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Impact of Essential Oils on Some Pathogenic Bacteria. A review

Khodier R.A. MSc
Botany and Microbiology Department, Faculty of Science, Fayoum University, Egypt.
Email: khodierrania@gmail.com

Prof. El-Sayed El-Desouky, Th
Botany and Microbiology Department, Faculty of Science, Fayoum University, Egypt.
E-mail: sarwat_radwan@yahoo.com

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ABSTRACT

During the treatments of pathogenic bacterial diseases using antibiotics several problems emerge viz antibiotics toxicity to the patients and resistance of the bacteria to different antibiotics. Essential oils are natural products having antimicrobial activity to different microorganisms (bacteria, fungi, actinomycetes, and bacteroides). These essential oils can also be combined with antibiotics (*Lavandula* oil mixed with Ciprofloxacin for treatment of *Salmonella spp*). The oils are used for the treatment of multi-drug-resistant bacteria as *Mentha pulegium* L oil is used for the treatment of imipenem resistant *acinetobacter baumannii* and methicillin-resistant *Staphylococcus aureus* (MRS). The antimicrobial activities of essential oils are exhibited under the effect of constituents as aldehydes, fatty acids, ecosom, and hexagonal demonic acids present in *Atropa belladonna*. Other plants and *Lavandula pedunculata* contain camphor, fenchor, polyphenols, flavonoids, and hydroethanolic acids. These ingredients function as antioxidants, alteration of cell wall composition, impairment of nucleus and cytoplasm.

Keywords: Antibiotics, Essential oils, pathogenic microorganisms, infectious diseases.

1. Antimicrobial activity of essential oils:

Once the urgent need to find alternative antimicrobial agents to restrict the antibiotic resistance probability (Famuyide *et al.,* 2019); essential oils were a great choice especially in the food preservation process (Huang *et al.,* 2017). The antimicrobial activity of essential oils is related to its chemical constituents such as oxygenated terpenoids, phenols and alcoholic compounds (Rauha *et al.,* 2000). *Cinnamomum verum* (Cinnamon) has antimicrobial activities against *S. aureus, Listeria monocytogenes, E. Coli, B. Ceres, S. typhimurium* (Saad *et al.,* 2022).

Origanum majorana (oregano), showed the highest antimicrobial activities against *Salmonella enteritidis, S. Typhimurium* and *listeria monocytogenes, gram* negative and positive bacteria respectively (Choi *et al.,* 2008). *Syzygium aromaticum* (clove) used for food preservation, treatment of oral infection and as a savoring agent. It Inhibits the growth of bacteria, fungi, also used as insecticidal and antioxidant material. It has many properties as for dental care, *E. Coli* inhibitor (Friedman *et al.,* 2002 and Cressy *et al.,* 2003), fungicidal, anti-carcinogenic, and has antimutagenic activity (Chami *et al.,* 2005).

Anethum graveolens (Dill) used as food additive and against putrefaction bacteria (Oskaloosa *et al.,* 2020), it is specific for *Acinetobacter beijerinckii* growth inhibition, it also inhibit the growth of *E. Coli, S. Typhimurium* (György *et al.,* 2020). *Thymus vulgaris* (thyme). It completely inhibits the growth of *Pseudomonas aeruginosa, Listeria innocua, Streptococcus pyogenes* under the effect of its volatile oils (Rasooli *et al.,* 2006). *Lavandula angustifolia* (Lavender) used for perfume and soap production (Lis-Balchin, *et al.,* 2002), food industry and pudding (Burdock *et al.,* 1998).

Nigella sativa (black seed), it was reported that *N. Sativa* is used for various diseases such as for respiratory system, Immunological system, GIT, CVS, and nephrological system (Sharma *et al.,* 2001).

Corresponding Author: Khodier R. A., Botany and Microbiology Department, Faculty of Science, Fayoum University, Egypt. Email: khodierrania@gmail.com

Furthermore, it was cited that black seed extract is used as antimicrobial, immune stimulant, hypotensive, anti- inflammatory, anticancer, antioxidant, hypoglycemic spasmolytic and bronchodilator (Halawani *et al.,* 2009).

Prunes dulcis (Almond), almond oil has many properties and is used in complementary medicine circles as anti- inflammatory, immunity boosting and anti-hepatotoxicity effect. It reduces irritable bowel syndrome, reduces incidence of colonic cancer, cardiovascular benefit by increasing the level of good cholesterol (Ahmad *et al.,* 2010). *Citrus lemon* (lemon juice), it contains many bioactive compounds, it has Antibacterial and antioxidant activities, it contains vitamin C and Citric acid (Ekawati *et al.,* 2019). *Pimpinella anisum* (Anise), an oldest medicinal plant, is used as flavoring, Digestive, carminative agent and relief gastrointestinal spasm (Shojaii *et al.,* 2012).

Zingiber officinale (Ginger) Essential oil is considered as a strong antimicrobial, antifungal, and antioxidant activities (Da Silva *et al.,* 2018). *Foeniculum vulgaris* (fennel) Essential oil regulates the peristaltic functions of gastrointestinal tract, relieves the spasms of intestines, muscular and rheumatic pains (Saharkhiz *et al.,* 2011).*Carum carvi* (Caraway), it is used as a food additive due to its pleasant flavor, it is used as preservative agent in stored tubers of potato and onions because it Inhibits the germination of seed and prevent the growth of certain fungi and microbes (Raal *et al.,* 2012), and bronchodilator (Halawani *et al.,* 2009).

1.2. In addition to severe side effects of antibiotics

Many pathogenic bacteria showed high resistance to these antibiotics. In this connection (Li *et al.,* 2018), cited that 80% of *E. coli* isolated from hospitalized burn patients were resistant to Ampicillin, piperacillin, cefazolin, amoxicillin, tetracycline, and sulfamethoxazole. Talabi *et al.* (2014) showed that *Enterococcus fascium* isolated from urinary tract infections were resistant to Ciprofloxacin erythromycin, Ampicillin, and Gentamicin antibiotics. Quilitz *et al.* (2014) found that vancomycin-resistant *Enterococcus fascium* has been reported to be increasing in frequency and is Associated with significant morbidity and mortality rates in patients with acute leukemia with prolonged neutropenia and VREF colonization. Lobez Marti *et al.* (2009) stated that linezolid is an antibiotic used to treat highly resistant infections, including vancomycin-resistant *Enterococci* and methicillin-resistant *Staphylococcus aureus, Enterococcus* in pediatric patients. Control of pathogenic bacteria by antibiotics have many lethal harmful side effects, such as Ciprofloxacin that develop severe respiratory failure, intermittent high fever, dyspnea and severe hypoxemia in a 68 years old woman (Steiger *et al.,* 2004).

Headache was recovered in 8% of patients taking Ciprofloxacin (Mc Carry *et al.,* 1999). Ciprofloxacin can cause confusion and general seizures (Tattevin *et al.,* 1998). Immune hemolytic anemia was originally described with penicillin G but subsequently also with other penicillins and cephalosporins (funicella *et al.,* 1977). Tangerine (1998) cited that, ototoxicity is a major adverse effect among antibiotics. On the other hand, Caraffini *et al.* (1995) showed that allergic contact dermatitis causing conjunctivitis and blepharitis has been reported with topical ophthalmic tobramycin.

