SYNERGISTIC EFFECT OF VOLATILE OILS AND ANTIBIOTICS AGAINST SOME GRAM POSITIVE AND NEGATIVE PATHOGENIC BACTERIA

Ghaly1, M.F.

ABSTRACT

Eight most currently used antibiotics were examined for their antibacterial properties against Gram-ve bacteria as Pseudomonas aeruginosa, E. coli, Proteus vulgaris and Gram+ve as Staphylococcus aureus, Streptococcus pneumonia. Nitrofurantoin was the most effective against the tested bacteria, the inhibition zones ranged between 16-20mm and the MIC between 65-85ug/ml followed by ampicillin (11-18mm), ciprofloxacin (9-12mm) and gentamicin (6-9mm). The erythromycin was the lowest effective against the tested bacteria. Also, seven volatile oils were applied by contact and fumigation methods to study their effect on the tested bacterial strains. The fumigation method gave the highest inhibitory effect more than contact method and the thyme oil gave maximum inhibitory action (inhibition zone 20-28mm) against all the tested bacteria, and the MIC ranged between 0.1-0.15mg/ml followed by marjoram oil (19-25mm) and the MIC between 0.1-0.2mg/ml, cinnamon oil (12-16mm) and the MIC between 0.2-0.3mg/ml. Anise and chamomile oils did not gave any response against all the tested bacteria. The combination between thyme and other tested oils gave a synergistic effect for inhibitory action against all the tested bacteria, if compared with thyme oil alone. The combination between thyme and marjoram oil gave the maximum inhibition zones (20-29mm), followed by thyme with cinnamon oil (20-27mm), thyme with geranium gave (18-27mm), thyme with peppermint (17-27mm), thyme with chamomile (16-27mm) and thyme with anise oil (15-26mm). The combination of thyme oil with different tested antibiotics gave the lowest inhibitory effect than combination between thyme and other volatile oils against all the tested bacteria. The protein and DNA content of treated bacteria with thyme oil were increased by 38.46-47.37% and 34.26-46.94% respectively, if compared by non-treated bacteria.

Keywords: Pseudomonas aeruginosa, E. coli, Proteus vulgaris, Staphylococcus aureus, Streptococcus pneumonia, Antibiotics, Plant extract, Volatile oils

1- Botany Department, Faculty of Science, Zagazig University, Egypt.

(Received November 14, 2005)
(Accepted December 17, 2005)
INTRODUCTION

Resistance of bacteria to antimicrobial agents has become a worldwide problem, both in hospitals and in the community (Molstad and Otto, 1999). Essential oil extracts of various plants have been reported to have inhibitory effect against diverse types of microorganisms including Gram-positive and Gram-negative bacteria, fungi and viruses (Sue et al 2000). The development of antimicrobial agents has advanced significantly in recent years and a large number of new drugs are available for clinical practice, yet the use of these drugs has caused changes in the bacteria that cause infection resulting in the appearance of drug-resistant strains (Ooishi and Miyao, 1997).

Numerous studies have also shown that many of these oil exert potent antimicrobial effects on a wide variety of human pathogens and food spoilage microorganisms (Abo-Ghalia et al 2004). Diab et al (2004) reported that, the treatment of urinary tract infection by Pseudomonas aeruginosae was completely treated by imipenem and cefotoxime antibiotics.

This study aimed to differentiate between the inhibitory effect of volatile oils, antibiotics either used separately or in combination between each of them against some pathogenic bacterial (Gram +ve and Gram –ve) strains.

MATERIAL AND METHODS

Bacterial strains

All bacterial isolates were provided by Prof. Dr. Hosam Ibrahim El-Sharkawy Prof.of Microbiology, Faculty of Medicine, Zagazig University. Identification of bacterial isolates were carried out by typical colonial morphology and Gram stain then biochemical tests according to Cheesbrough (1985).

