ABSTRACT

Key words: Olive, Basil, Antimicrobial, GC-MS, HPLC

Objectives: To evaluate the antimicrobial activity of extracts of olive leaves from Sinai and basil leaves from Iran against some selected pathogenic bacterial and fungal strains and to analyze both extracts to prove the active components responsible for their antimicrobial activity. Methodology: Methanolic/chloroform extract of olive and methanolic extract of basil leaves were prepared and their antimicrobial activities were tested against 5 types of pathogenic bacteria; Staphylococcus aureus, Staphylococcus epidermidis, Escherichia coli, Pseudomonas aeruginosa, and Klebsiella and one type of fungus, Candida spp. using agar well-diffusion method. HPLC was done for analysis of phenolic compounds and GC-MS was done for analysis of volatile compounds. Results: Antimicrobial activity of basil extract was stronger than that of olive. HPLC showed that the main phenolic compounds were olerpein for olive and rosmarinic acid for basil. GC-MS showed the major peak for olive was triterpene and that for basil was Linalool. Conclusion: Basil has stronger antimicrobial activity than olive. It varies with different strains being the best against S. aureus, Pseudomonas and candida. Phenolic compounds mainly olerpein for olive and rosmarinic acid for basil and caffeic acid in both had antimicrobial activity. In vivo study is recommended.

INTRODUCTION

In recent times, there have been increases in antibiotic resistant strains of clinically important pathogens, which have led to the emergence of new bacterial strains that are multi-resistant. The non availability and high cost of new generation antibiotics with limited effective span has led to the search for more effective antimicrobial agents among materials of Africa, Northern Iraq and Iran. Throughout the history of civilization, the olive plant has been an important source of nutrition and medicine. The first formal report of medicinal use was made in 1854, when olive leaf extract was reported to be effective in treating fever and malaria, it contains compounds with potent antimicrobial activities against bacteria, fungi, and mycoplasma the antimicrobial properties of phenolic compounds in olive products refer to compounds obtained from olive fruit, particularly hydroxytyrosol and olerpein. The leaves are rich in polyphenols, namely olerpein, tyrosol, hydroxytyrosol, rutin, verbascoside, apigenin-7-glucoside and luteolin-7-glucoside. Polyphenols are responsible for the functional properties especially antimicrobial activity. Olerpein is the most abundant compound in HPLC chromatogram of phenolics in the chloroform/methanol extract of olive leaves. The olerpein is an important constituent in the leaf and fruit extracts and present in higher concentration in the leaves than in the fruits and other parts of the plant. The maximum antimicrobial activities were found for the methanolic extracts, this might be due to the good extraction efficacy of methanol compared to other solvents, the second and third effective solvents were ethanol and water. Olive leaves essential oils are rich with antimicrobial component, particularly Docosane and triterpene.
Common basil or sweet basil (Ocimum basilicum L.), a member of the Lamiaceae family is an annual herb which grows in several regions around the world. Basil is native of Iran and commonly grows in Azerbaijan provinces. Sweet basil is a multi-purpose medicinal herb commonly used in folk medicines to treat different diseases like upper respiratory tract infections, diarrhea, headache, opthalmic, skin disease, pneumonia, cough, fever and conjunctivitis. Volatile oil of Ocimum basilicum contained mostly monoterpinol, particularly L-linalool and it is probably responsible for its reported antimicrobial action. Basil is rich with phenolic compounds, and the major phenolics are rosmarinic, gallic, protocatechuic, caffeic acids. The phenolic acids reported to have antimicrobial activity. The methanol extract of O. basilicum has a stronger and broader spectrum of antimicrobial activities compared to other solvents such as water and ethanol.

The aim of this study was to evaluate the antimicrobial activity of Methanolic/chloroform extract of olive and methanolic extract of basil leaves against some selected pathogenic bacterial and fungal strains and to analyze both extracts to prove the active components responsible for their antimicrobial activity.

**METHODOLOGY**

1- **Preparation of plant extracts**: Leaves of Olea europaea L. were collected from the region of Sinai. The leaves were dried at room temperature and then powdered (30g). The powder was extracted successively with (150ml) chloroform and (150ml) methanol by maceration at room temperature for 24 hours, and then it was filtered. The extract was concentrated using Rotary evaporator according to Mahjoub et al. Leaves of Ocimum basilicum from Iran were dried at 70°C for 2 days in an electric oven. Dried powder leaves were pulverized into fine powder form using a grinder. The methanolic extract was prepared by using 10 g of leaf powder extracting with 200 ml of methanol. The methanolic extract was concentrated using Rotatory evaporator according to Khan et al.

