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THERAPEUTIC PROPERTIES OF MEDICINAL PLANTS: A REVIEW OF THEIR ANTIBACTERIAL ACTIVITY (PART 1)

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ABSTRACT

Previous studies showed that medicinal plants exerted a wide range of antibacterial activity. These plants included: *Achillea santolina, Adiantum capillus-veneris, Agrimonia eupatoria, Agropyron repens, Ailanthus altissima, Alhagi maurorum, Allium cepa, Allium porrum, Allium sativum, Allium schoenoprasum, Alpinia galangal, Althaea officinalis, Althaea rosea, Ammannia baccifera, Ammi visnaga, Anagyris foetida, Anchusa strigosa, Anethum graveolens, Anthemis nobelis, Antirrhinum majus, Apium graveolens, Arachis hypogaea, Arctium lappa, Artemisia campestris, Arundo donax, Asclepias curassavica, Asparagus officinalis, Avena sativa, Bacopa monniera, Ballota nigra, Bauhinia variegata, Bellis perenni, Benincasa hispida, Betula alba, Bidens tripartite, Brassica rapa, Bryophyllum calycinum, Caesalpinia crista, Calamintha graveolens, Calendula officinalis, Calotropis procera, Canna indica, Capparis spinosa, Capsella bursa-pastoris, Capsicum annuum, Capsicum frutescens, Carthamus tinctorius, Carum carvi, Cassia occidentalis, Casuarina equisetifolia, Celosia cristata, Centaurea cyanus, Chenopodium album* and *Chrozophora tinctoria*. This review was designed to highlight the antibacterial effects of these medicinal plants.

Key Words:- Medicinal plants, Antibacterial, Pharmacognosy, Pharmacology, Therapeutics.

INTRODUCTION

Plants are a valuable source of a wide range of secondary metabolites, which are used as pharmaceuticals, agrochemicals, flavours, fragrances, colours, biopesticides and food additives (Al-Snafi AE, 1999; Marbin MI *et al*., 2005; Al-Snafi AE *et al*. 2008; Al-Snafi AE, 2015; Al-Snafi AE, 2009, Al- Tahan FJ *et al*., 1998). Two thirds of the new chemicals identified yearly were extracted from higher plants. 75% of the world's population used plants for therapy and prevention. In the USA where chemical synthesis dominates the pharmaceutical industry, 25% of the pharmaceuticals are based on plant-derived chemicals (Orhan IE, 2012). This review will highlight the antibacterial effects of medicinal plants.

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Achillea santolina

Achillea santolina exerted antimicrobial activity against *Staphylococcus aureus*, *Pseudomonas aeruginosa*, and *Candida albicans*. MICs of *Achillea santolina* extracts against these microorganisms were 40, 60 and 12 ppm respectively (Khalil *et al*., 2009). Ahmadi *et al* found that the standard strains of *Staphylococcus aureus* presented the greatest sensitivity to the stem extract and leaf extract in MIC(mg/l) > 0.573 and MBC> 1.146, respectively and to the flower extract in MBC> 1.663 and MIC> 0.831, respectively. In addition, it presented an intermediate sensitivity to standard strains *E.coli* with MBC> 2.293 and MIC> 1.146, respectively to the stem and leaf extract and MBC> 6.650 and MIC> 3.325 respectively to the flower extract. However, the standard strains of *Candida albicans* and *P.aeruginosa* did not show a significant sensitivity to the extracts (Al-Snafi AE, 2013). However, methanolic extracts of *Achillea santolina*

was inactive against *Candida albicans, Candida glabrata*, and *Candida krusei* strains (Darwish RM and Aburjai TA, 2011).

Adiantum capillus-veneris

The methanolic extracts of *Adiantum capillus-veneris* aerial part showed antimicrobial properties in concentrations between 0.5-2 mg/ml of the extract against *Bacillus, E. coli, Staphylococcus, Proteus, Pseudomonas*, and *Candida* (Mahmoud MJ *et al*., 1989). The methanolic extract of *Adiantum capillus-veneris* was also tested for its antimicrobial activity against five grams positive (including multi-resistant *Staphylococcus aureus*), six grams negative bacteria and against eight fungal strains. The extract showed broad antibacterial activity and a very low minimum inhibitory concentration value (0.48 mµg/ml) against *Escherichia coli* (Singh M *et al*., 2008). The aqueous and alcoholic leaves extract of *Adiantum capillus-veneris* were found to be effective against *Agrobacterium tumefaciens, Escherichia coli, Salmonella arizonae, Salmonella typhi and Staphylococcus aureus* bacterial strains (Pradeep P et al., 2007).

Agrimonia eupatoria

Marked antibacterial activity against *Staphylococcus aureus* and *α-haemolytic Streptococci* has been reported for agrimony. Aqueous extracts inhibited *Mycobacterium tuberculosis*, including the strains resistant to streptomycin and p-aminosalicylate. Essential oil was antibacterial, it was active against *Bacillus subtilis* (Khare CP, 2007). The antibacterial (against *Staphylococcus aureus, Pseudomonas aeruginosa and Escherichia coli*) and wound healing effects of the extracts of *Agrimonia eupatoria* (aqueous and ethanolic) were studied. The results showed that the ethanolic extract was more effective on inhibiting the tested bacteria than the aqueous extract. *P. aeruginosa* was the most resistant bacteria, while highest inhibition zone appeared against *E. coli* (20 mm). There was a moderate activity against *S. aureus* with inhibition zone of 15 mm (Ghaima KK, 2013). Preparations of *Agrimonia eupatoria* L were screened for antimicrobial activity against selected Gram-positive and Gram-negative bacteria of relevance in wounds using a 96 well plate microdilution method (200, 40 and 8µg/ml). It exerted moderate antibacterial effects (Petkov V, 1986).

Agropyron repens

A post-marketing surveillance was designed to investigate the efficacy and tolerability of a fluid extract of Agropyron repens [Elymus repens] (Acorus drops) in patients with urinary tract infections or irritable bladder. Data for 313 patients with urinary tract infections or irritable bladder were analysed. The patients were treated on average for twelve days with 50-60 drops 3 times a day. The primary efficacy criterion was the change of urological symptoms during the course of therapy. Between 69% and 91% of the urological symptoms initially documented were relieved in the course of therapy. Depending on the underlying urological diagnosis, between 32% and 53% of the patients were completely free of symptoms following treatment. Acorus drops were tolerated very well. No adverse drug reactions occurred (Watkins F et al., 2012).

Ailanthus altissima

Metanolic extracts from leaves and hydrodistilled residues were efficient against gram-positive bacteria (Hautmann C and Scheithe K, 2000). A new naturally occurring sterol and six known stigmasterols isolated from fruits of *Ailanthus altissima* showed potent activity against many bacterial isolates. However, two compounds exhibited moderate activity (Zhao CC *et al*., 2005). The antibacterial effects of methanolic extracts of *Ailanthus altissima* leaves were evaluated by agar disk diffusion method against 11 (six gram-positive and five gram-negative) foodborne bacteria. The methanol extract and its different polar subfractions inhibited significantly the growth of all six gram-positive bacteria: *Listeria monocytogenes* (ATCC 19116, ATCC 19118 and ATCC 19166), *Staphylococcus aureus* (ATCC 6538 and KCTC 1916) and *Bacillus subtilis* ATCC 6633 and two gram-negative bacteria: *Pseudomonas aeruginosa* KCTC 2004 and *Escherichia coli* ATCC 8739. The zones of inhibition of methanol extract and its derived different polar subfractions against the tested bacteria were found in the 12.1–23.2 mm range and the minimum inhibitory concentration values were recorded between 62.5 and 500 mg/ml (Rahman A *et al*., 2009). Anti-tuberculosis activity was conducted for quassinoids isolated from *Ailanthus altissima*, although the activities were low, the resulting data provided a picture of structure-activity relationships (Rahman S *et al*., 1997).

Alhagi maurorum

Aqueous extract of *Alhagi maurorum* in different concentrations had no antibacterial activity against both Gram negative (*Escherichia coli and Pseudomonas aeruginosa*) and Gram positive (*Staphylococcus aureus and Stroptococcus pyogenes)* bacteria. Antimicrobial activity of the leaves and flowers extracts was tested against [*Staphylococcus aureus* (ATCC 25923), *Bacillus subtilis* (ATCC 6633), *Pseudomonas aeruginosa* (ATCC 15523), *Salmonella typhi-murium* (ATCC 13311) and

Candida albicans (ATCC 10231)] using disc diffusion method. Both extracts showed antibacterial and antifungal activity. The minimum inhibitory concentrations of the leaves extract were 80.7±4.5, 68.8±4.6, 60.6±8.3 and 58.0±6.3, and of flowers extract were 84.0±0.0, 65.0±2.7, 65.2±6.2, 62.4±5.0 and 60.4±5.6 µg/ml against the mentioned microorganisms, respectively (Sulaiman GM, 2013). The antibacterial activity of methanol extracts (6 mg/ml) of the fresh aerial parts of *Alhagi maurorum* were evaluated against gram positive microorganisms [*B cereus, C. perfringens* ATCC 13124, *L. innocua* ATCC 33090, *L. ivanovii* Li4 (pVS2), *L. monocytogensis* ATCC 19116, *S. aureus* 72, *S. aureus* 132, *S. aureus* 224 and *S. epidermis*]. It showed antibacterial activity against only *B cereus*, *L. ivanovii* Li4 (pVS2), *S. aureus 72*, *S. aureus* 132 and *S. aureus* 224 with diameter of inhibition of 10, 7, 5, 12 and 20 mm respectively. The extract at the same concentration was also evaluated against gram negative microorganisms [*E. coli*, *Y. Enterocolitica* ATCC 23715, K. *oxytoca*, *K. pneumonia*, *S. enterica* ATCC 25566]. It showed activity against only *K. pneumonia* with a diameter of inhibition of 7mm. Increase the concentration to 23 mg/ml gave antibacterial activity only against *K. oxytoca* and *K. pneumonia* with a diameter of inhibition of 18 and 7mm respectively. The antibacterial activity of hexane extracts (6 mg/ml) of the fresh aerial parts of *Alhagi maurorum* were evaluated against gram positive microorganisms [*B cereus, C. perfringens* ATCC 13124, *L. innocua* ATCC 33090, *L. ivanovii* Li4 (pVS2), *L. monocytogensis* ATCC 19116, *S. aureus* 72, *S. aureus* 132 *and S. aureus* 224]. It showed antibacterial activity against only *B cereus, L. ivanovii* Li4 (pVS2), *L. monocytogensis* ATCC 19116, *S. aureus* 72 and *S. aureus* 132, with diameter of inhibition of 7, 7, 10, 10 and 15 mm respectively. The extract at the same concentration was also evaluated against gram negative microorganisms [*E. coli*, *Y. Enterocolitica* ATCC 23715, *K. oxytoca*, *K. Pneumonia, S. enterica* ATCC 25566]. It showed activity against only *E. coli*, *Y. Enterocolitica* ATCC 23715, *K. oxytoca* and K. *pneumonia* with diameter of inhibition of 12, 13, 11 and 15 respectively (Abdel Rahman SM *et al*., 2011). The MIC of 90% methanolic extract of the leaves of *Alhagi maurorum* Medic, *against Escherichia coli, Moraxella lacunata, Proteus merabiles, Proteus vulgaris, Pseudomonas aeruginosa, Salmonella typhi, Micrococcus luteus, Sarcina ventricull, Streptococcus byogenes and Saccharomyces cerevisiae* were 3,2,3,3,4,4,4,5, 5 and 5 mg/ml (Zain ME *et al*., 2012). Antihelicobacter activity of 70% methanol extract of the whole *Alhagi maurorum* plant was carried out by cup diffusion techniques. It exerted anti H. pylori effect, the diameter of zone of inhibition was 38 MIC was 0.79 mg/ml (Ramadan MA and Safwat NA, 2009). However, Neamah found that all doses of aqueous extract have no antibacterial activity against *Escherichia coli*, *Pseudomonas aeruginosa*, *Staphylococcus aureus* and *Streptococcus pyogenes*, using Cup-plate diffusion method (Neamah NF, 2012).