Volatile oils used

Seven volatile oils were used in this study purchased from Sekem company, Egypt. These oils used for testing their antimicrobial activities against bacterial strains. The testing oils were as follows: marjoram (Margarana hortensis), thyme (Thymus vulgaris), geranium (Pelargonium graveolens), peppermint (Mentha piperata), anise (Pimpinella anisum), cinnamon (Cinnamomum zylanicum) and chamomile (Matricaria recutica)

Antimicrobial assay

Seeded agar plates were prepared using 25ml of molten Muller-Hinton agar for bacterial growth as described by Bauer, et al (1966). A well of 5mm in diameter was made in solidified agar and 10ul of tested oil or combined with antibiotics was added to the well, plates were incubated at 28-30ºC for 24 h. Oils were mixed with 1-2drops of tween 80 for emulsified before using. Inhibition zones were measured in mm. MIC is recorded as the lowest concentration of the antibiotics that inhibites the growth of tested organisms.

Antibiotics susceptibility test

Antibiotics susceptibility test was done by the disc-diffusion technique using commercially available antibiotic disc as recommended by Bauer, et al (1966).

Effect of combined between thyme and marjoram oils on protein and DNA content.
Each bacterial strains was treated with lowest MIC concentration of thyme with marjoram oils and incubated at 28-30°C for 24h., centrifuged and washed several times with sterile distilled water. The pellet was dried at 55-60°C then collected for extraction and measuring the protein and DNA content colorimetrically.

**Extraction and measurement of protein**

The dried pellets of the tested bacteria were extracted with 1N (NaOH) solution at 70°C for 30 min as recommended by Peiterson, (1977). The extracted protein was determined as described by Lowry, et al (1951) using bovine albumin as a standard protein in concentrations ranging from 10µg to 100µg/ml.

**Extraction and measurement of DNA**

DNA was extracted according to Boom, et al (1990). Dried pellets were transferred to epindorff tubes containing 1ml of TE buffer (10mM Tris-HCl and 1mM EDTA pH 8). The samples were boiled at 100°C for 10 min and centrifuged at 14000 rpm for 5 min. the supernatant containing DNA was transferred to a new tube and applied to measurement according to Burton, (1968) where it depends on measuring the color developed after treating the extracted DNA with diphenylamine reagent. The absorbance was measured at 600 nm.

**RESULTS AND DISCUSSION**

Eight antibiotics namely ampicillin (30 µg, Am), nitrofurantoin (300 µg, Nt) ciprofloxacin (5 µg,Cp), amikacin (3 µg, Am), cephradine (30 µg, Ce), gentamycin (30 µg, Gm), impenem (10 µg, Im) and erythromycin (30 µg, Er) were used as illustrated in Table (1) with standard disc diffusion method. The presented data revealed that the highest effective antibiotic was obtained by nitrofurantoin against either Gram–ve or Gram+ve bacteria, resulted to inhibition zone ranged between 16-20 mm. Ampicillin represent the second inhibitory effect antibiotic against either Gram–ve or Gram+ve of the tested strain except Staphylococcus aureus, since amikacin gave the same inhibition zone as nitrofurantoin being 16 mm. It is also interesting to mention that, all the tested strain were resistance to erythromycin except Streptococcus pneumonia and Proteus vulgaris.

Gentamycin gave the lowest inhibition zones against Gram–ve bacteria which ranged between 6-8 mm. These results were agreement with Gupta et al (1999) who showed that the susceptibility of Gram-negative bacteria E.coli to nitrofurantoin reach to 70%. David et al (2000) found that 63%of E. coli isolates were resistant to gentamicin, also Fawzy (2004) reported that 34% of E.coli isolates from diarrhea were sensitive to gentamycin. Diab et al (2004) revealed that 90% of Pseudomonas aeruginosa isolates from out patient was sensitive to ciprofloxacin antibiotic. The results in Table (2) illustrated that the MIC values of ampicillin and nitrofurantoin differ according to bacterial isolates, in generally the MIC of nitrofurantoin higher than ampicillin on all the tested bacterial strains.