2- **Preparation of the test microorganisms**

Staphylococcus aureus, Staphylococcus epidermidis, Escherichia coli, Pseudomonas aeruginosa, Klebsiella and Candida spp. Ten strains for each were obtained from Research Institute of Ophthalmology and Kasr-El Aini, and were identified by Gram stains, cultural characteristics and specific biochemical tests for each species according to Cheesbrough. Then a loopful of the test organisms were inoculated into 5.0ml of nutrient broth and incubated at 37°C for 24 hours. 0.2ml from the 24 hours culture organism was dispensed into 19.8ml sterile nutrient broth and incubated for 3-5 hours to standardize the culture to 10⁶cfu/ml according to Abalaka et al.

3- **Screening of extract for antimicrobial activity** by agar well diffusion method as described by Rahbar and Diba for the extracts and disc diffusion method for discs immersed in the extracts. For every microbial strain two plates were inoculated with the standardized broth culture (10⁶cfu/ml) using sterile cotton swab to be evenly spread onto the surface of nutrient agar plates for bacteria and Sabouraud's dextrose agar for Candida. Using sterile cork borer 6 mm diameter to punch 2 wells in the first plate for olive extract (3 drops), basil extract (3 drops) and one well in the second plate for combination of both extracts (3 drops), positive control disc was placed onto the agar surface of the first plate and also applied to the second plate but after its immersing into the combined extracts. The antibacterial +ve control used was imipenem disc and the antifungal +ve control was fluconazole disc. The plates were put in the incubator for 24 hours and the inhibition zones around the wells and discs were measured to evaluate the antimicrobial activity in comparison with the antibacterial or antifungal controls (Figure 1).

4- **High performance liquid chromatography** (HPLC) analysis: was performed at National Product Center (NPC), Pharmacognosy Department, Faculty of Pharmacy, Cairo University. Basil & olive leaves (500mg) were separately extracted with 70% methanol 15ml, HPLC grade using ultrasonic bath for 15 min; the volume was completed to 25ml with 70% methanol according to Wang et al.

5- **Verification of the antimicrobial activity of some phenolic compounds present in olive and basil leaves**: Methanolic phenolic compounds of oleuropein, rosmarinic acid, ferulic acid, protocatechuic acid, caffeic acid and rutin were prepared and sterilized discs were immersed in each phenolic compound and left to evaporate methanol. These discs with concentration 3mg/5ml were placed onto the surface of inoculated plates with the selected bacterial and fungal strains to determine the effective compounds against each microorganism.

6- **Gas chromatography and mass spectrometry** (GC-MS) analysis: was made at (National Reasearch Center, Giza) to extract volatile compounds. Extraction using diethyl ether (1:10 w/v) for three times 15 minutes each time with the assistance of ultrasonic. The obtained turbid solution was filtrated and the solvent of filtrate was removed by Rotary evaporation under reduced pressure. Then the extract was diluted with 1ml of anhydrous ethyl alcohol: hexane (1:1 v/v) and was filtered through 0.22μm membrane filter. 1μl of...
The subsequent filtrate was injected to GC/MS for analysis according to Xie et al. 18.

RESULTS

The results represented in (table 1) and (figure 1) showed more resistant strains with olive than with basil. The combination of both extracts had better antimicrobial activity in treating resistant strains than olive extract alone. Also lesser resistant strains were obtained when the antimicrobial discs were immersed into the combination mixture. However the best results were obtained with basil extract alone indicating stronger antimicrobial activity of basil than that of olive.

Table 1: Antimicrobial activity of olive and basil leaf extracts against selected bacterial and fungal strains in the Lab of Research Institute of Ophthalmology.