Allium cepa

The petroleum ether extract of Bulbus *Allium cepa* inhibited the *growth* of *Clostridium paraputrificum* and *Staphylococcus aureus*. The aqueous extract or the juice of *Allium cepa* inhibited the *growth* of *Escherichia coli, Serratia marcescens, Pseudomonas aeruginosa*, *Salmonella typhi, Streptococcus* species and *Lactobacillus odontolyticus.* The extracts of dried scale leaves of *Allium cepa* exerted antibacterial activities against Gram positive bacteria like *Staphylococcus aureus* and *Bacillus subtilius* and Gram negative bacteria like *Escherichia coli* and *Klebseilia pneumonia* (Nath KVS *et al*., 2010). Antimicrobial activity of different concentrations (50, 100, 200, 300 and 500 ml/l) of essential oil extracts of three type of onions (green, yellow and red) against two bacteria, *Staphylococcus aureus, Salmonella enteritidis*, and three fungi, *Aspergillus niger*, *Penicillium cyclopium* and *Fusarium oxysporum*, was investigated. The essential oil extracts of onions exhibited marked antibacterial activity, comparatively, 50 and 100 ml/l concentrations of onions extracts were less inhibitory than 200, 300 and 500 ml/l concentrations. However *S. enteritidis* was strongly inhibited by the red onion essential oil extract. The fungus *F. oxysporum* showed the lowest sensitivity towards extracts, whereas *A. niger* and *P. cyclopium* were significantly inhibited particularly at low concentrations (Benkeblia N, 2004). The effect of the ethanolic extracts of onion against *V. cholera* was investigated. All tested strains of *V. cholerae* were sensitive to onion (*Allium cepa*) extracts of two types (purple and yellow). Purple type of extract had MIC range of 19.2–21.6 mg/ml while, the extract of yellow type onion had an MIC range of 66– 68.4 mg/ml (Humayun AT *et al*., 2010). The essential oil exerted antifungal activity against *Aspergillus niger, Cladosporium werneckii, Candida albicans, Fusarium oxysporium, Saccharomyces cerevisiae, Geotrichum candidum, Brettanomyces anomalus,* and *Candida lipolytica*. Bulb essential oil, at a concentration of 1.0%/disc, was active against *Brittanomyces anomalus, Hansenula anomala, Kloeckera apiculata* and *Lodderomyces elongisporus*. A concentration of 10.0% /disc was active against *Kluyveromyces fragilis, Metschnikowia pulcherrima, Pichia membranaefaciens, Rhodotorula rubra,* and *Saccharomyces cervisiae* (Ross IA, 2001). The antimicrobial effects have been attributed to the action of

allicin (diallyldisulphide oxide) on the growth and respiration of microorganisms such as *Staphylococcus aureus, Escherichia coli* and *Candida albicans. Candida* was the most sensitive of these organisms to allicin, whilst *E. coli* seemed to be less sensitive than *Staphylococcus aureus.* The -SO-S- group is essential for the antibacterial action of allicin as it inhibited the –SH enzymes. It has been observed that the permeability of bacterial cells to allicin is greatly influenced by the lipid content of the microorganisms (Kabelik J, 1949; Willis ED, 1969; Whitemore BB and Naidu AS, 2000).

Allium porrum

All the Allium species possessed thiosulfinate contents. It reached 0.15 µmol/g in leek (*A. porrum*). Thiosulfinates are the best studied compounds arising from *Allium* species. The antibacterial and antifungal activities against a variety of Gram-negative and Gram-positive bacteria were frequently recorded (Yamada Y and Azuma K, 1997; Benkeblia N and Lanzotti V, 2007).

Allium sativum

Numerous reports indicate that garlic extract has broad spectrum antimicrobial activity against Gram positive and Gram negative microorganisms. The juice , aqueous and alcoholic extracts, and the essential oil of garlic inhibited the *in vitro* growth of *Staphylococcus aureus, Streptococcus faecalis, Bacillus* sp., *Clostridium* , *Escherichia coli*, *Shigella sonnei*, *Proteus* sp., *Pseudomonas aeruginosa*, , *Erwinia carotovora*, *Pasteurella multocida*, *Mycobacterium tuberculosis* , *Candida* sp, *Cryptococcus* sp, *Toruloposis* sp. , *Trichosporon pullulans*, *Rhodotorula rubra*, and *Aspergillus niger* (Adetumbi MA, and Lau BHS, 1983; Abbruzzese MR et al., 1987; Fitzpatrick FK, 1954; Sharma VD, 1980; Arunachalam K, 1980). In 1982 Bolton *et al* mentioned that, around the turn of the century, Minchin, the head of the tuberculosis ward at a Dublin hospital, wrote that garlic had a remarkable cure rate for tuberculosis. It was used as an inhalant and taken internally. At the same time, McDuffie, in New York City, compared garlic with 55 other treatments for tuberculosis and concluded that it was the most effective (Bolton S, 1982). 2 mg/ml of garlic extract was required to inhibit one Mycobacterium tuberculosis strain (Rao RR *et al*., 1946)**.** Thirty strains of mycobacterium, consisting of 17 species, were inhibited by various concentrations of garlic extract. The inhibitory concentration was ranged from 1.34 mg/ml to 3.35 mg/ml. *M.bovis* was the species most easily inhibited by the extract, requiring only a concentration of 1.34 mg/ml. The six strains of *M. tuberculosis* required only slightly more concentration, with a mean value of 1.67 mg/ml of media (Gonzalez-Fandos E et al., 1994). Garlic extracts can also prevent the formation of *Staphylococcus* enterotoxins A, B, and C1 and thermonuclease. Garlic extracts are also effective against *Helicobacter pylori* (Cellini L, 1996). Pure allicin produced significant antibacterial effects against various bacterial isolates (Rabinkov A, 1998). In general, the antimicrobial effects have been attributed to the action of thiosulfinates. Inhibition of certain thiol-containing enzymes in the microorganisms by the rapid reaction of thiosulfinates with thiol groups was assumed to be the main mechanism. Allicin also inhibited other bacterial enzymes such as acetate kinase and phosphotransacetyl - CoA synthetase. Allicin also inhibited the DNA and protein synthesis, the effect on RNA is suggesting that RNA could be a primary target of allicin (Focke M, 1990).

Allium schoenoprasum

Diallyl sulfides (diallyl monosulfide, dially disulfide, diallyl trisulfide, and diallyl tetrasulfide) are believed to be responsible for the antimicrobial activity in Allium species. Chive oil was examined for its diallyl sulfide content and its antimicrobial activity against some strains of food-borne pathogenic bacteria. Chive oil had a low concentration of diallyl monosulfide in comparison with the other diallyl sulfides. They inhibited all the tested pathogenic bacteria with a different degree of inhibition. Chive oil was also shown to be able to inhibit Escherichia coli O157:H7 in a food model (Rattanachaikunsopon P *et al*., 1990).

Alpinia galanga

The essential oils of rhizome of *A. galangal* showed antimicrobial activity (Pooter D *et al*., 1985). Thomas *et al,* found that ether and ethyl acetate extract of *A. galangal* exerted antibacterial activity. Aqueous extract of *A. galanga* showed significant activity against *Klebsiella pneumonia*, *Escherichia coli*, Pseudomonas aeruginosa, S. aureus and Streptoccocus pyogenes except Staphylococcus epidermidis (Turker A and Usta C, 2002). Essential oil had shown significant activity against *Staphylococcus aureus, Streptococcus suis, Erysipelothrix rhusiopathiac, Pseudomonas aeruginosa, E. coli*, *Pasteurella multocida* and *Arcanobacterium pyogenes*, the effects were attributed to 1,8-cineole, 4- allyphenyl acetate and α-bisabolene (Tachakittirungrod S and Chowwanapoonpohn S, 2007) . Oven-dried ethanol extract from *Alpinia galanga* flower was the most effective against *S. aureus* with inhibition zone of about 26–31 mm and the minimum inhibitory concentration (MIC) ranging from 0.352–0.547 mg/mL. No antimicrobial activity was observed on *E. coli* O157:H7 and *Salmonella*. Overall

antimicrobial activity of oven-dried samples extracted with ethanol was the highest with inhibition zone of 8.94 mm and MIC of 1.457 mg/mL. In contrast, freeze-dried samples extracted with ethanol exhibited the lowest overall antimicrobial activity (7.05 mm and 2.470 mg/mL) (Hsu W *et al*., 2010). *Alpinia galanga* ethanolic extract had strong inhibitory effect against S. aureus. The minimum inhibitory concentration (MIC) of the galangal extract was 0.325 mg/ml and the minimum bactericidal concentration (MBC) was 1.3 mg/ml using the broth dilution method. Transmission electronmicroscopy demonstrated that the *Alpinia galanga* extract caused both outer and inner membrane damage, and cytoplasm coagulation. The disruption of the cytoplasmic membrane properties was determined by the releasing of cell materials including nucleic acids (Oonmetta-aree J *et al*., 2006).

Althaea officinalis

A methanolic extract prepared by exhaustive extraction from marshmallow root has been shown to possess an inhibiting activity able to diminish significantly the periodontal pathogens resident in the oral cavity (*Porphyromonas gingivalis, Prevotella spp., Actinomyces odontolyticus, Veilonella parvula, Eikenella corrodens, Fusobacterium nucleatum, Peptostreptococcus spp.*). Antimicrobial activity against *Pseudomonas aeruginosa, Proteus vulgaris* and *Staphylococcus aureus* has been documented for chloroform and methanolic extracts of marshmallow roots. The hexane extracts of flower and root of *Althaea officinalis* exerted antimicrobial activity against Gram-positive and Gram-negative bacteria (*Escherichia coli, Pseudomonas aeruginosa, Klebsiella pneumoniae, Bacillus subtilis, Enterococcus faecalis, Staphylococcus aureus* and *Staphylococcus epidermidis),* as well as three fungi *(Aspergillus niger, Candida albicans and Saccharomyces cerevisiae*) (Valiei M *et al*., 2011). Rashidi *et al* also found that 80 % ethanolic *Althaea officinalis* extract was active against *Aspergillus niger, Aspergillus fumigatus*, and *Aspergillus flavus* species. MIC of *Althaea officinalis* 80 % ethanolic extract 50-100 mg/ml. However, ethanol, water and hexane extracts of the dried seed at a concentration of 10.0 mg/ml, were inactive on Candida albicans and Candida tropicalis (120). Ethanolic extract of dried whole plant, in cell culture at variable concentrations is inactive on adenovirus, coxsackie B2 virus, Herpes virus type 1, measles virus, poliovirus 1 and Semlicki-Forest virus vs plaque inhibition (Berghe, 1978). Water extract of the dried leaf, in cell culture at a concentration of 10.0%, was inactive on Herpes virus type 2, influenza virus A2 ,poliovirus 11 and vaccinia virus A (May G and Willuhn G, 1985) .

Althaea rosea

The antimicrobial activities of n-hexane, methanol, ethanol, ethyl acetate and water extracts of *Althaea rosea* L. flowers were reported against *Escherichia coli* ATCC 29998, *Escherichia coli* ATCC 25922, *Escherichia coli* ATCC 11230, *Staphylococcus aureus* ATCC 6538, *Staphylococcus aureus* ATCC 29213, *Staphylococcus epidermidis* ATCC 12228, *Salmonella thyphimurium* CCM 5445, *Enterobacter cloacae* ATCC 13047, *Enterococcus faecalis* ATCC 29212, *Pseudomonas aeroginosa* ATCC 27853 as bacteria and *Candida albicans* ATCC 10239 by disc diffusion method (Mert T *et al*., 2010).

Ammannia baccifera

1,4-naphthoquinone and 4-hydroxy-1-tetralone extracted from the crude hexane and ethyl acetate extract of *Ammannia baccifera* showed significant antibacterial activity against *Staphylococcus aureus, Salmonella typhi* and *Pseudomonas aeruginosa* at MIC = 2.35, 2.35, 9.38 for hexane and 150, 150, 300 ppm for ethyl acetate extracts respectively. Alkyl rans-4-hydroxycinnamte which also extracted from the crude hexane and ethyl acetate extract of *Ammannia baccifera*, was found active against only *S. typhi* and *P. aeruginosa* at MIC 250 ppm (Jani S *et al*., 2012). Upadhyay and Thakur found that 4-hydroxyl –a-tetralone extracted from the ethanolic extract of *Ammannia baccifera* , and its semi synthetic compound , 4-O-myricitoyl- a –tertralone were active against *Mycobacterium tuberculosis*. Their MIC was 50 and 100 µg/ ml respectively (Upadhyay HC and Thakur JP, 2013) .