The efficacy of seven volatile oils on bacterial strains were illustrated by contact method in Table (3) and by fumigation method in Table (4). These results indicated that, the thyme oil with contact
Table 1. Antibiotics susceptibility test against the tested bacterial strains

| Bacterial strains   | Inhibition zones (mm) |
|---------------------|-----------------------|
|                     | Am | NT | Cp | Ak | Ce | Gm | Im | Er |
| Gram -ve            |    |    |    |    |    |    |    |    |
| Pseudomonas aeruginosa | 18 | 20 | 10 | 17 | 12 | 8  | 15 | -ve|
| E.coli              | 16 | 18 | 11 | 15 | 10 | 6  | 12 | -ve|
| Proteus vulgaris    | 15 | 16 | 9  | 15 | 11 | 8  | 11 |  6 |
| Gram+ve             |    |    |    |    |    |    |    |    |
| Staphylococcus aureus | 11 | 16 | 12 | 16 | 14 | 13 | 13 | -ve|
| Streptococcus pneumonia | 18 | 18 | 14 | 15 | 12 | 14 | 14 |  7 |

Am = ampicillin     Nt = nitrofurantoin     Cp = ciprofloxacin   Ak = amikacin   Ce = cephradine
Gm = gentamicin     Im = imipenem       Er = erythromycin

Table 2. MIC of ampicillin and nitrofurantoin antibiotics against the tested strains

| Bacterial strains     | Ampicillin (ug/ml) MIC | Nitrofurantoin (ug/ml) MIC |
|-----------------------|------------------------|--------------------------|
| Gram -ve              |                        |                          |
| Pseudomonas aeruginosa| 14                     | 80                       |
| E.coli                | 20                     | 72                       |
| Proteus vulgaris      | 18                     | 65                       |
| Gram+ve               |                        |                          |
| Staphylococcus aureus | 16                     | 85                       |
| Streptococcus pneumonia | 18                 | 82                       |

MIC = Minimum Inhibitory Concentration.
Table 3. Effect of different volatile oils against the tested strains by contact method

| Volatile oils | Pseudomonas aeuroginosa | E. coli | Proteus vulgaris | Staphylococcus aureus | Streptococcus pneumonia |
|---------------|-------------------------|--------|------------------|-----------------------|------------------------|
| Marjoram      | 20                      | 19     | 18               | 20                    | 18                     |
| Thyme         | 22                      | 22     | 20               | 18                    | 17                     |
| Geranium      | 0                       | 12     | 0                | 10                    | 9                      |
| Peppermint    | 0                       | 10     | 0                | 9                     | 0                      |
| Anise         | 0                       | 0      | 0                | 0                     | 0                      |
| Cinnamon      | 16                      | 15     | 14               | 15                    | 13                     |
| Chamomile     | 0                       | 0      | 0                | 0                     | 0                      |
| Control       | 0                       | 0      | 0                | 0                     | 0                      |

Table 4. Effect of different volatile oils against the tested bacterial strains by fumigation method