<table>
<thead>
<tr>
<th>Microorganism</th>
<th>Olive (o)</th>
<th>Basil (B)</th>
<th>Olive+basil (O+B)</th>
<th>Antimicrobial control</th>
<th>Antimicrobial control+(O+B)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Staphylococcus aureus</strong></td>
<td>11-30.3</td>
<td>13.6-32</td>
<td>10.3-33</td>
<td>15-32.6</td>
<td>14-35</td>
</tr>
<tr>
<td>Mean level in mm</td>
<td>5</td>
<td>-</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>No.of resistant strain</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Staphylococcus epidermidis</strong></td>
<td>24</td>
<td>9-25</td>
<td>12-20</td>
<td>5-40</td>
<td>21-43</td>
</tr>
<tr>
<td>Mean level</td>
<td>9</td>
<td>2</td>
<td>5</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>No.of resistant strain</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>E.coli</strong></td>
<td>13-20</td>
<td>6-26</td>
<td>11-24.6</td>
<td>13-32</td>
<td>12-32</td>
</tr>
<tr>
<td>Mean level</td>
<td>6</td>
<td>2</td>
<td>5</td>
<td>1</td>
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<tr>
<td>No.of resistant strain</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Pseudomonas aeruginosa</strong></td>
<td>13-26</td>
<td>12-30</td>
<td>14-27</td>
<td>8-36</td>
<td>9-36</td>
</tr>
<tr>
<td>Mean level</td>
<td>3</td>
<td>-</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>No.of resistant strain</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Klebsiella spp</strong></td>
<td>11-18</td>
<td>11-23</td>
<td>12-19</td>
<td>15-25</td>
<td>9-23</td>
</tr>
<tr>
<td>Mean level</td>
<td>7</td>
<td>3</td>
<td>7</td>
<td>6</td>
<td>4</td>
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<tr>
<td>No.of resistant strain</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td><strong>Candida spp</strong></td>
<td>12-23</td>
<td>12-22</td>
<td>12-25</td>
<td>16-25</td>
<td>15-28</td>
</tr>
<tr>
<td>Mean level</td>
<td>4</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>No.of resistant strain</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Fig. 1: Antimicrobial activity (a) olive extract (left well), basil extract (right), and imipenem disc (down) against *Staphylococcus aureus*. (b) combination of two extracts (left) and combination of two extracts with imipenem disc (right) against *Staphylococcus aureus*. (c) olive extract (left), basil extract (right), and imipenem disc (down) against *Staphylococcus epidermidis*. (d) combination of two extracts (left) and combination of two extracts with imipenem disc (right) against *Staphylococcus epidermidis*. (e) olive extract (left), basil extract (right), and imipenem disc (down) against *E.coli*. (f) combination of two extracts (left) and combination of two extracts with imipenem disc (right) against *E.coli*. (g) olive extract (right), basil extract (left), and imipenem disc (down) against *Klebsiella*. (h) showed combination of two extracts (left) and combination of two extracts with imipenem disc (right) against *Klebsiella*. (i) olive extract (right), basil extract (left), and imipenem disc (down) against *Pseudomonas aeruginosa*. (j) combination of two extracts (left) and combination of two extracts with imipenem disc (right) against *Pseudomonas aeruginosa*. (k) olive extract (right), basil extract (left), and imipenem disc (down) against *Candida*. (l) combination of two extracts (left) and combination of two extracts with fluconazole disc (right) against *Candida*. 
HPLC results of *Ocimum basilicum* and *Olea europaea* leaves:

In this study, the methanolic/chloroform extract of olive leaf (*Olea europaea*) has been investigated by HPLC-UV (280 nm). Among the identified phenolic compounds were; gallic, caffeic, p-coumaric, ferulic acids, luteolin-7-glucoside and rutin flavonoid glycoside. Protocatechuic, chlorogenic acid and rosmarinic acid were absent (table 2). The methanolic extract of *Ocimum basilicum* has been investigated by HPLC-UV (280 nm). Among the identified phenolic compounds were; gallic, caffeic, protocatechuic, p-coumaric, rosmarinic acids and rutin flavonoid glycoside. Ferulic, chlorogenic acid and luteolin-7-glucoside were absent (table 2). The HPLC chromatograms for olive and basil samples with standard phenolics are shown in (Figure 2).

