, 3 (4), 2014, 306-309

6. NIMET KARA, HASSAN BAYDAR, Determination of Lavender and Lavandin Cultivars (Lavandula sp.) Containing high quality essential oil in Isparta, Turkey, Turkish Journal of Field Crops, 2013, 18 (1), 58-65.

7.YUELING ZHANG, WEI WEI, PIPING LV, LIANYAN WANG, GUANGHUI MA, Preparation and evaluation of alginate–chitosan microspheres for oral delivery of insulin, European Journal of Pharmaceutics and Biopharmaceutics vol. 77, 2011, pp. 11–19.

8. S. S. DEO, F. INAM, R. P. MAHASHABDE, Antimicrobial Activity and HPLC Fingerprinting of Crude Ocimum Extracts, E-Journal of Chemistry, vol. 8(3), 2011, pp. 1430-1437.

9. K.A. HAMMER, C.F. CARSON, T.V. Riley, Antimicrobial activity of essential oils and other plant
extracts, Journal of Applied Microbiology, 1999, 86, 985–990

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