Also the use of life-saving antibiotics has long been plagued by the ability of pathogenic bacteria to Acquire and develop an array of antibiotic resistance mechanisms (Hobson *et al.,* 2021). Rapid emergence of multidrug-resistant (MDR) "superbugs" poses a severe threat to global health (pang *et al.,* 2019). It's crucial nowadays to search for other sources of promising antimicrobial agents and strategies for the treatment of serious gram negative and gram positive infections due to the emergence of multi-drug-resistant in common pathogens. Toxicity and carcinogenicity of synthetic additives have led scientists in food industry to search for alternatives specifically naturally occurring antimicrobial agents (Khalil *et al.,* 2018).

On the other hand, the main adverse reaction of aminoglucosides consist of kidney damage (often presenting as non-oliguric renal insufficiency) and ototoxicity, including vestibular and/or cochlear dysfunction. Neuromuscular transmission can be inhibited. Hypersensitivity reactions are most frequent after topical use, which should be avoided. Anaphylaxis reactions can occur. Tumor-inducing effects have not been reported. Also severe respiratory depression due to neuromuscular blocked has been observed (Emery ER.). Bronchospasm can occur as part of a hypersensitivity reaction.

1.3. Essential oils and cancer

Reports of previous reviews show cancer affects the mortality rate in all over the world. Although we have achieved many advancements in the fight against cancer, we still have failed to find treatment and drugs for some types of cancer. Many chemotherapeutic agents and drugs for the treatment of cancer are made up of traditional medications and show significant effect in treating cancer. Extracted essential oils from the various plant materials have been shown to be effective in the treatment of glioblastoma multiforme, colon cancer, stomach cancer, liver cancer, breast cancer, prostate cancer and cervical cancer. The effectiveness of some essential oils in a few of them has been discussed in the given below subsections (Fulekar *et al.,* 2014).

2. Different essential oils can be extracted by

Various extraction techniques are available for different parts of the plant. These techniques can be further divided into conventional and modern methods. Chemical composition of essential oils can be greatly affected by isolation techniques and optimization of extraction techniques. Therefore, choosing the right technique and extraction condition are the critical factors to be considered to obtain the essential oil with ideal properties. As a result, modern extraction techniques have been offered as replacements to the time consuming traditional method. (Essential Oils).

2.1. Steam distillation

Steam distillation is a separation technique for heat sensitive plant material and provides a good yield of essential oil as compared to hydro distillation. A packed bed of leafy plant materials is prepared and kept over the steam generator rather than directly immersing in boiling water. Plant materials are decomposed in steam and pass along with it through the condenser, received in the receiving flask. The problem with this method is that an appropriate amount of steam is required for different plants (Massango *et al.,* 2004). Indirect steam-distillation as in *Zingiber officinale, Cinnamomum verum, Trachyspermum ammi, Cuminum cyminum, Carum carvi, Cannabis aetheroleum, Materials are Frenc, Ocimum basilicu, Cupressus semperviren.*

2.1.1. Hydro- distillation

Hydrodistillation is the ancient and traditional method of extracting the essential oil. In the very beginning rose plants were used for the extraction of essential oils with this method. The plant materials having higher boiling point and hydrophobic in nature are submerged into the boiling water. With the help of a condenser, the vapors of the boiling liquid get converted into liquid. This condensate is then collected into a receiving flask for the separation of essential oil from water. Low cost, easy to construct, field use makes it a good method for extraction. But this method has many disadvantages. Such as, quality of product obtained and its limitations to isolate plant matrix having b.p. less than 100 °C. (Aziz, *et al.,* 2018)

Hydrodistillation as in *Thymus zygis, Thymus willdenowii Boiss,* the region of Ifrane, Middle Atlas of Morocco, *Achillea grandifolia,* (Serbia), *Lippia origanoides* Kunt, The Carajas National Forest, Brazil, *Origanum compactum*, *Mentha pulegium, Artemisia herba alba* , *Thymus zygis* L.,*Thymus willdenowii Boiss,* the region of Ifrane, Middle Atlas of Morocco , *Nicotiana rustica L.,* Borazjan city of Iran, *Myrica Gale*, a neglected non-wood forest product, Fruit samples from natural (Western Lithuania) and anthropogenic (Eastern Lithuania) *M. gale* populations were studied separately , *Citrus paradisi peel, Melissa officinalis,* (Algeria), *Atropa belladonna* L. Turkey, *Eucalyptus accedens* , *Eucalyptus punctata* , *Eucalyptus robusta* , *Eucalyptus bosistoana* , *Eucalyptus cladocalyx* , *Eucalyptus lesouef* , *Eucalyptus melliodora* , *Eucalyptus wando* (Syria) (Radi *et al.,* 2022; Drobac *et al.,* 2021; El-Amrani *et al.,* 2021; Ameur *et al.,* 2021; Bekka-Hadji *et al.,* 2022; Fard *et al.,* 2021; Loziene *et al.,* 2020; Nour El Houda *et al.,* 2020; Fidan *et al.,* 2021 and Fahima Abdellatif *et al.,* 2021).

3.Celevenger device as in ***Tanacetum lingulatum, Tanacetum polycephalum.***

3.1. Determination of minimum inhibitory concentration (MIC) of essential oils: (Man *et al.,* 2019)

two mL of each pure essential oil were mixed with an equal amount of sterile water in 15 mL sterile centrifuge tubes and gently but thoroughly mixed overnight at 25°C using an orbital plate mixer. The tubers were then centrifuged for 15 min at 5000 rpm in order to achieve a better separation of the aqueous and non-aqueous phases. After checking the complete separation, the bottom aqueous phase was recovered and further used as a working solution of essential oil (AqEO).

The minimum inhibitory concentrations (MIC) were determined in 96-well plates (eight rows marked from A-H and 12 columns marked from 1-12). Two-hundred microliters of AqEO were distributed in the first well of row (A-F); one hundred microliters of sterile distilled water were distributed in the columns 2-12. Using a multichannel pipette, 100 micron liters of AqEO from the first column were sequentially mixed with the water, achieving two-fold serial dilutions. The remaining 100 micron liters from the last dilution mix were discarded. The final concentrations of essential oils were 50%, 25%, 12.5%, 6.25%, 3.13%, 1.56%, 0.78%, 0.39%, 0.20%, 0.10%,0.05%, and 0.025% v/v in final volume (or as reported by other authors and rounded: 500, 250,125, 64, 32, 16, 8, 4, 2, 1, 0.5, and 0.25 microliter/ml).

From a pure Isolated cultures, standard inoculums of 0.5 McFarland units prepared in sterile saline. Ten microliters of inoculums were transferred in 9990 microliters of 2x concentrated Mueller-Hinton broth, and 100 microliters were transferred with a multichannel pipette from a pipetting tray over the 100 microliters of AqEO, obtaining a bacterial inoculums of approximately 2 × 10°4 CFU/well in a final volume of 200 microliters. Negative and positive control wells were prepared for each plate, in the last row (Mueller-Hinton broth and water for negative control in well H11, respectively bacterial inoculums and water, without essential oils for positive control in well H12). The plates were incubated at 35°C for 18 hours in a normal atmosphere. The MIC was interpreted in the last well of each row where no visible bacterial growth was noticed (bacterial growth inhibition), and interpreted as v/v percentage of stock solution.