| Volatile oils | Pseudomonas aeuroginosa | E. coli | Proteus vulgaris | Staphylococcus aureus | Streptococcus pneumonia |
|---------------|-------------------------|--------|------------------|-----------------------|------------------------|
| Marjoram      | 25                      | 22     | 20               | 21                    | 19                     |
| Thyme         | 27                      | 28     | 23               | 20                    | 20                     |
| Geranium      | 0                       | 13     | 0                | 12                    | 9                      |
| Peppermint    | 0                       | 12     | 0                | 11                    | 8                      |
| Anise         | 0                       | 0      | 0                | 0                     | 0                      |
| Cinnamon      | 16                      | 14     | 14               | 13                    | 12                     |
| Chamomile     | 0                       | 0      | 0                | 0                     | 0                      |
| Control       | 0                       | 0      | 0                | 0                     | 0                      |
and fumigation methods was the highest effective against all Gram-negative bacteria followed by marjoram and cinnamon oils, the remaining oils have low or not effect on Gram negative and positive bacteria. On the other hand, marjoram oil was the highest effective against Gram positive followed by thyme and cinnamon oil. There has been increasing interest in the use of natural substances with antimicrobial properties in preference to synthetic substances for controlling diseases (Dac-Vinh et al 2000; Hussain et al 2003; Dorman and Deans, 2004; and Abo-Ghalia et al 2004). These results were agreement with Chao et al (2000) who reported that Gram-ve bacteria have a cell wall covered by an outer membrane composed of lipopolysaccharide (LPS) and some proteins, this structure may prevent either the uptake of the oils or protect the peptidoglycan layer from the oils. The outer LPS membrane of Gram–ve bacteria present a permeability barrier to hydrophobic substances that can enter and inhibit the growth of Gram +ve bacteria (White, 1995). Gram +ve bacteria had not the outermembrane and the peptidoglycan layer is on the outside and more available to contact with the oils. On the other hand, Zambonelli et al (2004) suggested that the alterations caused by thymol are due to its ability to damage the cellular membranes and to interfere with the membrane enzymatic reactions which are fundamental for cellular membrane. Bacteriostatic (MIC) effect of thyme, marjoram and cinnamon which selective the most effective oils (by contact method) were tested against selected strains. The results were reported in Table (5) which illustrated that the lowest MIC of the thyme followed by marjoram and cinnamon oils against Gram positive and negative bacteria. MIC of the thyme oil ranged between 0.1-0.15mg/ml, whereas marjoram from 0.1-0.2 and cinnamon oil from 0.2-0.3 mg/ml. Abo-Ghalia et al (2004), reported that the MIC of thyme oil 0.32 mg/ml against Staphylococcus aureus , Streptococcus pyogenes, E. coli and Proteus vulgaris, however Klebsiella sp. and Streplococcus faecalis were inhibited by 0.64 mg/ml. Thyme oil had a bacteriostatic concentrations against E. coli and S. enteridis at 0.05% and 0.04% respectively, as reported by Smith et al (1998).

The data presented in Table (6) clearly show that the highest figures of synergistic inhibitory effect against all the tested strains, which express as inhibition zones (mm) were obtained in the treatment contained equal mixture of thyme and marjoram (10ul) than other combination of rest oils. Cappelletty and Rybak (1996) reported that the combinations of antimicrobial agents are considered to be synergistic if the effect of the combination is greater than the effect either agent alone or greater than the sum of the effect of the individual agents. Antagonism results occurred if the combination provides an effect more than the effect of either agent alone or more than the sum of the effects of the individual agents. The combination of thyme oil with different antibiotics were tested and the results in Table (7) revealed that the combination of thyme oil with nitrofuratoin gave the highest inhibitory effect against all tested bacterial strains and the action of thyme oil with all tested antibiotics increase the synergistic inhibitory effect against resistant bacterial isolates with treated antibiotics only. The combination between amoxycillin and 10 µl anise oil gave a
Synergistic effect against some bacteria

Table 5. MIC of thyme, marjoram and cinnamon oils against the tested strains

| Bacterial strains | Thyme oil (mg/ml) | Marjoram oil (mg/ml) | Cinnamon oil (mg/ml) |
|-------------------|-------------------|----------------------|---------------------|
| **Gram-ve**       |                   |                      |                     |
| *Pseudomonas aeuroginosa* | 0.10              | 0.15                | 0.25                |
| *E.coli*          | 0.15              | 0.20                | 0.30                |
| *Proteus vulgaris* | 0.10              | 0.15                | 0.20                |
| **Gram+ve**       |                   |                      |                     |
| *Staphylococcus aureus* | 0.10              | 0.10                | 0.20                |
| *Streptococcus pneumonia* | 0.15              | 0.10                | 0.25                |