Ammi visnaga

The antimicrobial effects of the ethanolic and aqueous extract of *Ammi visnaga* were tested against eight pathogenic microorganisms *Staphylococcus aureus, Leuconostic mesontroide, Enterococcus faecalis, Escherichia coli, Pseudomonas aeruginosa, Klebsiella pneumoniae, Candida tropicans* and *C. albicans***.** The most active extract against Gram-positive bacteria was ethanol extract with a minimal inhibitory concentration (MIC) value of (5mg/ml) against *Enterococcus faecalis.* In addition, the same extract exerted antimicrobial activity against the Gram-negative bacteria *Escherichia coli, Klebsiella pneumoniae* with an MIC value of 12.5mg/ml. In yeast a high concentration of extract was needed to cause inhibition (Ghareeb AM *et al.*, 2011). The essential oil of *Ammi visnaga* was tested against *Escherichia coli ATCC 25922, Escherichia coli, Staphylococcus aureus ATCC 43300, Staphylococcus aureus, Pseudomonas aeruginosa* ATCC 27853, *Pseudomonas*

aeruginosa, Enterobacter aerogenes, Klebsiella pneumoniae, and *Morganella morganii*. The essential oil exhibited the best antibacterial activity against *Escherichia coli ATCC 25922, Escherichia coli, Staphylococcus aureus ATCC 43300* and *Pseudomonas aeruginosa* ATCC 27853 , the diameter of the inhibitory zones were 29 , 25, 25 , 25 mm respectively[125]. Ethanol extract of *Ammi visnaga* fruits (at a dilution of 1:40) inhibited the growth of *Mycobacterium tuberculosis* H37RVTMC 102. An aqueous extract of the fruits, 2–10 mg/ml inhibited growth and aflatoxin production of *Aspergillus flavus*, the effects were dose-dependent. The aqueous and hydroalcoholic extract of seed and stem of *Ammi visnaga* showed a good antibacterial activity against *Streptococcus mutans*, *Streptococcus salivarius* and *Streptococcus sanguis* oral pathogens (Semyari1 H *et al.*, 2011).

Anagyris foetida

The methanolic extracts of *Anagyris foetida* was examined against sensitive and multidrug-resistant E. coli strain . It reduced the activity of amoxicillin against the sensitive strain but enhanced the activity against resistant strains (Darwish RM and Aburjai TA, 2009).

Anchusa strigosa

The antibacterial activity of the extracted lipid constituents against different bacteria strains, has been investigated. This effect was significant at different concentrations of the extracted lipids (0.01-10mg/ml). It appeared that *Anchusa strigosa* lipids were more effective against Gram positive microorganisms in comparison with Gram negative. The antibacterial activity against Gram positive as follow : *Streptococcus faecalis* > *Staphylococcus aureus* >*Bacillus sp*, while the effect against Gram negative was in the flowing sequent: *Pseudomonas aeruoginosa* > *Proteus sp*. > *E. coli* > *Enterobacter sp.* > *Klebsiella sp*. The volatile oil of *Anchusa strigosa* Lab. exhibits potent antibacterial activity against both Gram positive and Gram negative bacteria, especially in a high concentrations (200 and 500µgm /ml). On the other hand, the fixed oil showed good activity a gainst *Klebsiella sp., Proteus sp*. and *Pseudomonos aeruginosa* especially at higher conc. (500µg. /ml). However, the volatile oil showed greater inhibitory activity when compared to fixed oil . The antibacterial activity of aqueous extracts of *Anchusa strigosa* was also studied on the following fish bacterial pathogens: *Aeromonas hydrophila*, *Photobacterium damselae* subspecies piscicida, *Streptococcus iniae*, and *Vibrio alginolyticus*. A high inhibitory effect (14-19.5 mm) was produced by *Anchusa strigosa* (Abutbul S *et al*., 2005).

Anethum graveolens

The essential oil and different extracts of *Anethum graveolens* seeds exerted antimicrobial activity against wide range of microorganisms. The essential oils and acetone extracts shown antimicrobial activity against *Staphylococcus aureus*, *Bacillus cereus*, *Enterococcus faecalis*, *Listeria monocytogenes*, *Escherichia coli*, *Yersinia enterocolitica*, *Salmonella choleraesuis*, S. typhimurium, Shigella flexneri, Salmonella typhii, *Pseudomonas aeruginosa*, and Mycobacterium. *Anethum graveolens* seed extracts have also been reported to possess anti-ulcer activity, and have shown moderate activity against *Helicobacter pylori*. Aqueous and organic extracts of seeds have exhibited potent antibacterial activity (Stavri M, Gibbons S, 2005; Delaquis PJ *et al*., 2002; Singh G *et al*., 2001).

Anthemis nobelis

The extract and essential oil of Roman chamomile flower head showed antibacterial activity against *P. gingivalis*. The antimicrobial effects were evaluated by disk diffusion method. The results indicated that the means of inhibition zone for chamomile extract and essential oil were 13.33±3.4 and 20.5±0.5 respectively (Saderi H *et al.*, 2005)**.** Azulenes and bisabolol were anti-inflammatory and antispasmodic, reducing histamine-induced reactions, including hay fever and asthma. Flavonoids, especially anthemidin, were also antispasmodic. Valerianic acid and cyanogenic glycosides were sedative**.** Two hydroperoxides compounds isolated from *Anthemis nobilis* showed a medium antibacterial activity (Rücker G *et al*., 1989). In a clinical study , *Anthemis nobelis* showed a good result in the treatment of recurrent aphthous stomatitis as estimated by the time of pain elimination and the duration of the healing (Jafari S *et al*., 2003).

Antirrhinum majus

The antimicrobial assay of different concentrations of plant extract and fractions was studied against selected microorganisms. The results showed that when the concentration of plant extract and fraction was increased the antimicrobial activity also increased. The plant samples exhibited considerable antimicrobial activity against most of the bacterial and fungal strains. Disc diffusion method measured in inhibition zone (IZ) indicated that absolute methanol extract has significant inhibitory activity at the concentration of 10 mg/mL against bacterial strains such as *S. aureus* (IZ = 33.60 mm), *B. subtilis* (IZ 31.40 mm), *P. multocida* (IZ 29.40 mm), *E. coli* (IZ 30.50 mm) and against fungal strains *R. solani*, (IZ 31.10 mm), *A. niger* (IZ 30.30 mm), *A.*

alternata (IZ 27.20 mm) and *A. flavus* (IZ 25.30). The *n*-hexane extract (extracted by soxhlet) showed less activity against all the tested bacterial and fungal strains. It was observed that when the concentration of plant extract and fraction increased to 5 mg/ml some of the strains also inhibited which were resistant at 1 mg/ml concentration. The *n*-butanol fraction was unable to inhibit the growth of *E. coli*. The chloroform fraction was also unable to inhibit the growth of *S. aureus, B. subtilis, A. alternata* and *A. niger*. The ethyl acetate fraction showed significant activity as compared to the other fractions (Riaz M *et al*., 2013).

Apium graveolens

Essential oil and aqueous extract prepared from the aerial parts of *A. graveolens* were tested to determine their antibacterial activity. Essential oil of *A. graveolens* was strongly inhibitory against *Escherichia coli* and moderately inhibitory against *Pseudomonas aeruginosa* and *Staphylococcus aureus* (Baananou S *et al*., 2012). *Apium graveolens* boiling water extract showed a wide zone of inhibition of *E.coli* growth in concentration of 5% (Naema NF *et al.,* 2010) . The antimicrobial activity of *the* liquid carbon dioxide extracts of *Apium graveolens* were tested against *Escherichia coli, Listeria monocytogenes, Citrobacter freundii, Hafnia alvei, Salmonella typhimurium, Bacillus cereus, Enterococcus faecalis, Enterobacter aerogenes, Staphylococcus aureus* and *Proteus vulgaris*. It was found that all the investigated leaf extracts were effective inhibitors of *H. alvei, S. aureus, E. coli, Bac. cereus, E. faecalis* and *E. aerogenes*, however the extracts isolated from the roots were less effective; all of them possessed high activity only against *B. cereus* and *E. faecalis. C. freundii* and *P. vulgaris* were resistant against celery extracts isolated both from roots and leaves (Sipailiene A *et al.,* 2005).

Arachis hypogaea

Peanut seed showed antioxidative and antibacterial activities (Lopes RM *et al*., 2011). Peanut peptides also exerted antimicrobial effects. They were active against *Escherichia coli* O157:H7 and *Listeria* monocytogenes (Quist EE, 2005).

Arctium lappa

Antibacterial activity against Gram negative (*E. coli, Shigella flexneri, and Shigella sonnei*), Gram positive (*Staphylococcus aureus , Bacillus subtilis*) and Mycobacterium , have been documented for *A. lappa*. The lyophilized extract of *A. lappa* was effective against *B. subtilis* and *C. albicans*. Ethyl acetate fraction was used as intracanal medication for 5 days in teeth infected with *C. albicans, E. coli, L. acidophylus, P. aeruginosa* and *S. mutans.* It inhibited microbial growth after 14 days.The antimicrobial activity of rough extracts from leaves of *Arctium lappa* and their phases was tested *in vitro* against microorganisms commonly found in the oral cavity, specifically in endodontic infections, *Enterococcus faecalis, Staphylococcus aureus, Pseudomonas aeruginosa, Bacillus subtilis* and *Candida albicans*. The *Arctium lappa* constituents exhibited a great microbial inhibition potential against the tested endodontic pathogens (Pereira JV *et al*., 2005; Gentil M *et al*., 2006).

Artemisia campestris

The methanolic leaves extract of *A. campestris* exerted antibacterial activity only against Gram-positive with no antagonistic effects against Gram-negative bacterial species. The minimum inhibitory concentrations against *Bacillus subtilis, Staphylococcus aureus, Escherichia coli, Pseudomonas aeruginosa, and Salmonella typhi* were 12.5 , 12.5 , 250 , 500 and 250 µg/ml respectively. The antibacterial activity of *Artemisia compestris* L. essential oil was tested against *Escherichia coli ATCC 25922, Escherichia coli, Klebsiella pneumoniae, Pseudomonas aeruginosa ATCC, Pseudomonas aeruginosa 27853, Salmonella typhimurium, Staphylococcus aureus ATCC 43300, and Staphylococcus aureus.*. The best antibacterial activity was obtained against *Pseudomonas aeruginosa* ATCC 27853 and *Escherichia coli* with 23 mm and 20 mm inhibition zones, respectively (Djidel S and Khennouf S, 2014).