3.2. Gas chromatography

Gas chromatographic analysis was run using a GC HP 5890 (Hewlett Packard) with a flame ionization detector. The capillary column was an HP-5 fused-silica type with a 30-m dimension, 0.25-mm internal diameter, and 0.25-lm film thickness (Agilent Technologies, USA). The sample volume was 0.03 ll. The oven temperature was established from 60 C to 240 C at 3 C/min. The injector temperature was 250 C; the detector temperature was 280 C. The carrier gas was helium at a rate of 1.0 ml/ min. A volume of 0.02 ll of the oil was used in the automatic sample injection (split: 1/70). The relative proportions of the essential oil constituents were expressed as percentages obtained by peak area normalization. For the gas chromatography combined with mass spectrometry, the PerkinElmer quadrupole mass spectrometry system (Model 5; PerkinElmer, USA), coupled with the GC HP 5972 (Agilent Technologies, USA), with a HP-5-type capillary column, was used. The temperature of the oven was established from 45 C to 240 C (at 3 C/min). The temperature of the injector was 250 C. Helium was the carrier gas at a rate of 0.5 ml/min. A volume of 0.02 ll of the oil was used in the automatic sample injection (split: 1/70). The parameters of mass spectrometry operation were as follows: interface temperature was 300 C, ion source temperature was 200 C with EI mode (70 eV), and scan range was from 40 to 400 Amu.

3.3. Shell material preparation of urushiol-based microcapsules (UMs)

Following our previous report method (Zhiwe *et al.,* 2022), urushiol propylamine derivatives were prepared in Figs (1, 2). As shown in Fig 1, it showed the schematic of the preparation of different saturations urushiol (Ω = 1, 2, 3) based UMs copolymer. Briefly, triethylamine (50 μL) was dissolved in 50 mL DMSO solution of urushiol propylamine (1 mmol) and HDDA (226 mg) in a 250 mL three-neck flask at 400 rpm stirring for about 10 min. Then, the mixture was stirred vigorously at 60 ◦C for 15 h to form uniform solution and its pH was regulated in 8–9 by adding TEA. Then, mPEG-NH2 (5 g) was gradually dispersed to the above solution for another 72 h open-vessel reaction to obtain the crude Ums, which was performed under homogenization shearing (Ultra Turrax T25, IKA, Germany) at a rate of 8000 rpm for 5 min at ambient temperature. Thereafter, the occurring foam in the system was removed by adding two drops of n-octanol, and the pH of the mixture was regulated to 3–4 by subsequently adding HCl (1 mol/L). After the system temperature slowed to ambient temperature, the synthesized UMs were separated via membrane-based dialysis process and washed with methanol and distilled water, ethanol and isopropanol, respectively. Finally, the UMs were freeze dried at -40 ◦C for 72 h. Experimental amplification of preparation of concentrated UMs was conducted following the above same method. (Liandong Feng, *et al.,* 2014 and Gao, *et al.,* 2021).

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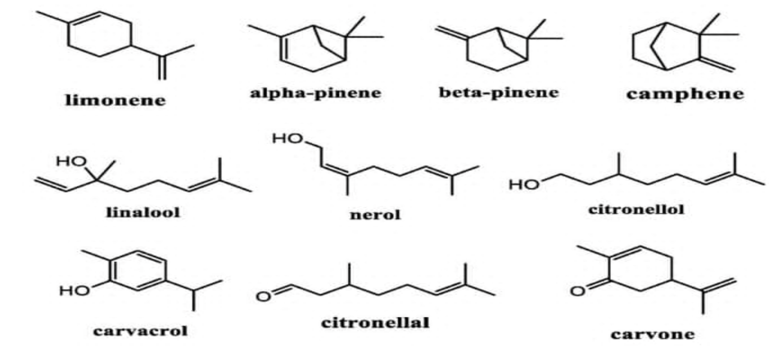

Fig. 1: Some monoterpenes compounds present in plant essential oils.

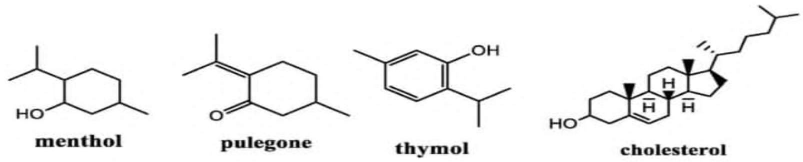

Fig. 2. Some terpenoides compounds present in plant essential oils.

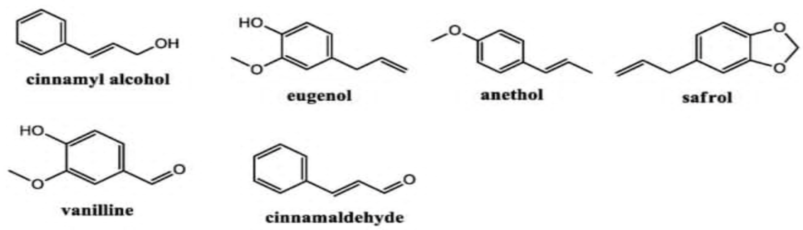

Fig. 2: Some aromatic compounds present in plant essential oils.

2.4.1. Preparation of EO-filled UMs (E-UMs).

E-UMs were prepared by using UMs as shell material, following the previous a two-stage solvent evaporation procedure. In the first step, the UMs powder was dissolved in ethyl acetate (EA, 90 wt%) under 650 rpm for at least 1h at ambient temperature. Then, EO was added gradually to the abovementioned solution under 650 rpm at ambient temperature, the core: shell ratios of final EO: UMs was 1:1, and the system was magnetically stirred for further 2 h to obtain the oil phase. In the second step, the oil phase was added dropwise to the aqueous solution (pH 7) of 1 wt% sodium dodecyl sulfate (SDS) and 0.05 wt% Dynol 604 surfactant saturated with ethyl acetate at 25 ◦C with magnetic stirring for 30 min. Then, the dispersion was continuously stirred at a constant speed of 800 rpm for 1 h, and gradually heating to 60 ◦C, and concentrated by continuous open-top stirring for 90 min. After complete removal of the solvent by evaporation, the stabilized E-UMs were washed with acetone and deionized water, and filtered to remove the remaining surfactant, and then freeze-dried at -40 ◦C for 72 h. 2.4. Preparation of epoxy resin coating containing E-UMs (E-UMs@ER) (Mirabedini *et al.,* 2012 and Li *et al.,* 2017).

Briefly, 10 wt% of E-UMs were gently dispersed into the epoxy resin solution, which was dissolved in xylene. The solid content of epoxy solution was kept at 90 wt%. The weight ratio of the hardener to epoxy resin is 1.35, was then added to the mixture. The coating solution of 40.0 mL was casted on 20.0 cm × 20.0 cm acrylic plate using a manual film applicator, dried in a fume hood at room temperature for 24 h, and uncovered (Jialan, *et al.,* 2019).

2.4.2 Characterization

The dried E-UMs powders were dissolved and dispersed into deionized water. The optical microscopy of the emulsions involved was viewed with a Leica optical microscope (Leica DM6 M) and image analysis software (ImageJ V1.3.8). E-UMs were examined in copper pieces with gold-plated conductive tape at 10 mbar for 90 s in a scanning electron microscope (SEM, JEOL-7500LV, JEOL Ltd., Japan) using a voltage of 15–20 kV at 1000× magnification from 300 to 2200 times. The morphologies of E-UMs were ruptured under rapid freeze-drying and mounted on a conductive stage to facilitate shell morphology, which followed the method reported by Chen *et al.,* (2018). The 1H

NMR spectra were recorded on a BRUKER AVANCE III 400 M NMR spectrometer (Bruker Corporation, Germany) and analyzed by MestReNova software (Bruker Corporation, Germany). The