<table>
<thead>
<tr>
<th>Name of phenolic</th>
<th>Rt</th>
<th>Conc mg/100g leaf powder</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Olea europaea</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gallic acid</td>
<td>1.865</td>
<td>99.7</td>
</tr>
<tr>
<td>Caffeic acid</td>
<td>4.24</td>
<td>44.7</td>
</tr>
<tr>
<td>Rutin</td>
<td>5.957</td>
<td>350</td>
</tr>
<tr>
<td>P-coumaric acid</td>
<td>6.612</td>
<td>49.7</td>
</tr>
<tr>
<td>Luteolin-7-glucoside</td>
<td>6.884</td>
<td>identification</td>
</tr>
<tr>
<td>Ferulic acid</td>
<td>7.898</td>
<td>57.3</td>
</tr>
<tr>
<td>Oleuropein</td>
<td>11.024</td>
<td>6444</td>
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<tr>
<td>Gallic acid</td>
<td>1.84</td>
<td>101.5</td>
</tr>
<tr>
<td>Protocatechuic acid</td>
<td>2.43</td>
<td>190.5</td>
</tr>
<tr>
<td>Caffeic acid</td>
<td>4.20</td>
<td>57.0</td>
</tr>
<tr>
<td>Rutin</td>
<td>6.04</td>
<td>420.0</td>
</tr>
<tr>
<td>p-coumaric acid</td>
<td>6.66</td>
<td>193.5</td>
</tr>
<tr>
<td>Rosmarinic acid</td>
<td>10.53</td>
<td>620.0</td>
</tr>
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</table>

Table 2: Phenolic compounds of *Olea europaea*, and *Ocimum basilicum* with their retention times

Results of the antimicrobial activity of six identified phenolic standards against the isolated microorganisms showed variations against different isolated microorganisms; *Staphylococcus aureus* was inhibited by oleuropein, rosmarinic acid, and caffeic acid but was not affected by the other phenolic compounds while *Pseudomonas* and *Candida tropicalis* were inhibited by all phenolic compounds (figure 3).

Fig. 2: Chromatogram of phenolic compounds of *Olea europaea* leaves and *Ocimum basilicum*

Fig. 3: The antimicrobial activity of six identified phenolic standards against *Staphylococcus aureus*, *Klebsiella*, *Pseudomonas* and *Candida*. (1) Oleuropein (2) Rosmarinic acid (3) Ferulic acid (4) protocatechuic acid (5) Caffeic acid (6) Rutin.
Results of GC-MS analysis of *Olea europaea* leaves and *Ocimum basilicum*:

For olive, at retention time 50.16 that is the major peak, the compound is squalene with molecular weight is 410 and molecular formula is C_{30}H_{50}. This compound is volatile oil triterpene (Figure 4). For basil, at retention time 15.21 that is the major peak, the compound is linalool, which is volatile oil (Monoterpinol) has molecular weight 154 and molecular formula C_{10}H_{18}O (Figure 5).

**DISCUSSION**

Our results showed more resistant strains with olive than with basil indicating stronger antimicrobial activity of basil than that of olive. However antimicrobial activity of basil was best shown with *S. aureus* and *Pseudomonas* as no resistant strains then with *candida* as only one resistant strain while two strains out of ten for each *S. epidermidis* and *E. coli*. Meanwhile *Klebsiella* had three resistant strains to basil.

Sudjana and his coauthors in their study to investigate the activity of a commercial extract derived from the olive leaves of *Olea europaea* against a wide range of microorganisms. Using agar dilution and broth microdilution techniques, olive leaf extract was found to be most active against *Campylobacter jejuni*, *Helicobacter pylori* and *Staphylococcus aureus* including meticillin-resistant *S. aureus* (MRSA) They concluded that olive leaf extract was not broad-spectrum in action, showing appreciable activity only against *H. pylori*, *C. jejunii*, *S. aureus* and MRSA. They reported given this specific activity, olive leaf extract may have a role in regulating the composition of the gastric flora by selectively reducing levels of *H. pylori* and *C. jejunii*.

Hussain et al. in their study found that the antibacterial activity of olive leaf extract was higher for...
the gram negative strains as compared to gram positive strains.

Many differences in the papers of the literature including differences of methodologies of evaluating the antimicrobial properties, and also differences in herbal contents and compositions from different geographical regions, makes it difficult and even impossible comparing the studies on the antimicrobial activities of *O. basilicum* 24, in their study reported better activity of essential oil of *O. basilicum* on Gram-negative germs than Gram-positive ones.

They explained that the differences in the plant compounds and the extracting methods may affect the antimicrobial activities. It is due to the physiological differences of the different stages of its growth; hence this affects the composition and extraction content of the final essential oil. Additionally, the environmental factors, including day length, light intensity and ambient temperature influence on the quantity and quality of the essential oil content and eventually will affect the medicinal properties of the plants.