Arundo donax

Aqueous extract of the stem nodes of *Arundo donax* exerted antibacterial activity against methicillin resistant *Staphylococcus aureus* (MRSA) in a concentration of 128 µg/ml. The aqueous extracts of the reed nodes (which contain the white hemicellulose membrane) demonstrated a marked dose-dependent response for anti-biofilm activity, both in preventing MRSA biofilm formation and disrupting established biofilms. These results may suggest that the traditional application of the reed membrane to fresh lacerations may be useful as a prophylactic for biofilm-related infection. The antimicrobial effects of methanolic extracts of 14 medicinal plants species were examined comparing to conventional therapeutic antibiotics against standard bacterial strains (*Staphylococcus aureus, Micrococcus luteus, Klebsiella pneumonia, Escherichia coli and Pseudomonas aeroginosa). Arundo donax* extract showed the maximum effect against *Escherichia coli* and *Pseudomonas aeroginosa* among the examined fourteen medicinal plants species. The antimicrobial effects of 4%

methanolic extracts of *Arundo donax* were comparable to Cephalotin (30mcg), Piperacilin (30mcg) and Amikacin (30mcg) against *Escherichia coli* and *Pseudomonas aeroginosa* (Shirkani A *et al.*, 2014)

Asclepias curassavica

The antibacterial activity of *Asclepias curassavica* was examined against *Bacillus subtilis, Staphylococcus aureus, Proteus vulgaris, Escherichia coli* and *Klebsiella pneumoniae.* Methanol extract was found to exhibit growth inhibition on all tested microorganisms, except *P. vulgaris*. Petroleum spirit extract showed activity against three out of five tested organisms, but comparatively with less activity than methanolic extract. A poor response was obtained by ethyl acetate extract which showed activity against only two microorganisms, *S. aureus* and *B. subtilis*. There was no antibacterial activity for chloroform and hexane extracts . Among all the tested organisms, *P. vulgaris* was found to be resistant and remained unaffected by all extracts. *K. pneumoniae* showed moderate inhibitory zone with three extracts. The effect of petroleum spirit root extract against *E. coli* was so prominent. Among the various solvent extracts of leaf and root tested against different bacteria, the root extracts showed better inhibitory effects than leaf extracts. The crude extracts of petroleum ether, chloroform and methanol and two pure fractions obtained from methanol extract were tested for their antimicrobial property. The crude extract of chloroform was effective against *Pseudomonas solanacearum* and *Escherichia coli* than other extracts. The *in vitro* bioassay of the root extracts of *Asclepias curassavica* Linn. was done by cold percolation and Soxhlet method against four bacterial species, *Staphylococcus aureus*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa* and *Proteus vulgaris* and two fungal species *Candida albicans* and *Aspergillus niger*. The MIC value for root extract of *Asclepias curassavica* was 3.06 mg/ml and the bactericidal concentration was found to be 100 mg/ml (Kurdekar RR *et al*., 2014).

Asparagus officinalis

The antibacterial potential of the ethanolic extracts of *in vitro* grown *A. officinalis* as well as ethanolic extract of undifferentiated callus cells of *A. officinalis* were studied using the paper disc diffusion method against two gram-negative pathogenic bacteria (*Escherichia coli* and *Pseudomonas aeruginosa*) and two gram-positive pathogenic bacteria (*Staphylococcus aureus* and *Bacillus cereus*). Antibacterial effect recorded only for callus extract (100 mg/ml) against *Bacillus cerus.* The rest of the extracts showed no antimicrobial activity in the same concentration against any of the tested pathogenic bacteria. However Naema *et al*., found that aqueous extract of *Asparagus officinalis* showed a wide zone of inhibition when tested against *E. coli* growth in a concentration of 5% (Zhu X *et al*., 2010)

Avena sativa

The 70% ethanolic extract of the *Avena sativa* exerted antibacterial and antifungal activity against gram positive bacteria (*Staphylococcus aureus*), and gram negative bacteria (*E. coli, Proteus vulgaris, Pseudomonas aerugiuosa, and Klebsiella*), *A. niger*, and *Candida* (Ahmed A *et al*., 2012).

Bacopa monniera

Methanol extracts of *Bacopa monniera* were found to be the most potent antimicrobial agent in comparison to other extracts. Aqueous extracts showed no activity against any of the microorganisms. Hexane and petroleum ether extracts showed similar antimicrobial activity but less significant in comparison to methanol extracts. The MIC of the methanol extracts was found to be the lowest against *E.coli, Salmonella typhimurium*, *Staphylococcus aureus* and *Saccharomyces cerevisae* (Mathur A *et al*., 2010). Methanolic extract (1mg/ml) of callus of *Bacopa monnieri* shows good activity against *Staphylococcus aureus*, *Salmonella typhi* and *E. coli* and maximum activity was observed against *Staphylococcus aureus*. No activity was observed against *K. pneumoniae*. Ether extract of Bacopa *monnieri* showed antimicrobial activity against four bacteria and one fungus, *Salmonella typhi, Pseudomonas aeruginos***,** *Staphylococcus aureus, Vibrio cholera* and *Candida albicans* (Azad AK *et al*., 2012)**.**

Ballota nigra

B. nigra subsp. *Anatolica and B. nigra* subsp. *Foetida* showed a good antibacterial activity against *Listeria monocytogenes , L. ivanovii, L. innocua* and *L. murrayi*. However, *B. nigra* subsp. *nigra and B. nigra* subsp. *Uncinata* showed nearly the same activity except against *L. innocua* (Yilmaz BS *et al*., 2005).

The phytochemicals (flavonoids, terpenoids, saponins, tannin, alkaloids, and phenol) in different parts (root, stem, and leaves) of *Ballota nigra* was investigated and correlated to inhibition of microbes (bacteria and fungi), protozoan (Leishmania), and heavy metals toxicity. In root and stem, flavonoids, terpenes and phenols present in ethanol, chloroform, and ethyl acetate soluble fraction; these were found to be the most active inhibiting fractions against all the tested strains of bacteria, fungi, and leishmania. While in leaves, flavonoids, terpenes, and phenols were present in ethanol, chloroform, and n-

butanol fractions which were the most active fractions against both types of microbes and protozoan (leishmania) in *in vitro* study. Ethanol and chloroform fractions show maximum inhibition against *Escherichia coli* (17 mm). The antibacterial effects were correlated with the presence of heavy metals in *Ballota nigra*. The oil was active against both Gram-negative and Gram-positive bacteria as well as against three Candida species. Phenylpropanoid glycosides isolated from generative aerial parts of *Ballota nigra* exhibited moderate antimicrobial activity against *Proteus mirabilis* and *Staphylococcus aureus* including one methicillin-resistant strain (Didry N *et al.*, 1999).

Bauhinia variegata

The antibacterial effects (against *Escherichia coli* MTCC 64, *Enterobacter aerogenes* MTCC 111, *Klebsiella pneumoniae* MTCC 39, *Pseudomonas aeruginosa* MTCC 424, *Salmonella typhi*, *Bacillus subtilis* MTCC 121), of the ethanolic extracts of *Bauhinia variegata* were investigated *in vitro* . It appeared that the extracts were more effective against gram positive compared to gram negative bacteria (Kanak S and Verma Anita K, 2012). The extracts of *B. variegata* and fractions were evaluated for their antibacterial potential against selected bacterial strain (*Staphylococcus aureus*, *Bacillus subtilis* and *Klebsiella pneumonia*). The chloroform and methanolic fractions of *B. variegata were* found to be active against *Staphylococcus aureus, Klebsiella. pneumonia, Bacillus subtilis* and showed high inhibitory zone of (14 nm) at the concentration of 22 mg/ml. The antimicrobial effect of *Bauhinia variegata* L. leaf and bark extract was evaluated on Gram positive species *Staphylococcus aureus* and *Bacillus subtilis* and Gram negative species *Escherichia coli* and *Pseudomonas aeruginosa.* The alcoholic extract of leaves of *Bauhinia variegata* shows maximum antimicrobial activity compared with petroleum ether and chloroform extracts. Ethanolic extract of the stem bark of *B. variegata* exerted antimicrobial activity against *B. subtilis, P. aeruginosa, S. typhi, S. dysenteriae, S. aureus* and *Vibrio cholerae*. It was more effective against gram positive than gram negative bacteria (Jigna P *et al*., 2006). Methanolic extracts of leaves of *Bauhinia variegata* also showed antifungal activity against *Aspergillus fumigates* and *Aspergillus niger* (Sharma RN *et al.*, 1996).

Bellis perenni

The antimicrobial effect of the aqueous and ethanolic extracts of the aerial parts of *Bellis perennis* was studied by *in vitro* method. Among the microorganisms tested, the most susceptible strains were *Staphylococcus epidermidis* MU 30 and *Staphylococcus aureus* MU 38. The antibiofilm effect of the extracts was measured by microplate biofilm method. Ethanolic extract of *Bellis perennis* did not inhibit biofilm formations of the tested microorganisms, however the aqueous extract showed limited anti-biofilm activity against *P. aeruginosa* ATCC 27853, *P. fluorescens* MU 181 and *S.epidermidis* MU 30 at 10 mg/ml concentration. Anti-Quorum Sensing (QS) activity of extracts was determined using biosensor bioassay with *Chromobacterium violaceum* CV026. The concentration of 100 mg/ml of aqueous extract of *Bellis perennis* showed promising anti-QS activity on *Chromobacterium violaceum* CV026 with zone of pigment inhibition of 10mm. Inhibition of QS-regulated violacein production in *Chromobacterium violaceum* ATCC 12472 and swarming motility in *Pseudomonas aeruginosa* PA01 were carried out using standard methods. Aqueous and ethanol extracts of *Bellis perennis* inhibited swarming by 9.5% and 38.1%, respectively. The results suggest that *Bellis perennis* could be an alternative source to explore for useful contents in the fight against bacterial infections (Ceylan O *et al*., 2014). Deca-4,6-diynoic acid and deca-4,6-diyne-1,10-dioic acid showed antimicrobial activity, the two compounds effective against Gram-positive and Gram-negative bacteria, respectively (Avato P, 1997).

Benincasa hispida

The antibacterial activity of seed oil of *B. hispida* was tested against selected pathogens (gram positive, *M. luteus, S. aureus and B. subtilis*; and gram negative, *E. coli, P. multocida and P. aeruginosa*). Maximum mean zone of inhibition was observed against *B. subtilis* (16mm) and the minimum against *Micrococcus luteus* (11mm) (Tahir L *et al*., 2013). However, the antibacterial activity of methanolic extract of *Benincasa hispida* was studied against three gram positive bacteria *Staphylococcus aureus, Staphylococcus epidermidis and Bacillus subtilis* and three gram negative bacteria *Escherichia coli, Pseudomonas aeruginosa* and *Klebsiella pneumonia*. The methanolic extract of *Benincasa hispida* showed no antibacterial activity (Natarajan D *et al*., 2003).

Betula alba

Betulinic acid showed a considerable antibacterial effects, it was active against *Bacillus subtilis, Staphylococcus aureus* and *E coli*, and it also showed a strong inhibition of the urease activity of *Helicobacter pylori* (Shin S *et al.*, 2009).

Bidens tripartita

The antibacterial and antifungal properties of the essential oil were evaluated against eight Gram-positive and 11 Gram-negative bacterial species and 10 fungal strains. The oil exhibited a strong antifungal activity.

Twelve extracts and two essential oils of *Bidens tripartita* were investigated for activity against different Gram-positive *Bacillus subtilis*, *Micrococcus luteus*, *Staphylococcus aureus*, Gram-negative bacteria *Escherichia coli*, *E. coli* (β-lactamase+), *Klebsiella pneumoniae* (ESBL+), *Pseudomonas aeruginosa* and some fungal organisms *Candida albicans*, *C. parapsilosis*, *Aspergillus fumigatus*, *A. terreus* using a broth microdilution and disc diffusion methods. The results obtained indicate antimicrobial activity of the tested extracts (except butanolic extracts), which however did not inhibit the growth of fungi used in this study. Bacteriostatic effect of both essential oils is insignificant, but they have strong antifungal activity (Tomczykowa M *et al*., 2008).

Brassica rapa

The susceptibility of six microorganisms covering gram positive bacteria, gram negative bacteria and two fungi to the extracts and fractions of *Brassica rapa* was measured using cut plug method and the results compared with standard antibiotic gentamycin and the standard antifungal fluconazole. All the tested fractions and crude extracts revealed positive inhibitory effects against *Pseudomonas aeruginosa* and *Bacillus subtilis*.MIC of the two aqueous extracts as well as the ethylacetate fraction of turnip roots of *Brassica rapa* L were calculated as 25mg /ml, 25mg /ml and 12.5 mg /ml respectively (Beltagy AM, 2014).