FT-IR spectra was recorded and analyzed via Nicolet iS10 IR spectrometer (Thermo-Fisher Corporation, USA) equipped with an all-reflective diamond ATR. All spectra were obtained in absorbance mode with 32 scans at an infrared spectral resolution of 4 cm− 1 from 4000 cm− 1 to 400 cm^{-1}. TG was performed on a STA 409PC thermogravimetry instrument (Netzsch Corporation, Germany) at a heating rate of 10 ◦C/min from 0 to 800 ◦C under nitrogen atmosphere. A PerkinElmer DSC 8000 instrument (Bruker Corporation, Germany) was employed at 0–800 ◦C with a heating rate of 10 ◦C/min for the DCS analysis. Both samples at a weight of 5 mg were put to an aluminum pan that was used as a reference in its empty form. The coating aqueous contact angles were performed by a data-physics OCA15EC contact angle measurement instrument (Zhiwen *et al.,* 2021)

2.4.3. Determination of EO sustained release from E-UMs

The content of the EO in E-UMs was determined by extraction in n- hexane. In order to investigate the EO release behavior, the pure EO and E-UMs were placed in oven and measured by electronic microbalance. Weighted samples were stored at 50 ◦C, 100 ◦C and 150 ◦C at 48 h and weighed every 6 h to examine the release properties of EO that was released from E-UMs. Release rate (%) of EO was calculated as follows:

$$\frac{Mt - Ma}{\text{Release rate (\%)}} = 100(1)\ Mt$$

where Mt is the weight of samples after 6 h storage and Ma is the weight of samples before storage. All experiments were conducted in triplicate and values are expressed means (Zhiwen *et al.,* 2021)

3.1. Mode of action of different essential oils on pathogenic microbes:

Lavandula pedunculata, *Lavandula angustifolia*, *Lavandula maroccana* (Morocco)

On Three pathogenic foodborne bacteria, *Salmonella spp,* and 128 fold bacteria and five fungal strain Causing Antioxidant, Antibacterial, and Antifungal with Ciprofloxacin remarkable antimicrobial activity against the tested bacteria with (MICs) ranging from 3.53 to 15.96 mg ml^{-1} (Alvarez-Ordonez *et al.,* 2013 and Radi *et al.,* 2022).

Citrus bergamia on Multi-drug-resistant (MDR) pathogens and fungi distilled extract of bergamot exhibited significant antimicrobial activity and a specific bactericidal effect against the bacterial and fungal strains tested. Furthermore, confocal microscope images clearly showed compromised membrane integrity, damage and cell death in bacterial samples treated with the distilled extract of bergamot. In addition, progressive alterations in cell-wall composition, cytoplasmic material and nucleus structure triggered by exposure to the distilled extract of *bergamot* were identified in the fungal samples considered (Quirino *et al.,* 2022).

Nigella sativa L Moroccan (Morocco), *Nigella sativa* L (Saudi Arabia), *Nigella sativa* L (Syria), *Nigella sativa* L (India), On Gram-positive (+) bacteria were slightly sensitive to the Eos tested than the Gram-negative (-) bacteria Causing (MIC) and (MBC) obtained for the four Eos) tested were ranging from 3 to 40 l/ml. (Dalli *et al.,* 2021).

Mentha pulegium L., *Mentha pulegium*, against two multi-drug-resistant bacteria strains: imipenem-resistant *Acinetobacter baumannii* (IRAB S3310) and methicillin-resistant *Staphylococcus aureus* (MRSA S19)., Causing the strongest synergistic effect was observed with *M. pulegium* in association with amikacin (Ak) (Bekka-Hadji *et al.,* 2022)

Artemisia herba alba against two multidrug-resistant bacteria strains: imipenem-resistant *Acinetobacter baumannii* (IRAB S3310) and methicillin-resistant *Staphylococcus aureus* (MRSA S1 The best effect was observed with *A. herba alba* essential oil in association with cefoxitin (CX) against MRSA S19. However, for IRAB S3310 (Bekka-Hadji *et al.,* 2022)

Litsea cubeba North Vietnam against *Escherichia coli* changes in cell morphology, loss of integrity and permeability of the cell membrane, as well as DNA loss. *Thymbra capitata* against methicillin-resistant *Staphylococcus aureu causing* reducing cellular metabolism and cellular culturability (Almeida *et al.,* 2022). *Citrus paradisi* peel (Algeria) against the tested bacteria (*Escherichia coli, Pseudomonas aeruginosa*, and *Staphylococcus aureus*) and the yeast (*Candida albicans*) against the tested bacteria (*Escherichia coli, Pseudomonas aeruginosa,* and *Staphylococcus aureus*) and the yeast (*Candida albicans*), with an inhibition zone ranging from 4 to 20 mm. Both essential oils showed no effect against *Aspergillus niger, Verticillium sp* and *Thielaviopsis sp.* The insecticidal activity was investigated against adults *ceratitis capitata* (Nour El Houda *et al.,* 2020).

Cupressus semperviren obtained from Dhana Natural Reserve, Al-Tafilah, Jordan against *Bacillus subtili, Micrococcus luteus, Staphylococcus epidermidis, Staphylococcus aureus, Escherichia coli and Enterobacter aerogenes, Pseudomonas aeruginosa, M. luteus, Klebsiella pneumonia, Salmonella typhi* the growth inhibition of *Bacillus subtilis, Micrococcus luteus, Staphylococcus epidermidis and Staphylococcus aureus* and producing inhibition zone ranges between 12-15 mm. The MIC values recorded by essential oils o*f C. sempervirens* were as follow: *S. epidermidis and S. aureus* (370g/mL), *Escherichia coli* and *Enterobacter aerogenes* (1000g/mL), *Pseudomonas aeruginosa* (2000g/mL) and *M. luteus, Klebsiella pneumonia* and *Salmonella typhi* (3000g/mL) (Qaralleh *et al.,* 2021)

Citrus spp fruits. BIOLL+(R), a commercial extract (for some *Brachyspira hyodysenteriae* strains, For various *Salmonella enterica* and *Escherichia coli* strains. Strong activities with (MIC) ranging from 10 ppm (for some *Brachyspira hyodysenteriae* strains) to 80 ppm (for various *Salmonella enterica* and *Escherichia coli* strains) were observed. Membrane integrity tests and Fourier transform infrared (FT-IR) spectroscopic analyses were performed to shed light on the effects caused on molecular structure and composition. Physical effects, with formation of pores and leakage of intracellular components, and chemical effects, which were dependent on the bacterial species, were evident on cellular envelopes. Whereas for *S. enterica* and *E. coli*, changes were focused on the carboxylic group of membrane fatty acids, for B. hyodysenteriae, the main effects were found in polysaccharides and carbohydrates of the cell wall (Carvajal *et al.,* 2013).

3.2. Essential oils and its native country, Antimicrobial spectrum, mode of action and combination with antibiotics, and extraction and chemical composition.

Lavandula pedunculata (Morocco) against three pathogenic foodborne bacteria, *Salmonella spp*, and 128fold bacteria and five fungal strains Showed antioxidant, antibacterial, and antifungal with Ciprofloxacin remarkable antimicrobial activity against the tested bacteria with (MICs) ranging from 3.53 to 15.96 mg ml-1 ,The oil GC/MS, abundance of camphor (74.51%) and fenchone (27.06%), camphor (41.15%) and fenchone (15.70%), the content of polyphenols and flavonoids is higher in the hydroethanolic extract, camphor (41,15%) and fenchone (15,70%) are the major compounds of *L. pedunculata* (Alvarez-Ordonez *et al.,* 2013, and Radi *et al.,* 2022).