Table 6. Efficacy of combination between thyme oil and different volatile oils against the tested strains

| Treatment          | Inhibition zones (mm) |
|--------------------|-----------------------|
|                    | *Pseudomonas aeuroginosa* | *E.coli* | *Proteus vulgaris* | *Staphylococcus aureus* | *Streptococcus pneumonia* |
| Thyme + marjoram   | 29                    | 28       | 24                 | 20                      | 21                      |
| Thyme + geranium   | 26                    | 27       | 22                 | 19                      | 18                      |
| Thyme + peppermint | 27                    | 26       | 23                 | 20                      | 17                      |
| Thyme + cinnamon   | 27                    | 27       | 22                 | 20                      | 20                      |
| Thyme + anise      | 26                    | 26       | 23                 | 18                      | 15                      |
| Thyme + chamomile  | 27                    | 27       | 22                 | 20                      | 16                      |
Table 7. Effect of combination between thyme oil and different antibiotics against the tested strains

| Treatment                  | Pseudomonas aeuruginosa | E.coli | Proteus vulgaris | Staphylococcus aureus | Streptococcus pneumonia |
|----------------------------|-------------------------|--------|------------------|-----------------------|-------------------------|
| Thyme + ampicillin         | 22                      | 20     | 20               | 18                    | 17                      |
| Thyme + nitrofurantoin     | 23                      | 22     | 21               | 19                    | 21                      |
| Thyme + ciprofloxacine     | 20                      | 20     | 18               | 17                    | 17                      |
| Thyme + amikin             | 21                      | 20     | 19               | 18                    | 18                      |
| Thyme + cephradine         | 20                      | 20     | 20               | 17                    | 19                      |
| Thyme + gentamicin         | 21                      | 21     | 18               | 16                    | 18                      |
| Thyme + imipenem           | 22                      | 20     | 19               | 16                    | 17                      |
| Thyme + erythromycin       | 20                      | 21     | 20               | 15                    | 17                      |

Table 8. Effect of thyme oil (10ul) on protein and DNA content of the tested Gram positive and negative bacteria

| Bacterial strains   | Protein content (mg/gm) | DNA content (ug/gm) |
|---------------------|-------------------------|---------------------|
|                     | Control | Treated | % of increasing | Control | Treated | % of increasing |
| **Gram-ve**         |         |         |                 |         |         |                 |
| *Pseudomonas aeuruginosa* | 40      | 58      | 45.00           | 110     | 148     | 34.55           |
| *E.coli*            | 38      | 56      | 47.37           | 108     | 145     | 34.26           |
| *Proteus vulgaris*  | 41      | 58      | 41.46           | 105     | 142     | 35.24           |
| **Gram+ve**         |         |         |                 |         |         |                 |
| *Staphylococcus aureus* | 38      | 54      | 42.10           | 98      | 144     | 46.94           |
| *Streptococcus pneumonia* | 38      | 54      | 38.46           | 105     | 150     | 42.86           |

\[
\text{% of increasing} = \frac{\text{Treated} - \text{Control}}{\text{Control}} \times 100
\]
Synergistic effect against some bacteria

Synergistic effect against the multiresistant isolates of *Ps. aeruginosa* where this combination increases the inhibition zone of the amoxycillin disc against all chosen multiresistant isolates of *Ps. aeruginosa*, Zaid (2001). Fawzy (2004) revealed that the combination between antibiotic and 10ul thyme oil gave a synergistic effect against *E. coli*, *Salmonella typhi* and *Shigella* sp.

The effect of thyme oil on protein and DNA content of the tested bacterial strains were reported in Table (8), these results indicated that the protein and DNA content of all the tested bacterial strains increased if compared with non treated chosen isolates, but the percentage of increasing different according to the treated bacterial isolates. The protein and DNA content of *Pseudomonas aeruginosa* increased by ratio 45.0 and 34.55% respectively. The maximum increasing rate of protein and DNA content were attained at *E. coli* and *Staphylococcus aureus* by ratio 47.37 and 46.94%, respectively. Wesam, (1994) reported that the cephalosporins treatments were associated with inharmonious effect on the nitrogen metabolism of *Bacillus megaterium* and *E. coli*. It increased the protein-N of *B. megaterium*, on the contrary, the protein-N was decreased significantly in treated *E. coli* with cephalosporins. Such inharmonious behavior of cephalosporins can be explained at the basis of the low concentration that increased the protein synthesis through the acceleration of protein building, while the higher concentration decreased the protein synthesis (Egorov, 1985). As regards the effect of thyme oil treatment on DNA content, Fawzy, (2004) revealed that DNA content of treated isolates increased compared with controls. The data reported in this concern were linked with the effect of antibiotics on nucleic acid contents. Gottfredsson et al (1995) have shown that the post antibiotic effect (PAE) phase after ceprofloxacin exposure is characterized by a progressive increase in DNA synthesis, which could be due to an increase in DNA repair as a result of persistent antimicrobial action during the post antibiotic effect. Alternatively, the increase in DNA could be due to continued attempts at DNA replication, since DNA polymerase activity is not hampered, but this replication is abortive because the circular DNA cannot be separated as a result of gyrase inhibition.