Bryophyllum calycinum

The antimicrobial effects of petroleum ether, chloroform, methanol and aqueous extracts was evaluated in *vitro* against *Staphylococcus aureus*, *Escherichia coli*, *Pseudomonas aeruginosa* and *Candida albicans*. Methanolic extract of roots *was* found to be most effective antibacterial compared to others, while none of extract showed the activity against *C. albicans* (Quazi MA, 2011). Agar cup plate test was used to determine the sensitivity of the tested *Bryophyllum calycinum* Salisb leaf extracts and the micro-dilution method was used to determine the minimum inhibitory concentration. The aqueous extract was active against all tested microbial strains (Gram-positive :*Staphylococcus aureus* ATCC 25925, *Bacillus subtilis* ATCC 6633, *Staphylococcus epidermis* ATCC 12228 and *Micrococcus luteus* ATCC 10240 ; and Gram-negative : *Enterobacter aerogens* ATCC 13048, *Escherichia coli* ATCC 25922, *Salmonella typhi* ATCC 51812 and *Shigella dysenteriae* ATCC 25931). The aqueous extract showed antimicrobial activity against all tested microorganism with minimum inhibitory concentration ranging between 0.26 to 2.08 mg/ml, while , the MICs of alcoholic extract ranged between 1.04 to 8.32 mg/m. Flavonoids , (5 methyl 4,5,7 trihydroxyl flavone and 4,3,5,7 tetrahydroxy 5-methyl 5-propenamine anthocyanidines) possessed significant antimicrobial activity against *Pseudomonas aeruginosa*, *Klebsiella pneumonia*, *E.coli*, *Staphylococcus aureus*, *Candida albicans* and *Aspergillus niger* (Okwu DE and Nnamdi FU, 2011; Akinpelu DA, 2010).

Caesalpinia crista

The compound, α-(2-hydroxy-2-methylpropyl) -ω-(2-hydroxy -3- methylbut -2- en-1- yl) poly methylene, isolated from ethyl acetate leaf extract of *Caesalpinia crista* was evaluated against *Candida albicans* and *Rhodotorula sp.* using agar diffusion method. The compound exerted a concentration-dependent activity against tested yeast strains comparable to standards fluconazole and griseofulvin for *Candida albicans* and *Rhodotorula sp.* The inhibition zones was (IZ >20 mm) for *C. albicans* and *Rhodotorula sp* (Sagar K and Vidyasagar GM, 2010).

Calamintha graveolens

The crude extracts obtained from the roots and aerial parts of the plant. were evaluated for *in vitro*. antimicrobial activity against five Gram-positive bacteria including *Staphylococcus aureus*., *Micrococcus luteus*, *Mycobacterium smegmatis*, *Bacillus subtilis*, *Bacillus subtilis*. var. *niger*., and three Gram-negative bacteria including *Aeromonas hydrophila*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*., and the yeast *Candida albicans*.. The inhibition zone diameter was determined using the agar well diffusion method at a concentration of 12.5 mg/ml. The acetone extracts of the roots demonstrated significant inhibitory effects against most microorganisms under test. The acetone extracts of the roots of the plant demonstrated significant inhibitory effects against *A. hydrophila* (Ulukanli Z *et al.*, 1996).

Calendula officinalis

The antimicrobial effect of ethanol crude extract of petals and reproductive parts of flowers in different concentrations was evaluated against eight types of bacteria (*Bacillus subtilis*, *Staphylococcus aureus*, *Staphylococcus epidermidis*, *Escherichia coli*, *Klebseilla pneumoniae*, *Pseudomonas aeruginosa*, *Proteus mirabilis* and *Enterococcus pneumoniae*). The extracts of petals part were clearly superior against all bacteria especially *Pseudomonas aeruginosa* (inhibition zone was 25mm in the concentration of 100 mg/ml), and *Staphylococcus aureus* (inhibition zone was 14mm in the concentration 50mg/ml); while the extracts of reproductive parts were

less effective than petals part (Hamad MN *et al.,* 2011). The antimicrobial activity of methanol and ethanol extracts of *Calendula officinalis* petals was tested against clinical pathogens including bacteria and fungi. Methanol extract of *C. officinalis* exhibited better antibacterial activity against most of the tested bacteria, than ethanol extract. The methanol extract and 10% decoction of the plant's flowers showed antimicrobial activity against facultative aerobic periodontal bacteria (*Porphyromonos gingivalis, Prevotella* spp., *Furobacterium nucleatum, Caphocytophaga gingivalis, Veilonella parvula, Eikenella corrodens, Peptostreptococcus micros* and *Actinomyces odontolyticus)* with MIC 2048 mg/l (Iauk L *et al*., 2003). Mouthwashes containing *Calendula officinalis* reduced the number of microorganisms adhered to the sutures after extraction of unerupted third molars compared to the control group (Faria RL, 2001). The antibacterial activities of free oleanolic acid and its glucosides and glucuronides isolated from marigold (*Calendula officinalis*) were investigated. Oleanolic acid inhibited bacterial growth and survival, influenced cell morphology and enhanced the autolysis of Gram-positive bacteria suggesting that bacterial envelopes are the target of its activity (Szakiel A *et al*., 2008).

Calotropis procera

The antimicrobial activity of aqueous and ethanolic extract of roots and leaves of *Calotropis procera* against *Staphylococcus aureus, Streptococcus pyogen, Escherichia coli* and *Pseudomonas aeruginosa* was studied on disc method. Both ethanolic and aqueous extracts of *Calotropis procera* had inhibitory effect on the growth of isolates. The effect exhibited by ethanolic extract of leaves and roots was significantly greater than that of the aqueous extract of leaves and roots. The petroleum ether extract of *Calotropis procera* exhibited the best antibacterial activity against *Pseudomonas aeruginosa* ATCC and *Klebsiella pneumonia* while the chloroform extract was more potent antibacterial against *Pseudomonas aeruginosa* ATCC with 19 mm, 16 mm and 17 mm inhibition zone diameters respectively (Bouratoua A, 2013). The methanolic and aqueous extract of leaves of *Calotropis procera* were subjected to the potential antibacterial against both Gram-positive bacteria (*Staphylococcus aureus, Staphylococcus epidermidis, Staphylococcus saprophyticus* and *Streptococcus pyogenes*) and Gram-negative bacteria (*Plesiomonas shigelloides, Shigella dysenteriae, Vibrio cholerae, Salmonella typhi, Shigella flexneri, Shigella boydii, Shigella sonnei and Pseudomonas aeruginosa*) in agar diffusion method. It was evident that both extracts are active against the bacteria at low concentrations. Antimicrobial activity of solvent extracts of *Calotropis procera* growing wild in Saudi Arabia was evaluated against Gram-positive bacteria (*Staphylococcus aureus* and *Bacillus subtilis*) and Gram-negative (*Pseudomonas aeruginosa* and *Salmonella enteritidis*) using agar well-diffusion method. A bioassay-guided fractionation of the crude flavonoid fraction (Cf3) of methanol extract which showed the highest antimicrobial activity led to the isolation of four flavonoid glycosides as the bioactive constituents. Most of the isolated extracts showed antimicrobial activity against the test microorganisms, where the crude flavonoid fraction was the most active, diameter of inhibition zones ranged between 15.5 and 28.5 mm against the tested bacterial strains, while reached 30 mm against *Candida albicans*. The minimal inhibitory concentrations varied from 0.04 to 0.32 mg/ml against all of the tested microorganisms in case of the crude flavonoid fraction. Quercetin-3-O-rutinoside showed superior activity over the remainder flavonoids. The Gram-positive bacteria (*Staphylococcus aureus* and *Bacillus subtilis*) were more susceptible than the Gram-negative (*Pseudomonas aeruginosa* and *Salmonella enteritidis*), and the yeast species were more susceptible than the filamentous fungi. Calo-protein was purified from the most-active aqueous extracts of *C. procera* and showed broad-spectrum antibacterial activity. Calo-protein inhibited the growth of *S. aureus* and *E. aerogenes* effectively at 25µg/ml concentration. Ethyl acetate, methanol, and aqueous extracts (20µL of the extracts, containing 100 µg of residues), displayed high antimicrobial activity against *E. coli E. aerogenes P. vulgaris P. mirabilis P. aeruginosa* and *S. aureus.* Methanolic extract appeared as the most potent antimicrobial extract, with a diameter of inhibition zone (mm) of 14±0.31, 19±0.2, 23±0.4, 20±0.6, 8±0.12 and 27±0.06 against *E. coli, E. aerogenes, P. vulgaris, P. mirabilis, P. aeruginosa* and *S. aureus* respectively (Samy RP and Chow VTK, 2012; Nenaah G, 2013).

Canna indica

Methanolic extract of *Canna indica* leaves and flowers showed antibacterial activity against *B subtilis*. Ethyl acetate extracts of flowers and stems/ barks also showed activity against *B subtilis*, while, hexane and distilled water extracts of *Canna indica* leaves, flowers and stems/ barks showed no antibacterial activity. The oil showed good antibacterial activity against *Staphylococcus aureus* but mild activity against *Bacillus subtilis* (Indrayan AK, 2011).

Capparis spinosa

The antibacterial activity of petroleum ether, water, butanol, methanol and hexane crude extracts

obtained from the aerial parts of *C. spinosa* was examined by agar well diffusion method. Different fractions exhibited good to moderate degrees of activity against most of the tested bacteria. Extracts were most active against *Staphylococcus epidermidis* and *Streptococcus faecalis*. Crude extract fractions and essential oils obtained from *Capparis spinosa* L. var. *aravensis* from Jordan were examined for antibacterial activity. Antibacterial activities of extract fractions were evaluated *in vitro* against a variety of Gram-positive and Gram-negative bacteria by agar well diffusion. The butanol fraction showed the broadest range of antibacterial efficacy, while the hexane fraction showed the narrowest. . Antibacterial activity tests of essential oils showed that they were antibacterial, and the highest activities were recorded against *Micrococcus luteus* (Muhaidat RM *et al*., 2011). The petroleum ether, methanol, hexane, butanol and aqueous crude extracts of the whole aerial parts of *Capparis spinosa* exhibited variable degrees of antimicrobial activity. Extracts had low to moderate actvity against four bacterial species (*E. coli, S. typhirnurium, B. cereus*, and *Staph. aureus*) (Mahasneh AM *et al*., 1996). Ethanolic and petrolium ether extracts were used to study the antimicrobial activity of *Capparis spinosa* against Gram positive and Gram negative organisms by disc diffusion method. Both extracts shown significant antimicrobial activity against Gram positive organisms, *Bacillus cerus* and *Staphylococus auerus*, and Gram negative organisms, *Pseudomonas aeruginosa* and *E.coli* compared with standard antibiotics (Jagannath R, 2010).

Capsella bursa-pastoris

Soxhlet benzene extracts of *Capsella bursa-pastoris*, exerted an effective antibacterial effects. Alkaloids and flavonoids of Capsella gave the highest antibiotic potencies and had the broadest antimicrobial spectra. Antibacterial activity of ethanolic and aqueous extracts of *Capsella bursa-pastoris* were carried out against eight different species of bacteria, Gram-positive *Staphylococcus aureus* and *Enterococcus fecalis* and Gram-negative *Escherichia coli, Proteus vulgaris, Serratia marcescens, Acinitobacter bumani, Klebsiella pneumoniae* and *Pseudomonas aeruginosa*. It is active antibacterial only against gram-negative bacteria. The ethanolic and aqueous extract showed different activities; the aqueous extract (hot) showed the same or greater activity than the ethanolic extract by disc diffusion. Hot aqueous extract in a concentration of 2000 and 3000 µg/ml inhibited the growth of five gram negative pathogens in almost similar pattern. Ethanolic extract was active only against *Ps. aeruginosa* and *K. pneumoniae*. All isolates were tested by different concentration of sub-MIC of aqueous and ethanolic extracts, these concentrations inhibited or omitted the ability of those isolates to produce virulence factors (DNase, haemolysin production and lipase production) (Hasan RN *et al*., 2013). *C. bursa-pastoris* ethanolic extract showed good antibacterial activity against six oral pathogens [*Streptococcus mutans* (PTCC 1683), *S. sanguis* (PTCC 1449), *Actinomyces viscosus* (PTCC 1202), *Enterococcus faecalis* (ATCC 29212) as oral pathogens and *Staphylococcus aureus* (ATCC 25923) and *Escherichia coli* (ATCC 29922)]. No strain showed resistance against this extract. The effect of *Capsella bursa pastoris* alcoholic extract was assayed on different stages of bacterial growth (*E. coli, Pseudomonas aerogenesis, Staphylococcus aureus, Bacillus cereus*). The results showed that extract caused significant changes in the bacterial growth in different concentrations. A sulforaphane-containing solution (SCS) isolated from shepherd's purse (*Capsella bursa-pastoris*) inhibited vancomycin-resistant enterococci (VRE) and *Bacillus anthracis*. The minimal inhibitory concentration was 250 µg/ml for VRE and 1,000 µg/ml for B. anthracis (Park C J *et al*., 2000). Two novel antimicrobial peptides were isolated and characterized from the roots of shepherd's purse, *Capsella bursa-pastoris*. These antimicrobial peptides, named shepherin I and shepherin II, consist of 28 and 38 amino acids, respectively, and are glycine- and histidine-rich peptides. Shepherin I and shepherin II have 67.9% and 65.8% (mol/mol) glycine, respectively, and 28.6% and 21.1% (mol/mol) histidine, respectively. Both shepherins have a Gly-Gly-His motif. These antimicrobial peptides exhibit antimicrobial activity against Gram-negative bacteria and fungi.