Khalil 21 used ethanolic extract of *O. basilicum* leaves from Saudi Arabia against two pathogenic bacteria *S. aures* and *E. coli*, He also found that the antimicrobial activity was stronger with the Gram negative bacteria *E. coli* than the gram positive *S. aures*.

While different results was obtained by Hamdan et al.22 who their work included a study of the mechanism of the impact of essential oil of *O. basilicum* on the bacterial cell wall their results indicated that all Gram positive bacteria were more sensitive than Gram negative bacteria. They explained Gram-negative bacterial cell wall has an outer membrane acting as a barrier also contain a high level of lipid materials which restricts the diffusion of hydrophobic compounds through its lipopolysaccharide covering.

In the present study the antimicrobial activity of olive was the best when the commercial antimicrobial discs whether the imipenem or the fluconazole were immersed into the combination mixture of the olive and basil leaf extracts. This is in accordance with Aboulmajd et al.23 who reported that the combined effect of imipenem and green tea extract was significantly synergistic against MRSA. Alshami and Alharbi, 23 also found that the interaction between hibiscus extract and the traditional antifungal agent against fluconazole-resistant *Candida albicans* isolates showed a high level of synergistic effect in vitro. Júnior et al. 24 also found that the combination of fluconazole with an extract of *Luehea paniculata* a tree of multiple medicinal can be an alternative way of minimizing side effects of the antibiotic, since it leads to a significant synergistic effect, thus reducing the dose which is necessary for its therapeutic use.

In the present study the analysis of phenolic compounds by HPLC showed that the main phenolic compounds were oleuropein for olive and rosmarinic acid for basil. Oleuropein in olive and rosmarinic acid in basil and caffeeic acid in both had antimicrobial activity towards most isolates.

Oleuropein has been shown to have strong antimicrobial activity against both Gram-negative and Gram-positive bacteria Different authors have used biophysical assays to study the interaction between oleuropein and membrane lipids however, the exact mechanism of the antimicrobial activity of oleuropein is still not completely established, although some authors have proposed that it is due to the presence of the ortho-diphenolic system (catechol) others proposed that the glycoside group modifies the ability to penetrate the cell membrane and get to the target site. Effective interference with the production procedures of certain amino acids necessary for the growth of specific microorganisms. Another mechanism proposed is the direct stimulation of phagocytosis as a response of the immune system to microbes of all types.25

Our results agree with Erdohan and Turhan 4 where Oleuropein was the most abundant compound in HPLC chromatogram of phenolics in the chloroform/methanol extract of olive leaves in their study they reported that the choice of solvents used in extracts, cultivars of olives, crop origin, harvesting time and climate may all change the leaf composition, which could influence antibacterial activities of extracts.

Karygianni et al. 26 in their study to examine the antimicrobial activity of natural plant and fruit extracts of Mediterranean origin against various microbial species. more specifically five different extracts from olive leaves were screened against a panel of nine relevant pathogenic microorganisms, which constitute typical residents of the oral microflora, including one strain of *Candida albicans*. Additionally, *Staphylococcus aureus* and *Escherichia coli*, normally a part of skin and intestinal flora, served as reference bacterial strains. The qualitative and quantitative determination of the tested extracts was performed in a HPLC system and the obtained extract contained 60% oleuropein.

Earlier workers 27 have observed that caffeeic acid and rosmarinic acid have strong antibacterial activity against Gram positive bacteria and partial inhibition of Gram negative bacteria as the liposaccharide of Gram negative bacteria might be imperable to the polar phenolic acids. It has been postulated that the antibacterial properties of rosmarinic acid is due to nucleoid damage with an increase in spatial division and condensation of genetic material and the antifungal activity of polyphenolic compounds might be due to the formation of multinucleate stage by the breakage of interna and condensation of genetic material and the antifungal activity of polyphenolic compounds might be due to the formation of multinucleate stage by the breakage of interspata in mycelum and cell surface damage by pilferage.

Guzman et al. 28 in their study reported antibacterial and antifungal activity of some phenolics when tested against bacterial and fungal reference strains they
reported antibacterial activity of rosmarinic acid against
*Staphylococcus aureus*, *S. epidermidis*, *Pseudomonas* and *E. coli*. Caffeic acid and methyl caffeate had antimicrobial activity to *C. albicans*, *S. aureus* and *E. coli* and ferulate ester against *C. albicans*, *S. aureus*, *E. coli* and *K. pneumoniae*.