**REFERENCE**

Abo-Ghalia, H.; M. El-Mokadem; A. Ghanem and K. Shaheen (2004). Antimicrobial activity of assential oils of some medicinal plants. *Egypt. J. Microbiol.* 9: 221-241.

Bauer, A.W.; W.M. Kirby; J.C. Sherris and M. Turk (1966). Antibiotic susceptibility testing by a standerized single disk method. *American Journal of Clinical Pathology*, 45: 493-496.

Boom, R.; C.J. Sol; M.M. Salimans; P.M. Jansencl and Vander Noordaaj (1990). Rapid and simple method for purification of nucleic acids. *J. Clin. Microbiol.*, 28: 495-503.

Burton, K. (1968). *Methods in Enzymology. 12 B* pp. 215-250, Interscience Publishers. Inc., New York .

Cappelletty, D.M. and M.J. Rybak, (1996). Comparison of methodologies for synergism testing of drug combinations against resistant strains of *Pseudomonas aeruginosa*. Antimicrob. *Agents. Chemother.*, 40: 677-683.
Chao, S.; D. Young and C. Oberg, (2000). Screening for inhibitory activity of essential oils on selected bacteria, fungi and viruses. *J. Essent. Oil Res., 12*: 639-649.

Cheesbrough, M. (1985). *Medical Laboratory Manual for Tropical Countries. Vol. II: Microbiology* pp. 225-247. Monica Cheesbrough (Eds), Great Britain Univ. Press, Cambridge.

Dac-Vinh, N.; M. Takacsova; T. Jakubik; H. Minh and T. Nhat (2000). In vitro antibacterial effect of the essential oil of *Thymus longiflorus*. *Microbes, 60* (242): 59-61.

David, G.W.; H. Charlene; J. Jhon; A. Sherry; Z. Shaohua Margie; B. Lance; F. Thomas and S. Julie (2000). Characterization of chloramphenicol and flofenicol resistance in *E.coli* associated with Bovine diarrhea. *J. Clin. Microbiol. 12*: 4593-4598.

Diab, A.M.; A.A. Abdelrahman and H.K. Abdel-Latif (2004). Evaluation of currently used antimicrobials to Gram-negative pathogens causing community acquired urinary tract infections. *N. Egypt. J. Microbiol. 9*: 345-356.

Dorman, H.J. and S.G. Deans (2004). Chemical composition, antimicrobial and in vitro antioxidant properties of *Mondora citriodora, Origanum vulgare, Pelargonium sp* and *Thymus zygis* oils. *J. Essent. Oils Res., 16*: 145-150.

Egorov, N.S. (1985). *Antibiotics A Scientific Approach* pp. 324-332. MIR Publishers, Moscow.

Fawzy, A. (2004). *Antimicrobial Studies of Essential Oils on Some Bacteria.* pp. 52-68. M.Sc. Thesis, Bot. Dept., Faculty of Science, Zagazig Univ. Egypt.

Gottfreddson, M.; H. Erlendsdottir; A. Gudmundsson and S. Gudmundsson (1995). Different pattern of bacterial DNA synthesis during post antibiotic effect. *Antimicrobial Agents and Chemotherapy. 39*: 1314-1319.

Gupta, K.; D. Scholes and W.E. Stamm (1999). Increasing prevalence of antimicrobial resistance among uropathogens causing acute uncomplicated cystitis in women. *JAMA, 281*:736-738.