Lavandula angustifolia (Morocco), against Three pathogenic foodborne bacteria, Salmonella spp., 128 fold bacteria and five fungal strain Showed antioxidant, antibacterial, an antifungal with Ciprofloxacin remarkable antimicrobial activity against the tested bacteria with (MICs) ranging from 3.53 to 15.96 mg ml^{-1}, GC/MS, eucalyptol (39.05%), camphor (24.21%) and borneol (8.29%), camphor and linalool as majority compounds with 20,17% and 12,41% respectively, the highest content of tannins, *L. angustifolia* contains camphor and linalool as majority compounds with 20,17% and 12,41% respectively (Alvarez-Ordonez; *et al.,* 2013 and Radi *et al.,* 2022).

Lavandula maroccana (Morocco) Three pathogenic foodborne bacteria. *Salmonella spp.*, and 128 fold. With Ciprofloxacin remarkable antimicrobial activity against the tested bacteria with (MICs) ranging from 3.53 to 15.96 mg ml-1, GC/MS, carvacrol (42.08%), camphor (17.95%) and fenchone (12.05%) (Alvarez-Ordonez *et al.,* 2013 and Radi *et al.,* 2022).

Cinnamon against Gram negative bacteria, Gram positive bacteria 25 mm (Saad *et al.,* 2022).

Thyme against Gram negative bacteria, Gram positive bacteria, Skin infections in dogs, (10b) bovine respiratory pathogens - focusing on *Pasteurella multocida* 18-21 mm. (Saad *et al.,* 2022, Bismarck *et al.,* 2022 and Terentjeva *et al.,* 2021).

Clove against Gram negative bacteria, Gram positive bacteria, bovine respiratory pathogens - focusing on *Pasteurella multocida* 14-16 mm. (Saad *et al.,* 2022, and Bismarck *et al.,* 2022).

cinnamon cassia, lemon grass, coriander, Mannheim haemolytica (peppermint oil) bovine respiratory pathogens - focusing on *Pasteurella multocida* (Bismarck *et al.,* 2022). *Oregano, Cinnamon* leaf Skin infections in dogs (Terentjeva *et al.,* 2021).

Citrus bergamia Multi-drug-resistant (MDR) pathogens and fungi distilled extract of *bergamot* exhibited significant antimicrobial activity and a specific bactericidal effect against the bacterial and fungal strains tested. Furthermore, confocal microscope images clearly showed compromised membrane integrity, damage and cell death in bacterial samples treated with the distilled extract of *bergamo*t. In addition, progressive alterations in cell-wall composition, cytoplasmic material and nucleus structure triggered by exposure to the distilled extract of *bergamot* were identified in the fungal samples considered (Quirino *et al.,* 2022).

Nigella sativa L Moroccan (Morocco), (Saudi Arabia), (Syria), Gram-positive (+) bacteria were slightly more sensitive to the Eos tested than the Gram-negative (-) bacteria. (MIC) and (MBC) obtained for the four Eos) tested were ranging from 3 to 40 l/ml. the presence of a-phellandrene (20.03-30.54%), beta-cymene (12.31-23.82%), and 4-caranol (9.77-14.27% (Dalli *et al.,* 2021).

Nigella sativa L (India) Gram-positive (+) bacteria were slightly sensitive to the Eos tested than the Gram-negative (-) bacteria, (MIC) and (MBC) obtained for the four Eos) tested were ranging from 3 to 40 l/ml, rich with 4-caranol (18.81%), beta-cymene (14.22%), a-phellandrene (10.58%), and beta-chamigrene (9.54%) (Dalli *et al.,* 2021).

Nigella sativa L (France) Gram-positive (+) bacteria were slightly sensitive to the Eos tested than the Gram-negative (-) bacteria, the low yield, rich with estragole (20.22%) and D-limonene (14.63%) (Dalli *et al.,* 2021).

Zingiber officinale, Cinnamomum verum, Trachyspermum ammi, Carum carvi bacteria inducing clonal dysbiosis *in vitro*, Indirect steam distillation (Tarhriz *et al.,* 2021).

Cuminum cyminum bacteria inducing clonal dysbiosis *in vitro*, antibiotic-resistant *Escherichia coli* strain, Semi-sensitive, Indirect steam distillation (Tarhriz *et al.,* 2021 and Alamoti *et al.,* 2022).

Mentha pulegium L against two multi-drug-resistant bacteria strains: imipenem-resistant *Acinetobacter baumannii* (IRAB S3310) and methicillin-resistant *Staphylococcus aureus* (MRSA S19). The strongest synergistic effect was observed with *M. pulegium* in association with amikacin (Ak). Analyzed by gas chromatography-flame ionization detector chromatography (GC-FID) and (GC-MS),

The chemical analysis of *M. pulegium* essential oil revealed the presence of pulegone (74.8%) and neo isomenthol (10.0%) (Bekka-Hadji *et al.,* 2022).

Artemisia herba alba against two multidrug-resistant bacteria strains: imipenem-resistant Acinetobacter baumannii (IRAB S3310) and methicillin-resistant Staphylococcus aureus *(*MRSA S19). The best effect was observed with *A. herba alba* essential oil in association with cefoxitin (CX) against MRSA S1, Analyzed by gas chromatography-flame ionization detector chromatography (GC-FID) and (GC-MS), characterized by camphor (32.0%), a-thujone (13.7%), 1,8-cineole (9.8%), beta-thujone (5.0%), bornol (3.8%), camphene (3.6%), and p-cymene (2.1%). (Bekka-Hadji *et al.,* 2022).

Zataria multiflora (Iran) antibiotic-resistant *Escherichia coli* strain, Most effective Antibacterial activity. (Alamoti *et al.,* 2022).*Mentha longifolia* (Iran) antibiotic-resistant *Escherichia coli* strain, Semi-sensitive (Alamoti, *et al.,* 2022).*Ferulago angulata* (Iran) antibiotic-resistant *Escherichia coli* strain , All strains were resistant to *Ferulago* oil (Alamoti *et al.,* 2022).*Thymus zygis L* (the region of Ifrane, Middle Atlas of Morocco) (*Acinetobacter baumannii*), Hydrodistillation, analyzed by (GC-MS), *T. zygis* EO is dominated by carvacrol (52.5%), o-cymene (23.14%), and thymol (9.68%) (Radi *et al.,* 2022).

Thymus willdenowii Boiss the region of Ifrane, Middle Atlas of Morocco against *Shigella dysenteriae* and *Salmonella Typhi* Hydrodistillation -Analyzed by (GC-MS), *T. willdenowii* contains germacrene D (16.51%), carvacrol (16.19%), and geranyl acetate (8.35%) as major compound (Radi *et al.,* 2022).

Cannabis aetheroleum Materials are French (bacteria, yeast fungi, dermatophytes). Exhibits antimicrobial properties (bacteria, yeast, fungi, dermatophytes, steam distillation of hemp panicles, harvested in full flower. derived from volatile mono- and sesquiterpenes (a-pinene, beta-pinene, 3-karen, myrcene, limonene, beta-felandrene, cis-ocymene, trans-ocymene, a-terpinene, trans-a-bergamotene, beta-caryophylene, beta-humulene, beta-farnesene, beta-selinene, selina-3.7(11)-diene and others) (Kaniewski *et al.,* 2021).

Achillea grandifolia (Serbia), eight ATCC bacterial strains and two ATCC strains of *Candida albican*, Hydrodistillation characterized by a high amount of oxygenated monoterpenes (72.7%) with 1,8-cineole (29.2%) and camphor (23.4%) being the most abundant. Sesquiterpenes were present in smaller quantities (4.8%) (Drobac *et al.,* 2021).