Regarding GC-MS results for olive showed the major peak was for the compound triterpene and that for basil was for the compound Linalool. Recent study by Hashmi et al. about the phytochemistry and pharmacology of olive (olea europaea) and its uses reported the isolation from ethyl acetate soluble fraction of O. europaea leaves yielded different triterpenoids. Volatile fractions from fresh and dried leaves of three Tunisian olive cultivators were subjected to GC-MS analysis and their antibacterial and antifungal activities were evaluated. They reported that all fractions showed significant antibacterial and antifungal activities, although there were differences in the responses of different cultivators to the microorganisms because of variability of the composition

Jesus et al. in their study reported triterpenoids are the most representative group of phytochemicals but due to their low hydrophilicity, triterpenes were considered to be inactive for a long period of time; however, evidence regarding their wide range of pharmacological activities is emerging, and elegant studies have highlighted these activities. Several triterpenic skeletons have been described, including some that have presented with pentacyclic features, such as oleanolic and ursolic acids. These compounds have displayed incontestable biological activity, such as antibacterial, antiviral, and antiprotozoal effects.

The compositional analysis of the essential oil of sweet basil has revealed a comprehensive diversity in the oil components and the different chemo varieties have been reported from various regions of the world, in their study of the essential oil of cultivated *O. basilicum* L. plant from Northwest Iran oxygenated monoterpenes were found to be the major components of the essential oil they are characterized by the presence of high amounts of menthone, estragol, isomenthol, menthol, pulegone and linalool. The results showed substantial chemical profile differences between their study and previous study also from Iran where methyl chavicol and linalool were the principle components of basil oil.

Hassanpouraghdam et al. in their study cited four chemotypes four chemotypes of estragol, linalool / estragol, methyl eugenol and methyl eugenol (E)-anethol from Togo. Seven chemotypes with major components greater than 50% namely methyl chavicol, linalool, geraniol, linalool / methyl cinnamate, linalool / geraniol, methyl cinnamate / linalool and eugenol / linalool, were characterized from Sudan. Linalool, linalool / eugenol, methyl chavicol, methyl chavicol / linalool, methyl eugenol / linalool, methyl cinnamate / linalool and bergamotene have been reported as the major chemotypes of *O. basilicum* from Mississippi, USA. Italian cultivars of sweet basil were categorized in three chemotypes of linalool, linalool / methyl chavicol and linalool / eugenol. Methyl eugenol and α-cubebene were reported as the main components of sweet basil oil from Turkey. Meanwhile, linalool, (Z) cinnamic acid methyl ester, estragol, eugenol, 1,8-cineole, bergamotene, methyl cinnamate, α-cadinol and limonene have been listed as major and predominant constituents of sweet basil oil from China, Croatia, Israel, Republic of Guinea, Nigeria, Egypt, Pakistan and Malaysia.

Khair-ul-Bariyah et al. proved the antimicrobial activity of the essential oil of *O. basilicum* against bacterial strains *S.aureus*, *E. coli*, *P. aeruginosa* and the yeast *Candida albicans*. Among other Ocimum species the oil of *O. basilicum* showed best MIC against *C. albicans*.

In a study made by Unnithan et al. GC-MS revealed the major compounds of the oil from *Ocimum basilicum* L, from Ethiopia are p-copaene, p-menth-2-en-1-ol, eugenylacetate, bornyl acetate, α-himachalene, rosfiolol and α-cubebene showed significant antibacterial activity against Gram positive (*Staphylococcus aureus* and *Candida albicans*). Among other Ocimum species the oil of *O. basilicum* showed best MIC against *C. albicans*.

**Conclusion and Recommendations**

Methanolic extract of basil had stronger antimicrobial activity than Methanolic/chloroform extract of olive. The antimicrobial activity varies with different strains being the best against *S. aureus*, *Pseudomonas* and *candida*. Phenolic compounds mainly olearupein for olive and rosmarinic acid for basil and caffeic acid in both had antimicrobial activity. The major essential oils were triterpene in olive and Linalool in basil. In vivo study of the antimicrobial activity of olive and basil leaf extracts is recommended.

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