Hussain, A.; S.M. Ashour; M.T. El-Mokadem and M.M. Refky (2003). Antifungal activity of Egyptian essential oils against some dermatophytes. *The African J. of Mycology and Biotechnology. 11* (2): 1-20.

Lowry, O.H.; N.J. Rosebrough; A.L. Farr and R.J. Randall (1951). Protein measurement with folin phenol reagent. *J. Biol. Chem., 193*: 265-283.

Molstad, S. and C. Otto (1999). Major change in the use of antibiotics following a national programme. Scand. *J. Infect. Dis., 31*: 191-195.

Ooishi, M. and M. Miyao (1997). Antibiotic sensitivity of recent clinical isolates from patients with ocular infections. *Ophthalkologica, 21*: 15-24.

Peiterson, N. (1977). Activity of essential oils on microorganisms. *Biotechnology. Bio., 19*: 337-348.

Smith-Palmer, A.; J. Stewart and L. Fyfe (1998). Antimicrobial properties of plant essential oils and essences against five important food borne pathogens. *Letters in Applied Microbiology. 26*(2): 118-122.

Sue, C.C.; D. Gary Young and J. Craig (2000). Screening for inhibitory activity of essential oils on selected bacteria, fungi and viruses. *J. Essent., Oil Res., 12*: 639-649.

Wesam, A.A.H. (1994). *Studies on the Biological Changes Induced by Certain Antibiotics and Gamma Radiation for Certain Bacteria* pp. 82-85. Ph.D. The-
Synergistic effect against some bacteria

Tahir, T.A. (2010). The physiology and biochemistry of prokaryotes. Oxford Univ. Press, New Yourk.

Zaid, A.M. (2001). Studies on Beta-Lactamases Producing Bacteria Belonging to Genus Pseudomonas, pp.

96-112. Ph.D. Thesis. Faculty of Science, Zagazig University, Egypt.

Zambonelli, A.; A.Z. Daulerio; A. Severi; S. Benvenuti and A. Bianchi (2004). Chemical composition and fungicidal activity of commercial essential oils of Thymus vulgaris L. J. Essential Oil Res., 16: 69-74.

مجلة اتحاد الجامعات العربية للدراسات والبحوث الزراعية ، جامعة عين شمس ، القاهرة ، (114) ، 2006

تأثير تآزر الزيوت الطيارة والمضادات الحيوية ضد بعض البكتريا المرضية

الموجبة والسالبة الجرام

[8]

محمد فاروق غالى

1 - قسم النبات- كلية العلوم - جامعة الزقازيق - مصر

تم استخدام ثماني مضادات حيوية شائعة

الاستخدام لدراسة نشاطها ضد البكتريبا السالبة لجرام مثل سيدوموناس اريجينوزا والاشيرشيا كولو و بروترياس فولجاس والموجبة لجرام مثل ستافيلوكوس اوريوس

وسترتيوكس نيومونيا المعزولة من عرف

العمليات. وقد وجد أن النتيزوفيرانتون أكثر

ثبيطاً للبكتريا المختبأة، حيث وصل النشاط

المثبط للنمو إلى 60-65% والتركيز

المثبط للنمو من 1-11 ميكروجرام/مل

يلبي الإسبيلين(11-16 مم)، والأمبيسين (1-17 مم)؛ والسيروفلافكسبيسين (12-16 مم)؛ والجنيتامبيسين (6-9 مم)، وأظهر

Arab Univ. J. Agric. Sci., 14(1), 2006
أظهرت النتائج أن خلط زيت الزيتون مع المضادات الحيوية غير مفيدة. ووجد أن خلط زيت الزيتون مع الزيوت الأخرى ينشط التأثير الضد بكتيري. ووضعت النتائج أن المحتوى البروتيني والحماض النووي للبكتريا المعاملة بزيت الزيتون يزيد بنسبة بين 38.47-76.37% للمحتوى البروتيني و64.46-59.64% للحماض النووي مقارنة بالغیر معامل.

تحكيم: أ.د. راوية فتحي جمال
أ.د. السيد علي السيد

Arab Univ. J. Agric. Sci., 14(1), 2006