The antibacterial potential of *Capsella bursa-pastoris* MeOH, MeOH/H2O and dichloromethane extracts were screened for activity against five Gram-positive *(Staphylococcus aureus, Staphylococcus epidermidis , Micrococcus luteus , Enterococcus faecalis and Bacillus cereus)* and four Gram-negative *(Proteus mirabilis, Escherichia coli, Pseudomonas aeruginosa and Salmonella typhimurium*) bacteria. The MICs obtained for MeOH and MeOH/H2O extracts were lower than those of dichloromethane. In addition, Gram-positive bacteria were more susceptible than Gram-negative ones (Grosso C *et al.*, 2011).

Capsicum annuum

The butanol extract of *Capsicum annuum* fruit showed high antimicrobial activity against all the tested pathogens while other extracts showed comparatively moderate activity. The ethanol extract (100 mg/ml) of *Capsicum annuum* showed high antimicrobial activity

against *Micrococcus sp* (20 mm), *Bacillus* (10 mm), *E. Coli* (17 mm), *Pseudomonas sp* (16mm) and *Citrobacter sp*(15 mm). The chloroform extract of *Capsicum annuum* showed less antimicrobial activity against all the tested pathogens (Hemalatha N and Dhasarathan P, 2013). The inhibitory effect of the extract of *Capsicum annuum* bell pepper type was evaluated against *Salmonella typhimurium* and *Pseudomonas aeruginosa*, inoculated in minced beef meat mixed with different concentrations of the extract, and stored at 7 degrees °*C* for 7 days. The minimum inhibitory concentration of the extract to prevent the growth of *S. typhimurium* in minced beef was 1.5 ml/100 g of meat. In the case of *P. aeruginosa*, a concentration of 0.3 ml of the extract/100 g of meat showed a bacteriostatic effect, while a concentration of 3 ml/100 g of meat showed a bactericidal effect (Careaga M, 2003). Antibacterial activity of *Capsicum annuum* was evaluated against pathogenic strains isolated from the urinary tract (2 *Klebsiella pneumoniae*, 2 *Pseudomonas aeruginosa* and 2 *E.coli*). The different concentrations of the plant extracts showed antibacterial activity at 5 and 10mg/ml against the tested microorganisms (Shayan S and Saeidi S, 2013).

Capsicum frutescens

C. frutescens exerted antibacterial and antifungal properties. CAY-1, a novel saponin isolated from *C. frutescens*, was found to be active against 16 different fungal strains, it acted by disrupting the membrane integrity of fungal cells (De Lucca AJ *et al*., 2006). The ethanol extract (100 mg/ml) of *Capsicum frutescens* showed high antimicrobial activity against *Micrococcus sp* (17 mm), *Bacillus* (10 mm), *E. Coli* (14 mm), *Pseudomonas sp* (12 mm) and *Citrobacter sp* (13 mm). The chloroform extract of *Capsicum frutescens* showed less antimicrobial activity against all the tested pathogens. The minimal inhibitory concentration of *C. frutescens* was determined against six strains of Gram positive (*Staphylococcus aureus* UFPEDA02, *Enterococcus faecalis* ATCC6057, *Bacillus subtilis* UFPEDA 86*)*, and Gram negative (*Escherichia coli* ATCC25922, *Klebsiella pneumonia* ATCC29665, *Pseudomonas aeruginosa* UFPEDA416) bacteria and one yeast strain (*Candida albicans* UFPEDA 1007), but for all of these microorganisms, the necessary concentrations were higher than 1000 µg/ml. The antifungal potential of aqueous leaf and fruit extracts of *Capsicum frutescens* against four major fungal strains associated with groundnut storage (*Aspergillus flavus, A. niger, Penicillium* sp. and *Rhizopus* sp) was studied. The minimum inhibitory concentrations (MIC) and minimum fungicidal concentration (MFC) of *C. frutescens* extracts were determined. MIC values of the fruit extract were lower compared to the leaf extract. At MIC, leaf extract showed strong activity against *A. flavus* (88.06%), while fruit extract against *A. niger* (88.33%) in the well diffusion method. Groundnut seeds treated with *C. frutescens* fruit extract (10mg/ml) showed a higher rate of fungal inhibition (Soumya SL and Nair BR, 2012).

Carthamus tinctorius

The antibacterial activity of methanol extract of *Carthamus tinctorius* was evaluated against *H. pylori*. The inhibition zone of methanol extract of *Carthamus tinctorius* at concentration 2 mg/disc against *H. pylori* clinical isolates was 18.77±0.56mm, while, MIC and MBC for the same extract were 691.25 691.25 µg/ml respectively. An ethanol extract of the flowers inhibited the growth of *Staphylococcus aureus in vitr*o at a concentration of 0.5 mg/plate, but was not effective against *Escherichia coli*. A 95% ethanol extract of the flowers inhibited the growth of *Bacillus subtilis, Candida albicans, Salmonella typhosa* and *Staphylococcus aureus in vitro* at a concentration of 100 µg/plate, but was not effective against *E. coli* and *Shigella dysenteriae* (Avirutnant W and Pongpan A, 1983).

Carum carvi

Carum carvi volatile oil showed weak antimicrobial activity against *Pseudomonas aeruginosa* and *Candida albicans* at 2% concentration. 1% concentration of the volatile oil was the minimum inhibitory concentration against *Escherichia coli* and 0.5% concentration against *Pseudomonas aeruginosa*. Against *Candida albicans*, caraway volatile oil exhibited antimicrobial activity at all tested dilution (0.5, 1 and 2%) (Grigore C *et al*., 2012). The essential oil of *Carum carvi* L. seeds was screened for its antimicrobial activity against ten pathogenic bacteria and six phytopathogenic fungi. The essential oil showed promising inhibitory activity against all the test bacteria. The minimum inhibitory concentration was 100-300 ppm and minimum bactericidal concentration was 200-400 ppm. Diameter of zone of inhibition (mm) of 2, 3, 10 and 15 (µl/disc) of essential oil of *Carum carvi* seeds against Gram-positive organism were: *Bacillus cereus* 30, 35, 38 and 43; *Bacillus megaterium* 38 42 47 52; *Bacillus subtilis* 38, 40, 43 and 46 ; *Staphylococcus aureus* 29, 34, 38 and 45 respectively, while , the diameter of zone of inhibition (mm) of the same concentrations against Gram-negative organism were: *Escheriachia coli* 31, 33, 36 and 40; *Pseudomonas species* 29, 32, 36 and 41 ; *Salmonella typhi* 27, 32, 35 and 39; *Shigella dysenteriae* 35, 39, 42 and 46 ; *Shigella sonnei* 45, 48, 52 and 59 and *Vibrio cholerae* 35, 38, 42 and 47. Caraway essential oil also inhibited growth of

Salmonella typhi, *Vibrio cholera* and *Mycobacterium tuberculosis*. The microbiological activity of caraway oil obtained from different genotypes was studied in addition to the correlation between the activity and essential oil content. Caraway essential oil exhibited medium antimicrobial activity, the minimal inhibitory concentration of oil, which inhibited standard bacterial strain (*Staphylococcus aureus* ATCC 6538 P) was investigated. MIC value was recalculated to antibiotic units (AU). The microbiological activity of caraway oil of the tested objects was significantly different. The strongest activity was recorded for the oil of genotype Cluj (MIC=0.16 mg/ml; AU=8650), while the weakest activity was determined for oil of population from genotype Krakow (MIC=1.75 mg/ml; AU=582). A significant negative correlation was observed between MIC and carvone content, however positive correlation was observed between MIC and limonene content (Seidler-Łożykowska K, 2013). Antibacterial activity of the essential oil was recorded against Gram-positive and Gram-negative bacterial species in this study. The activity was particularly high against the genera Clavibacter, Curtobacterium, Rhodococcus, Erwinia, Xanthomonas, Ralstonia, and Agrobacterium, a lower activity was observed against bacteria belonging to the genus Pseudomonas (Iacobellis NS *et al*., 2005). The antimicrobial efficacy of pullulan films containing caraway essential oil (CEO) was evaluated. The films were prepared from a 10% of pullulan, containing 0.12% to 10.0% CEO. The composition of the CEO was analyzed with the use of gas chromatography. The antimicrobial activity of the CEO was evaluated with the method of serial microdilutions, and the films containing CEO-with the agar diffusion method against selected Gram-negative, Gram-positive bacteria, and fungi. The structure of the film surface and its cross-section were analyzed using a scanning electron microscope (SEM). Analyses were also carried out to determine the efficacy of a pullulan coating with 10% CEO on baby carrots experimentally inoculated with *Salmonella enteritidis*, *Staphylococcus aureus*, *Saccharomyces cerevisiae*, or *Aspergillus niger* and stored at a room temperature for 7 d. At a concentration of 0.12%, CEO inhibited the growth of all the tested microorganisms. Pullulan films containing 8% to 10% CEO were also active against all tested microorganisms. Populations of *S. aureus* on carrot samples were reduced by approximately 3 log CFU/g, while those of *A. niger* and *S. cerevisiae* by, 5 and 4 log CFU/g respectively, after 7 days of storage. *S. enteritidis* was the most resistant among the tested species, since it was not significantly reduced after 7 days of storage. At the end of storage, samples treated with pullulan-caraway oil coating maintained better visual acceptability than control samples (Gniewosz M *et al*., 2013). The in vitro susceptibility of 15 *H. Pylori* strains to *Carum carvi* seed methanolic extract was studied. Methanol extracts of *Carum carvi* showed anti *H. pylori* effect with MIC of 100 microg/ml (Mahady GB *et al*., 2005).

Cassia occidentalis

Cassia occidentalis showed strong antimicrobial activity against *Staphylococcuss aureus*, *Bacillus subtilis*, *B. protens* and *Vibrio cholerae*. Leaves of *Cassia occidentalis* were extracted with ethanol and water. The extracts were used to carry out antimicrobial screening *in vitro* on *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Escherichia coli*, *Salmonella typhi*, *Shigella spp*. The result showed that these extracts were effective against all tested organisms. The highest activity (diameter of the zone of inhibition was about 18mm) was demonstrated by the ethanol extract of *Cassia occidentalis* leaves against *Salmonella typhi* while the lowest activity (7mm) exerted by the water extract against *Shigella spp*.On the other hand the ethanol extract were not active against *E. coli* at all concentration. The water extract showed inhibition at lower concentration (30 and 60mg/ml) against *E. coli* and *Salmonella typhi* (Sadiq IS *et al*., 2012). The antibacterial activity of the hexane, methanol, chloroform and water extracts of *Cassia occidentials* was tested against *E. coli*, *P. multocida*, *S. typhi*, *S. typhimurium*, *S. pyogenes*, *S. pneumoniae* and *K. pneumoniae*. The results showed that E. coli was the most susceptible microorganism. The antibacterial activity of *Cassia occidentalis* flower extract was evaluated against *Klebsiella pneumoniae*, *Staphylococcus aureus*, *Streptococcus pneumoniae* and *Pseudomonas aeruginosa*. The results showed that all the extracts had activity against *Klebsiela pneumoniae* at a concentration between 30-90 mg/ml. The minimum inhibitory concentration ranged between 35-55 mg/ml for water extract and 25-55 mg/ml for chloroform extract. The minimum bactericidal concentration was 55 mg/ml by both water and chloroform extract. Antibacterial activity (against *Staphylococcus aureus*, *Bacillus subtilis*, *Proteus vulgaris* and *Pseudomonas aeruginosa*) and antitubercular activities was evaluated for petroleum ether, benzene, chloroform and methanol extracts of *Cassia occidentalis* leaves. Several fractions of *C. occidentalis* extracts showed good antibacterial activity (MIC: 2–8 µg/ml) and moderate antitubercular activity (MIC 25-50 µg/ml). Antibacterial activity of various extracts of *Cassia occidentalis* L. seeds was evaluated against three respiratory tract pathogens (*Staphylococcus aureus* MTCC 1144, *Streptococcus pneumoniae* MTCC 655 and *Streptococcus pyogenes*