Ocimum basilicu against Various microorganisms, Gram negative and, Gram positive bacteria, and Yeast Steam distillation, GC/MS, DPPH, agar and disc diffusion and vapor phase methods were used to analyze the OBEO properties. The analysis of the chemical composition of OB, methyl chavicol (88.6%), 1,8-cineole (4.2%) and a-trans-bergamotene (1.7%). A strong antioxidant effect was demonstrated at the level of 77.3% (Kacaniova *et al.,* 2022).

Lippia origanoides Kunt the Carajas National Forest, Brazil against *Escherichia coli* and *Staphylococcus aureus* Obtained by hydrodistillation in a modified Clevenger-type apparatus, and their chemical composition was determined by (GC/MS) and flame ionization detection (GC/FID), The compounds identified at the highest concentrations were 1,8-cineole (35.04%), carvacrol (11.32%), p-cymene (8.53%), a-pinene (7.17%), and P-terpinene (7.16%) (Ribeiro *et al.,* 2021).

Algerian propolis: Candida albicans ATCC 10231, whereas, EOPO showed bacteriostatic effect against Escherichia coli O157:H7 and Pseudomonas aeruginosa ATCC27853 and fungistatic effect against *C. albicans* ATCC 10231. Thus, the obtained results suggest the important use of *propolis* EOs as preservative agents. Broad Terms GC/MS, cedrol (17.0%), beta-eudesmol (7.7%), and a-eudesmol (6.7%) in EO of propolis from Oum El Bouaghi (EOPO) whilst a-pinene (56.1%), cis-verbenol (6.0%), and cyclohexene,3-acetoxy-4-(1-hydroxy-1-methylethyl)-1-methyl (4.4%) in EO of propolis from Batna (EOPB). (Boulechfar *et al.*, 2021).

Argania spinosa L Northwestern Algeria Gram positive bacteria, Gram-negative bacteria, except *Pasteurella multocida* and *Klebsiella pneumoniae*. Among the 36 terpenic compounds identified, cubenol (31.02%) and 1,10-di-epi-cubenol (22.50%) were the most abundant, followed by camphor (8.22%), viridiflorol (7.10%), linalool (5.60%), and eucalyptol (5.40%) (Benabdesslem *et al.,* 2022).
Cinnamomum camphora 5 different habitats in China, 2 gram-negative bacteria and one gram-positive bacteria were assessed. GC/MS, a predominance of oxygenated monoterpenes, including linalool (42.65%-96.47%), eucalyptol (39.07%-55.35%) and camphor (26.08%) as well as monoterpene hydrocarbons such as sabinene (6.18%-12.93%) and a-terpineol (8.19%-13.81%) (Wan *et al.,* 2022).
Allium sativum, Allium ampeloprasum leaves and bulbs against *Listeria monocytogenes* and other food pathogens, four common bacterial strains responsible for food contamination *(Listeria monocytogenes, Escherichia coli, Acinetobacter baumannii,* and *Staphylococcus aureus)*(Polito *et al.,* 2022).

Vitex agnus-castus L. (Verbenaceae family) fruits, collected from two regions in Bulgaria (south-central and north-east Bulgaria) the pathogenic species *Salmonella abony, Staphylococcus aureus, and Bacillus subtilis,* but the Gram-negative bacteria *Escherichia coli* and *Pseudomonas aeruginosa* exhibited resistance to the oil.The content of proteins (5.3-7.4%), carbohydrates (73.9-78.8%), fiber (47.2-49.9%), ash (2.5-3.0%), essential oils (0.5%), and vegetable oil (3.8-5.0%) were identified in the fruits. The composition of the essential oils (EOs) of Vitex fruits from both regions was determined; the main compounds were 1,8-cineole (16.9-18.8%), a-pinene (7.2-16.6%), sabinene (6.7-14.5%), and bicyclogermacrene (7.3-9.0%) (Zhelev *et al.,* 2022).

Thymus broussonetii Boiss (Morocco) against nine bacteria species tested (*Enterococcus faecalis, Serratia fonticola, Acinetobacter baumannii, Klebsiella oxytoca,* sensitive *Klebsiella pneumoniae,* sensitive *Escherichia coli,* resistant *Escherichia coli,* resistant *Staphylococcus aureus* and *Enterobacter aerogenes)*, carvacrol (60.79%), thymol (12.9%), p-cymene (6.21%) and P-terpinene (4.47%) are the main compounds in *T. broussonnetii* essential oil (Tagnaouti *et al.,* 2022).

*Thymus capitatus (*L) (Morocco) against nine bacteria species tested (*Enterococcus faecalis, Serratia fonticola, Acinetobacter baumannii, Klebsiella oxytoca, sensitive Klebsiella pneumoniae,* sensitive *Escherichia coli,* resistant *Escherichia coli,* resistant *Staphylococcus aureus* and *Enterobacter aerogenes*), The major identified compounds of *T. capitatus* essential oil where carvacrol (75%) and p-cymene (10.58%) (Tagnaouti *et al.,* 2022).

Trichopus zeylanicus ssp against Gram-negative bacteria than Gram-positive bacteria. a-humulene (48.99%) and beta-caryophyllene (30.08%), whereas a-humulene (36.69%) and n-Hexadecanoic acid (17.41%) were the main components of the swollen part of petiole (Kala *et al.,* 2021).

Tanacetum lingulatum, the lowest IC50 (most potent radical scavenging activity) belonged to *T. ligulatum* essential oil. *Pseudomonas aeruginosa and Streptococcus pyogenes* showed resistance to *T. ligulatum* essential oil, Celevenger device, GC/MS, Camphor (Alamholo *et al.,* 2022). *Tanacetum polycephalum,* the highest sensitivity (MIC of 0.312 g mL-) was observed with *T. polycephalum* against *Bacillus subtili,* Celevenger device, GC/MS, 1,8- cineole (Alamholo *et al.,* 2022).

Origanum compactum against ATCC *Escherichia coli* and *Staphylococcus aureus.* Hydrodistillation, GC/MS, *O. compactum* essential oil were determined as carvacrol, thymol, p-cymene, and a-terpinene. Regarding *M. piperita* essential oil, menthofuran, menthol, methyl acetate, 1,8 cineole, and beta-pinene were the major compound (El-Amrani *et al.,* 2021).

Marrubium vulgare (Algeria) against a variety of pathogenic microorganisms including, *Staphylococcus aureus, Salmonella typhimurium, Escherichia coli, Bacillus subtilis, Pseudomonas aeruginosa* and *Candida albicans* showed the highest and broadest activit, Hydrodistillation, GC/MS, that major components in *M. vulgare* essential oil were beta-Bisabolene (16.50%), followed by s-Caryophylene (13.1%), a-Humulene (9.2%), E-beta-Farnesene (6.4%), germacrene (5.95%). For microbiological activity (Soltani, *et al.,* 2021).

Mentha pulegium against imipenem-resistant *Acinetobacter baumannii* (IRAB S3310) and methicillin-resistant *Staphylococcus aureus* (MRSA S1 The strongest synergistic effect was observed with *M. pulegium* in association with amikacin (AK), Hydrodistillation, GC/MS, the chemical analysis of *M. pulegium* essential oil revealed the presence of pulegone (74.8%) and neo isomenthol (10.0%) (Bekka-Hadji *et al.,* 2022).

Artemisia herba alba imipenem-resistant *Acinetobacter baumannii* (IRAB S3310) and methicillin-resistant *Staphylococcus aureus* (MRSA S1 The best effect was observed with *A. herba alba* essential oil in association with cefoxitin (CX) against MRSA S19. However, for IRAB S3310, Hydrodistillation, GC/MS. *A. herba alba* essential oil was characterized by camphor (32.0%), a-thujone (13.7%), 1,8-cineole (9.8%), beta-thujone (5.0%), born..ol (3.8%), camphene (3.6%), and p-cymene (2.1%) (Bekka-Hadji *et al.,* 2022).