MTCC 442). The results showed that methanol extract was more active antibacterial than other extracts. The zone of inhibition exhibited by methanol extract against tested microorganisms ranged between 20.9±0.21 to 23.1±0.15 mm. The rate of release of sodium and potassium ions by aqueous and ethanolic extract of leaves of *Cassia occidentalis* was investigated for some selected pathogenic bacteria in the genera Bacillus, Staphylococcus, Echerichia, Streptococcus, Klebsiella, Pseudomonas and Salmonella using flame photometer. The aqueous extract was found to be more effective in the leakage of Na^+ and K^+ ions than the ethanolic extract for all organisms investigated except Salmonella. The aqueous extract released 2.66 ppm sodium ions on *Pseudomonas aeruginosa*, whereas ethanolic extract released 13.3 ppm, while the K^+ions released were 9.282 and 49.980 ppm for ethanolic and aqueous extract, respectively. Comparison of the amount of Na^+ and K^+ ions release by the plant extract with two commercial antibiotic (chloramphenicol and tetracycline) showed that the latter gives a higher value than the former. For sodium ion, *Bacillus substilis* gives 167 ppm and 164 ppm for chloramphenicol and tetracycline respectively where as 2.28 and 3.42 ppm were released by ethanorlic and aqueous extract of the *Cassia occidentalis* responsively. There was no significant difference in the amount of leaked Na^+ ions and potassium ions between the two antibiotics. For Na^+ (Oladunmoye MK *et al*., 2007).

Casuarina equisetifolia

The crude methanolic extracts of bark, wood, leaf and fruits of *Casuarina equisetifolia* and chromatographically isolated compounds were studied for antibacterial and antifungal activity. The screenings of antibacterial and antifungal activities of isolated compounds were compared with ampicillin (10 units/disc) and ketokonazole (10 units/disc) respectively. The isolated compounds have shown activity against Gram negative bacteria and less activity against Gram positive bacteria. Among these, (gallic acid) and (lupeol) have shown good activity against Gram-negative (*E. coli* and *Pseudomonas aeuroginosa)* bacteria. Methanolic extracts of wood, bark and fruit has shown good activity (10.0, 12.0 and 10.0 mm respectively) against Gram positive microorganisms (*Staph. aureous*) while the extracts were without any effect against Gram negative microorganism. Fruit extract has resulted in good antifungal activity against *Candida albicans*. Lupeol, isolated from fruit, showed similar (8.0 mm) antifungal activity. Antibacterial activity of *Casuarina equisetifolia* was tested by the disc diffusion method. Methanolic extracts of the leaves of *Casuarina equisetifolia* showed mild antibacterial activity against Gram positive (*Bacillus subtilis* and *Bacillus cereus)* and Gram negative (*Pseudomonas aeruginosa* and *E. coli).* The diameter of zone of inhibition (mm) for 250µg/disc of the methanolic extract was 8.02 ±0.23, 6.11 ±0.12, 7.23 ±0.27 and 7.14 ±0.33 against *Bacillus subtilis, Bacillus cereus, Pseudomonas aeruginosa* and *E. coli.* Aqueous extract of *Casuarina equisetifolia* was active against *S. epidermidis, B. subtilis, P. pseudoalcaligenes* and *S. typhimurium* (Zone of Inhibition 8-11mm), while, methanolic extract was active against *S. epidermidis, B. subtilis, P. pseudoalcaligenes, P. vulgaris* and *S. typhimurium* (Zone of Inhibition 12-18mm) (Parekh J *et al*., 2005). The antibacterial effect of *Casuarina equisetifolia* was evaluated against *Bacillus cereus ATCC11778, Staphylococcus aureus ATCC25923, Enterobacter aerogenes ATCC13048, Escherichia coli ATCC25922* and *Klebsiella pneumoniae NCIM2719.* The solvents used for the extraction of plant were water and methanol. The *in vitro* antibacterial activity was performed by agar disc diffusion and agar well diffusion method. Water extract of *Casuarina equisetifolia* showed antibacterial effect against *B. cereus* (13mm), *S. aureus* (11mm) and *K. pneumonia* (10mm), while methanolic extract was active against *B. cereus* (19mm), *S. aureus* (17mm), *E. aerogenes* (12mm), *E. coli* (12mm) and *K. pneumonia* (17mm). The antimicrobial activities of leaves extract was investigated against 7 medically important bacterial strains, *Bacillus subtilis*, methicillin-resistant *Staphylococcus aureus* (MRSA), *Micrococcus, Escherichia coli, Pseudomonas aeruginosa* and *Klebsiella pneumoniae* and 4 fungi. The antibacterial activity of aqueous and organic solvents was determined by agar well diffusion method. The most pronounced effect was shown by the methanol extract. The most susceptible bacteria were *S. aureus*, followed by *K. pneumoniae*, while the most resistant bacteria was *B. subtilis* followed by *Micrococcus*. The antifungal activity of aqueous and organic solvents was also determining. The most pronounced effect was shown by ethanolic extract. The most susceptible fungi were *Aspergillus flavus* while the most resistant fungi were *Candida albicans* isolates (Gumgumjee NM and Hajar AS, 2012). The anti-*Helicobacter pylori* and urease inhibition activities of extracts of *Casuarina equisetifolia* were investigated. The extracts exhibited lower activity than the standard antibiotics (Amin M *et al*., 2013).

Celosia cristata

Celosia cristata flowers showed antimicrobial effect. The antimicrobial properties of ethanolic, methanolic and other solvent extracts of *Celosia cristata* L. was evaluated against micro

organisms, *Staphylococcus aureus, Bacillus subtillus, Salmonella typhimurium, Escherichia coli, Pseudomonas aeruginosa* and *Candida albicans*. The minimal inhibitory concentration (MIC) values of the extracts against animal pathogenic bacteria and yeast were assessed using the broth microdilution methods. Results showed that the different extracts differed clearly in their antimicrobial activities. MIC values in the range of 0.125 to 1mg/ml hexane fraction of methanolic and ethanolic extracts exhibited good activity against *Staphylococcus aureus* (0.125mg/ml), *Bacillus subtillus* (0.5mg/ml) and dichloromethane fraction showed similar results (Yun SM *et al*., 2008).

Centaurea cyanus

The drug has an antibacterial effect in vitro (centaurocyanin), but only for the aerial parts of the plant without the flowers. The water, ethanol and ethyl acetate extract of *Centaurea cyanus* were tested against *Agrobacterium radiobacter* var. *tumefaciens*, *Bacillus subtilis*, *Erwinia carotovora*, *Escherichia coli*, *Pseudomonas aeruginosa*, *Ps. fluorescens*, *Sarcina lutea* and *Staphylococcus aureus*, in a concentration of 5, 10, and 15mg/disc. The water and ethanol extracts showed moderate activity against *Staphylococcus aureus* only (Stanojković1 A *et al*., 2002).

Chenopodium album

The extracts of the plant caused varied inhibition of some bacterial strains(Adedapo A *et al*., 2011). The antibacterial effects of *Chenopodium album* ethanolic leaf extract (CAE) was studied against gram positive and gram negative microorganisms. Antibacterial activity was recorded against *Bacillus subtilis* with 13 mm of inhibition zone (Elif Korcan S, 2013). The *in vitro* antimicrobial activities of the flowers and leaves methanolic and ethanolic extracts of *Chenopodium album* was studied against 4 bacterial strains [*Escherichia coli* (ATCC 25922), *Pseudomonas aeruginosa* (ATCC 27853), *Bacillus cereus* (ATCC 1274) and *Staphylococcus aureus* (ATCC25923)]. However, in other studies, the antibacterial activities of *Chenopodium album* was investigated against five human pathogenic bacteria (*Escherichia coli, Salmonella typhimurium, Staphylococcus aureus, Proteus vulgaris* and *Pseudomonas aueruginosa*). The leaf extracts of *Chenopodium album* (aqueous and methanol) exhibited significant antibacterial activity against all the tested bacteria. The aqueous extract performed strongest antibacterial activity against *Staphylococcus aureus* with (25 mm) zone of inhibition and the least antibacterial activity was observed against *Salmonella typhimurium* with (17.75 mm) zone of inhibition. On the other hand, methanol leaf extract of *C album* also displayed potential antibacterial activity against all the tested bacteria. The strongest activity was recorded against *Pseudomonas aeruginosa* with (28.30 mm) zone of inhibition, while, the lowest antibacterial activity was observed against *Salmonella typhimurium* with (14.00 mm) zone of inhibition (Singh PK *et al*., 2011). The zones of growth inhibition of methanol and ethyl acetate extracts of the plant were: 17.3mm against *Staphylococcus aureus* ATCC 25923, 19.7mm against *Bacillus subtilis* UC 564 (19.7 mm), 18.3mm against *Bacillus polymexia* 474, 16.7mm against *Streptococcus faecalis* ATCC 29212, 17.7mm against *Pseudomonas aerugenosa* 25619), 16.7mm against *Salmonella typhi* 57, 17.3mm against *Vibrio cholerae* 824, 17.3mm against *Shigella dysenteriae* ATCC C3, 18.0mm against *Escherichia coli* NCTC 8196, 15.0mm against *Penicillum notatum* ATCC 11625, 16.3mm against *Aspergillus niger* AB 41 and 18.3mm against *Candida albicans* ATCC 18804 (Nayak DP *et al*., 2010). However, Amjad and Alizad mentioned that the flowers and leaves methanolic and ethanolic extracts of *Chenopodium album* don't have any activity against the tested bacterial strains (Amjad L and Alizad Z, 2012).

Chrozophora tinctoria

Antibacterial activity of crude plant extract was carried out against six bacterial strains [three gram-positive bacterial strains, Bacillus subtilis (ATCC 6633), Micrococcus leuteus (ATCC 10240), Staphylococcus aureus (ATCC 6538)] and three gram negative ones, Escherichia coli (ATTCC 1522), Salmonella setubal (ATCC 19196) and Bordetella bronchiseptica (ATCC]. The result showed that the plant extract showed antibacterial activity against three bacterial strains (M. leuteus, B. bronchiseptica, S. Setubal) at the concentrations 5-25mg/ml (Jamil M *et al*., 2012). The antibacterial effect of ethanolic and water extracts of *Chrozophora tinctoria* stems and leaves at different concentrations was evaluated against four endemic bacteria *E coli*, *Staph aereus*, *Ps aeroginesa* and *P mirabilis*. The alcoholic extract of the plant was more potent antibacterial (Diameter of inhibition 10.97mm) than water extract (Diameter of inhibition 5.38mm). The leaves extract was more potent than stems extracts (Diameter of inhibition 8.43 and 7.90 respectively) The concentration of 0mg/l was the more potent (Diameter of inhibition 13.96) followed by the concentration 25mg/l (Diameter of inhibition 11.12mm), then the concentration 10mg/l (Diameter of inhibition 1.03mm) (Saleh TA *et al*., 2009).

CONCLUSION

The paper reviewed the antibacterial effects of the medicinal plants to open the door for their utilization in medical applications as a result of effectiveness and safety.

REFERENCES

Abbruzzese MR, Delaha EC and Garagusi VF. Absence of antimycobacterial synergism between garlic extract and antituberculosis drugs. *Diagnosis and Microbiology of Infectious*, 8, 1987, 79–85.

Abdel Rahman SM, Abd-Ellatif SA, Deraz SF and Khalil AA. Antibacterial activity of some wild medicinal plants collected from western Mediterranean coast, Egypt: Natural alternatives for infectious disease treatment. *African Journal of Biotechnology*, 10(52), 2011, 10733-10743.