Thymus zygis L. the region of Ifrane, Middle Atlas of Morocco, *T. zygis* EO showed the most powerful activity against all the studied bacteria, Hydrodistillation, GC/MS, *T. zygis* EO is dominated by carvacrol (52.5%), o-cymene (23.14%), and thymol (9.68%) (Radi *et al.,* 2022). *Thymus willdenowii Boiss* the region of Ifrane, Middle Atlas of Morocco, *T. willdenowii* recorded moderate activity when tested against *Shigella dysenteriae* and *Salmonella Typhi,* Hydrodistillation, GC/MS, the EO of *T. willdenowii* contains germacrene D (16.51%), carvacrol (16.19%), and geranyl acetate (8.35%) as major compounds. (Radi *et al.,* 2022).

Nicotiana rustica L. Borazjan city of Iran, the best antimicrobial activity on *Pseudomonas aeruginosa, Bacillus cereus, E. coli,* and *Staphylococcus aureus.* The results of antimicrobial assays indicated that the most of examined microorganisms have been affected in low concentration, hydro -distillation using Clevenger type apparatus during 3 hours after that Qualitative and composition of the oil was determined by GC-MS, the results obtained showed the presence of 28 components, in the oil with the highest content of Myristicin (32.75%) and ar-Turmerone (5.71%) (Fard *et al.,* 2021).

Stahlianthus thorelii Gagnep. (Zingiberaceae). China, Thailand, India, and Vietnam against the Gram (+) bacteria *Bacillus subtilis, Staphylococcus aureus*, and the fungus *Aspergillus niger*. While the oil obtained from leaves at MIC 200 g/ml showed inhibitory activity against B. subtilis, GC/MS, as a complex of monoterpene fractions (14.2%/9.4%) and mainly sesquiterpenes (60.0%/63.9%) respectively. The most abundant sesquiterpenes in rhizomes were found to be a-copaene (32.2%) and (-)-allo-aromadendrene (11.3%) while these compounds in leaves were identified only as 5.0% and 5.3%, respectively (Nguyen Hoang Tuan *et al.,* 2021).

Litsea cubeba North Vietnam , *Escherichia coli* , changes in cell morphology, loss of integrity and permeability of the cell membrane, as well as DNA loss, 1,8-cineole or linalool. Linalool-type EOs were more effective against the eight bacterial strains tested than 1,8-cineole-type. Oil samples, LC19 (50% 1,8-cineole) and BV 27 (94% linalool). (Alamoti *et al.,* 2022). *Thymbra capitata* against methicillin-resistan*t Staphylococcus aureu* reducing cellular metabolism and cellular culturability (Almeida *et al.,* 2022).

Rhizomes and leaves of *Alpinia conchigera* the rhizome oil possessed moderate inhibitory activity against all tested bacteria and fungi, whereas leaf EO inhibited only Gram-positive bacteria. its chemical composition, antioxidant, and anti-microbial activities analyzed by using GC and GC-M,The major compound of the rhizome EO was eucalyptol (60.58%), whereas the most abundant compound in the leaf EO was beta-bisabolene (46.70%). The rhizome EO contained the most abundant polyphenolic compounds that possessed higher antioxidant activities compared to leaf EO and the reference antioxidant agent butylated hydroxytoluene (BHT). In addition, there exist a positive correlation between total phenolic content and antioxidant activities using DPPH ($R2= 0.7634$, $p < 0.05$) and beta-carotene antioxidant activity ($R2 = 0.6865$, $p < 0.05$) (Faridah Qamaruz Zaman *et al.,* 2021).

Myrica Gale, a neglected non-wood forest product. Fruit samples from natural (Western Lithuania) and anthropogenic (Eastern Lithuania) *M. gale* populations were studied separately against the selected pathogenic bacteria (*Staphylococcus aureus, Escherichia coli, Acinetobacter baumannii),* yeasts *(Candida albicans, C. parapsilosis),* fungi *(Aspergillus fumigatus, A. flavus)* and dermatophytes *(Trichophyton rubrum, T. mentagrophytes)* the antimicrobial study *in vitro* indicated that *C. parapsilosis,* dermatophytes and Aspergillus fungi were more susceptible to fruit essential oils of *M. gale*, whereas *E. coli and C. albicans* were weakly inhibited even at the highest essential oil concentration. The strongest growth-inhibitory and bactericidal effect of sweet gale essential oil was established on *S. aureus.* Essential oils were isolated from dried fruits by hydrodistillation and analyzed by GC/FID and GC/MS methods; enantiomeric composition of a-pinene was established by chiral-phase capillary GC (Loziene *et al.,* 2020).

Coridothymus capitatus L. against Bacteria and fungi, Standard methods were performed to evaluate the susceptibility of some Gram-positive and Gram-negative bacteria, and *Candida spp*. to the hydrolate, in comparison with its EO. GC-MS, identified 0.14% (v/v) of total EO content into hydrolate and carvacrol as a dominant component (Marino *et al.,* 2020).

Citrus paradisi peel Algeria against the tested bacteria (*Escherichia coli, Pseudomonas aeruginosa, and Staphylococcus aureus)* and the yeast (*Candida albicans*) against the tested bacteria (*Escherichia coli, Pseudomonas aeruginosa,* and *Staphylococcus aureus*) and the yeast (*Candida albicans)*, with an inhibition zone ranging from 4 to 20 mm. Both essential oils showed no effect against *Aspergillus niger, Verticillium sp* and *Thielaviopsis sp.* The insecticidal activity was investigated against adults *ceratitis capitata* microwave-assisted hydro-distillation (MAHD) and hydrodistillation (HD) techniques from the peel of grapefruit (*Citrus paradisi.* L) from Algeria was analyzed by gas chromatography-flame ionization detector (GC-FID) and gas chromatography/mass spectrometry (GC/MS), The main constituents were limonene (85.54%-87.51%) for MAHD and HD, beta-myrcene (2.99%-3.24%), nootkatone (1.78%-1.80%) (Nour El Houda *et al.,* 2020).

Cupressus semperviren obtained from Dhana Natural Reserve, Al-Tafilah, Jordan *Bacillus subtili, Micrococcus luteus, Staphylococcus epidermidis, Staphylococcus aureus, Escherichia coli* and *Enterobacter aerogene, Pseudomonas aeruginosa, M. luteus, Klebsiella pneumonia, Salmonella typh,* the growth inhibition of *Bacillus subtilis, Micrococcus luteus, Staphylococcus epidermidis and Staphylococcus aureus* and producing inhibition zone ranges between 12-15 mm. The MIC values recorded by essential oils of *C. sempervirens* were as follow: *S. epidermidis* and *S. aureus* (370g/mL), *Escherichia coli and Enterobacter aerogenes* (1000..g/mL), *Pseudomonas aeruginosa* (2000g/mL) and *M. luteus, Klebsiella pneumonia and Salmonella typhi* (3000g/mL. The procuring of essential oil was made by processing of dry leaves of *C. sempervirens* using steam-distillation method giving 0.26% (w/w) yield. The analysis of obtained EO for its chemical constituents, was achieved by GC-MS. The equivalent of 94.02% of the entire EO has been extracted and consists of twenty-two compounds. The characterization of EO was made by their presence of three groups of chemical compounds namely Sesquiterpene hydrocarbons (71.0%), Oxygenated sesquiterpenes (11.5%) and Monoterpenes hydrocarbons (10.6%). The major constituent was germacrene-D (14.2%) along with the d-cadinene (11.0%), pinene (10.0%) and isocedrol (9.8%) (Qaralleh *et al.,* 2021).

Atropa belladonna L. (Turkey) against the mold-yeast and gram-positive and gram-negative bacteria microorganisms among the 17 bacteria and 6 yeast-mold types used in the study, the hydrodistillation method in a Clevenger type device. The chemical composition of volatile oils was determined by analyzing with the GC-MS/MS instruments., (43.75%) aldehydes in leaves and as (39.96%) fatty acids in flowers. In addition, the main constituents found in volatile oils were eicosane (35.92%) in the leaves and hexadecenoic acid (18.84%) in the flowers of the *A. belladonna* (Fidan *et al.,* 2021).

Melissa officinalis (Algeria) The essential oil presented high antimicrobial activity against microorganisms, mainly five human pathogenic bacteria, one yeast, *Candida albicans*, and two phytopathogenic fungi, hydrodistillation (HD) using a Clevenger-type apparatus of dry leaves of *M. officinalis* and was analyzed by two techniques, gas chromatography coupled with flame ionization (GC-FID) and (GC-MS). Eighteen minerals comprising both macro- and microelements (As, Br, K, La, Na, Sb, Sm, Ba, Ca, Ce, Co, Cr, Cs, Fe, Rb, Sc, Th, and Zn) were determined using neutron activation analysis technique for the first time from Algerian *Melissa officinalis* plant. Seventy-eight compounds were identified in the essential oil, representing 94.090% of the total oil and the yields were 0.470%. The major component was geranial (45.060%). Other predominant components were neral (31.720%) and citronellal (6.420%) (Fahima Abdellatif *et al.,* 2021).

Mentha longifolia collected from different regions of Lorestan province (Khorramabad, Aleshtar, Delfan against three certain bacterial strains *(Pseudomonas aeruginosa, Staphylococcus aureus, Escherichia coli),* GC-MS analysis revealed that essential oil of *M. longifolia* from Khorramabad region was constituted by pulegone (54.41%) and 1, 8-cineole (22.05%) as a major component. *M. longifolia* from Aleshtarwas rich in piperitenone (29.29%), pulegone (17.53%), piperitenone oxide (14.35%), 1, 8-cineole (14.34%) and the main component of *M. longifolia* from Delfanwas citronellyl acetate (59.93%), aromadren (5.1%) (Afkar *et al.,* 2021).

Eucalyptus accedens , Eucalyptus punctata, Eucalyptus robusta, Eucalyptus bosistoana, Eucalyptus cladocalyx, Eucalyptus lesouef, Eucalyptus melliodora, Eucalyptus wando (Syria) against three bacterial isolates (*Haemophilus influenzae,Haemophilus parainfluenzae,* and *Klebsiella pneumoniae*) and three reference bacteria strains (*Alamoti aeruginosa,* ATCC 9027; *Staphylococcus aureus*, ATCC 6538; and *Escherichia coli*, ATCC 8739), Hydrodistillation, GC (RI) and GC/MS, 1,8-cineole was the most abundant component found, followed by a-pinene, p-cymene, and globulol (Ameur, *et al.,* 2021).

Citrus spp fruits, BIOLL+(R), a commercial extract (for some *Brachyspira hyodysenteriae* strains For various *Salmonella enterica* and *Escherichia coli* strains. Strong activities with (MIC) ranging from 10 ppm (for some *Brachyspira hyodysenteriae* strains) to 80 ppm (for various *Salmonella enterica* and *Escherichia coli* strains) were observed. Membrane integrity tests and Fourier transform infrared (FT-IR) spectroscopic analyses were performed to shed light on the effects caused on molecular structure and composition. Physical effects, with formation of pores and leakage of intracellular components, and chemical effects, which were dependent on the bacterial species, were evident on cellular envelopes. Whereas for *S. enterica* and *E. coli*, changes were focused on the carboxylic group of membrane fatty acids, for *B. hyodysenteriae*, the main effects were found in polysaccharides and carbohydrates of the cell wall. The great antibacterial activity shown by BIOLL+(R) and its proposed dual physico-chemical mode of action, with species-specific cellular targets (Carvajal *et al.,* 2013).

The treatment of infectious diseases some bacteria resist the used antibiotics such as MERS, VERS *Staphylococcus*, and linezolid resistant *Enterobacter*. On the other hand, antibiotics have some lethal effects on the patients. In contrast some natural products as essential oils have an antimicrobial effect on microorganisms, and have no side effect on the patients. For example, *Lyme, clove, oregano, pepper oil a bergamot.* The mechanism of action of oil on the bacterial cells are exhibited in disturbed membrane integrity, cell wall structure and composition, cytoplasmic and nucleus Denaturation (Quirino *et al.,* 2022).

The effect of essential oils in inter for with cell wall rigidity, structure, and function that leach destruction of cell wall and the bacterial cell lose the protection and rupture under the effect of osmotic pressure. Also the ingredients of essential oils as phenolic substances, polyphenols, fatty acids, eugenol, ergosterols, steroids reacts with the wall peptidoglycan, Carbohydrates, polysaccharides, Proteins, teichoic acid, Lipoteichoic acid, and increase the porosity of the cell wall that allows the passage of macromolecules. it, in turn, reacts with the cytoplasm and nucleus. After the disruption and disconfiguration of the cell wall, the essential oil components as pinene, beta- pinene, 3- keren, myrcene, beta felandreme, cis-ocymeme, trans-ocymene, a-terpinene, trans-a-bergamotene, beta-caryophylene, beta-humulene, beta-farnesene, beta-selinene and others interfere with plasma membrane, cytoplasm, and nucleus where, these components alter the function of the plasma membrane, interfere with it's osmotic power, in and out diffusion of materials, locations of enzymes and organelles as Ribosomes, energy production from food at mitochondria and pigments of some bacteria which carry the process of photosynthesis, moreover the essential oil component react with bacterial Capsule polysaccharides(Saleh . 1997).

Moreover, the bacterial chromosome DNA and plasmid may be affected by the component of the essential oils interacting with purines and pyrimidines bases causing spontaneous and induced Mutation of bacterial cells.

5. Conclusion

The study has shown that some essential oils have an antimicrobial spectrum including Gram positive, gram negative bacteria and fungi such as *Ocimum basilicum*. Others such as *Myrica gale* acts as a bactericidal agent for bacteria such as Staphylococcus *aureus, Escherichia coli*, *acinetobacter baumannii* . There are many essential oils as *Matricaria recutita* L, *Zygophyllum eichwaldii, Salvia hydrangea, Hedyosmum racemosum, Chaerophyllum bulbosum, Brocchia cinerea, Marrubium vulgare* L*., Pinus halepensis Mill., P. pinaster Aiton. and P. pinea L., Protium heptaphyllum, Elettaria cardamomum, Laurus nobilis, Piper boehmeria folium, Stachys pilifera Benth, Hertia cheirifolia L, Zanthoxylum chalybeum, Citrus aurantium L., Murraya koenigii, Etlingera pavieana, Dittrichia viscosa,Thymus daenensis, Thymus eriocalyx, Rosmarinus officinalis L., Aloe debrana, Laurus nobilis L., Lepidium sativum L., Ziziphora spp, Helichrysum italicum, Juniperus communis L., Inula viscosa, Houttuynia cordata* and *Persicaria odorata* . For further studies alone or mixed to detect the synergistic or antagonistic effects of these mixtures on pathogenic microorganisms.

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