Abutbul S, Golan-Goldhirsh A, Barazani O, Ofir R and Zilberg D. Screening of desert plants for use against bacterial pathogens in fish. *Israeli Journal of Aquaculture*, 57(2), 2005, 71-80.

Adedapo A, Jimoh F and Afolayan A. Comparison of the nutritive value and biological activities of the acetone, methanol and water extracts of the leaves of *Bidens pilosa* and *Chenopodium album*. *Acta Pol Pharm*, 68(1), 2011, 83-92.

Adetumbi MA, and Lau BHS. *Allium sativum* (garlic)- a natural antibiotic. *Med Hypotheses*, 12, 1983, 227-237.

Agostini-Costa TS, Gimenes MA and Silveira D. Chemical composition and biological activities of *Arachis* species. *J Agric Food Chem*, 59(9), 2011, 4321–4330.

Ahmed A, Al-Amiery H, Ali A, Al-Temimi RW, Abood H. A study of the biological activities of *Avena sativa* extracts. *Af J Pure Applied Chem*, 4, 2010, 31-34.

Akinpelu DA. Antimicrobial activity of *Bryophyllum pinnatum* leaves. *Fitoterapia*, 71, 2000, 193–194.

Al- Tahan FJ, Al-Janabi AS and Al-Snafi AE. The effect of chronic diazepam treatment in rats on fetal and pup characteristics. *Iraqi J Biol Science*, 14, 1995, 76-80.

Al-Snafi AE and Museher TR. Hypnotic, muscle relaxant, and anticonvulsant effects of Myristica fragrans. *Thi-Qar Medical Journal*, 2(1), 2008, 18-23.

Al-Snafi AE. Bioactive components *and* pharmacological effects of *Canna indica*- An Overview. *International Journal of Pharmacology and toxicology*, 5(2), 2005, 71-75.

Al-Snafi AE. Central nervous and endocrine effects of *Myristica fragrans*. 4th Arabic Conf. of Medicinal plants, Thamar Univ. *Yemen*, 15, 1999, 111-121 .

Al-Snafi AE. The chemical constituents and pharmacological effects of *Capsella bursa-pastoris* - A review. *International Journal of Pharmacology and toxicology*, 5(2), 2015, 76-81.

Al-Snafi AE. The miraculous nature of the prophet medicine: Analytical study. Al Diaa Publication house, Iraq, 2009.

Amin M, Anwar F, Naz F, Mehmood T and Saari N. Anti-*Helicobacter pylori* and urease inhibition activities of some traditional medicinal plants. *Molecules*, 18(2), 2013, 2135-2149.

Amjad L and Alizad Z. Antibacterial Activity of the *Chennopodium album* leaves and flowers extract. *World Academy of Science, Engineering and Technology*, 61, 2012, 903-906.

Arunachalam K. Antimicrobial activity of garlic, onion and honey. *Geobios*, 71, 1980, 46-47.

Ascenzi P; Bocedi A and Marino M. Structure-function relationship of estrogen receptor a and b: impact on human health. Mol. *Aspects Med*, 27, 2006, 299–402.

Avato P, Vitali C, Mongelli P and Tava A. Antimicrobial activity of polyacetylenes from *Bellis perennis* and their synthetic derivatives. *Planta Med*, 63(6), 1997, 503-507.

Avirutnant W and Pongpan A. The antimicrobial activity of some Thai flowers and plants. *Mahidol University Journal of Pharmaceutical Sciences*, 10, 1983, 81-86.

Azad AK, Awang M, Rahman MM. Phytochemical and microbiological evaluation of a local medicinal plant *Bacopa monnieri* (l.) Penn. *International Journal of Current Pharmaceutical Review and Research*, 3(3), 2012, 66-78.

Baananou S, Bouftira I, Mahmoud A, Boukef K, Marongiu B and Boughattas NA. Antiulcerogenic and antibacterial activities of *Apium graveolens* essential oil and extract. *Published online*:DOI: 10.1080/14786419.2012.717284.

Beltagy AM. Investigation of new antimicrobial and antioxidant activities of *Brassica rapa* L. *Int J Pharm Pharm Sci*, 6(6), 2014, 84-88.

Benkeblia N and Lanzotti V. Allium thiosulfinates: chemistry, biological properties and their potential utilization in food preservation. *Food*, 1(2), 2007, 193-201.

Benkeblia N. Antimicrobial activity of essential oil extracts of various onions (*Allium cepa*) and garlic (*Allium sativum*). *Lebensm.-Wiss u –Technol*, 37, 2004, 263-268.

Bolton S, Null G and Troetel WM. The medical uses of garlic-fact and fiction. *J Am Pharm Assoc*, 22, 1989, 40-43.

Bouratoua A, Khalfallah A, Kabouche A, Semza Z, and Kabouche Z. Total phenolic quantification, antioxidant, antibacterial activities and flavonoids of Algerian *Calotropis procera* (Asclepiadaceae). *Der Pharmacia Lettre*, 5(4), 2013, 204-207.

Careaga M, Fernández E, Dorantes L, Mota L, Jaramillo ME and Hernandez-Sanchez H. Antibacterial activity of Capsicum extract against Salmonella typhimurium and Pseudomonas aeruginosa inoculated in raw beef meat. *Int J Food Microbiol*, 83(3), 2003, 331-335.

Cellini L, Di Campli E, Masulli M, Di Bartolomeo S and Allocati N. Inhibition of *Helicobacter pylori* by garlic extract (*Allium sativum*). *FEMS Immunol Med Micrbiol*, 13, 1996, 273-277.

Ceylan O, Ugur A and Sarac N. *In vitro* antimicrobial, antioxidant, antibiofilm and quorum sensing inhibitory activities of *Bellis perennis* L. *J BioSci Biotech*, 2014, 35-42.

Conner DE and Beuchat LR. Effects of essential oils from plants on growth of food spoilage yeasts. *Journal of Food Science*, 49, 1989, 429-434.

Darwish RM and Aburjai TA. Antimicrobial activity of some medicinal plants against different Candida species. *Jordan Journal of Pharmaceutical Sciences*, 4(1), 2011, 70-80.

Darwish RM and Aburjai TA. Effect of ethnomedicinal plants used in folklore medicine in Jordan as antibiotic resistant inhibitors on Escherichia coli. *BMC Complement Altern Med*, 2010, 10-9.

De Lucca AJ, Boue S, Palmgren MS, Maskos K and Cleveland TE. Fungicidal properties of two saponins from *Capsicum frutescens* and the relationship of structure. *Canadian Journal of Microbiology*, 52(4), 2006, 336-342.

Delaquis PJ, Stanich K, Girard B *et al.* Antimicrobial activity of individual and mixed fractions of dill, cilantro, coriander and eucalyptus essential oils. *Int J Food Microbiol*, 74, 2002, 101-109.

Didry N, Seidel V, Dubreuil L, Tillequin F and Bailleul F. Isolation and antibacterial activity of phenylpropanoid derivatives from *Ballota nigra*. *J Ethnopharmacol*, 67(2), 1999, 197-202.

Djidel S and Khennouf S. Radical scavenging, reducing power, lipid peroxidation inhibition and chelating properties of extracts from *Artemisia campestris* L. aerial parts. *Annual Research & Review in Biology*, 4(10), 2014, 1691-1702.

Elif Korcan S, Aksoy O, Erdoğmuş SF, Ciğerci İH and Konuk M. Evaluation of antibacterial, antioxidant and DNA protective capacity of *Chenopodium album*'s ethanolic leaf extract. *Chemosphere*, 90(2), 2013, 374-379.

Faria RL, Cardoso LM, Akisue G, Pereira CA, Junqueira JC, Jorge AO and Santos Júnior PV. Antimicrobial activity of *Calendula officinalis*, *Camellia sinensis* and chlorhexidine against the adherence of microorganisms to sutures after extraction of unerupted third molars. *J Appl Oral Sci*, 19(5), 2011, 476-482.

Fitzpatrick FK. Plant substances active against *Mycobacterium tuberculosis*. *Antibiotics and Chemotherapy*, 4, 1954, 528–529.

Focke M, Feld A, and Lichtenthaler K. Allicin, a naturally occurring antibiotic from garlic, specifically inhibits acetyl-CoA synthetase. *FEBS Lett*, 261, 1990, 106-108.

Gentil M, Pereira JV, Silva-Sousa, YTC, Sousa-Neto M D, Vansan LP and França SC. *In vitro* evaluation of the antibacterial activity of *Arctium lappa* as a phytotherapeutic agent used in intracanal dressings. *Phytother Res*, 20(3), 2006, 184-186.

Ghaima KK. Antibacterial and wound healing activity of some *Agrimonia eupatoria* extracts. *J Baghdad for Sci*, 10(1), 2013, 152-160.

Ghareeb AM, Zedan TH , and Gharb LA. Antibacterial and antifungal activities of *Ammi visnaga* extracts against pathogenic microorganisms. *Iraqi Journal of Science*, 52(1), 2011, 30-36.

Gniewosz M, Kraśniewska K, Woreta M and Kosakowska O. Antimicrobial activity of a pullulan-caraway essential oil coating on reduction of food microorganisms and quality in fresh baby carrot. *J Food Sci*, 78(8), 2013, M1242-1248.

Gonzalez-Fandos E, Garcia-Lopez M L, Sierra M L, and Otero A. Staphylococcal growth and enterotoxins (A-D) and thermonuclease synthesis in the presence of dehydrated garlic. *J Appl Bacteriol*, 77, 1944, 549-552.

Grigore C, Colceru-Mihuli S, Paraschiv I, Nita S, Christof R, Iuksel R and Ichim M. Chemical analysis and antimicrobial activity of indigenous medicinal species volatile oils. *Romanian Biotechnological Letters*, 17(5), 2012, 7620-7627.

Grosso C, Vinholes J, Silva L R, de Pinho B G, Gonçalves R F, Valentão P, Jäger A K and Andrade P B. Chemical composition and biological screening of *Capsella bursa-pastoris. Brazilian Journal of Pharmacognosy*, 21(4), 2011, 635-644.

Gumgumjee NM and Hajar AS. Antimicrobial efficacy of *Casuarina equisetifolia* extracts against some pathogenic microorganisms. *Journal of Medicinal Plants Research*, 6(47), 2012, 5819-5825.

Hamad MN, Mohammed HJ and Merdaw MA. Antibacterial activity of *Calendula officinalis* flowers in vitro. Ibn Al-Haitham J. *Pure & Appl Sci*, 24(3), 2011, 1-7.

Hasan RN, Ali M R, Shakier S M, Khudhair M M, Hussin M S, Kadum Y A, Mohammed A I and Abbas A A. Antibacterial activity of aqueous and alcoholic extracts of *Capsella Bursa* against selected pathogenic bacteria. *American Journal of BioScience*, 1(1), 2013, 6-10.

Hautmann C. and Scheithe K. Fluid extract of *Agropyron repens* for the treatment of urinary tract infections or irritable bladder. Results of multicentric post-marketing surveillance. *Zeitschrift für Phytotherapie*, 21(5), 2000, 252-255.

Hemalatha N and Dhasarathan P. Comparative study on the antimicrobial activity of *Capsicum annuum* and *Capsicum frutescens. International Journal of Ethnomedicine and Pharmacological Research*, 1(1), 2013, 142-147.

Hsu W, Weissman SA and Kim J. Antimicrobial activity of greater galangal [*Alpinia galanga* (Linn.) Swartz.] flowers. *Food Science and Biotechnology*, 19(4), 2010, 873-880.

Humayun AT, Hussain MB , Yasir M and Sikandar S. *In vitro* antibacterial activity of onion (*Allium cepa*) against clinical isolates of *Vibrio cholera*. *J Ayub Med Coll Abbottabad*, 22 (2), 2010, 160-163.

Iacobellis NS, Lo Cantore P, Capasso F and Senatore F. Antibacterial activity of *Cuminum cyminum* L. and *Carum carvi* L. essential oils. *J Agric Food Chem*, 53, 2005, 57–61.

Iauk L, Lo-Bue AM, Milazzo I, Rapisarda A and Blandino G. Antibacterial activity of medicinal plant extracts against periodontopathic bacteria. *Phytother Res*, 17, 2003, 599-604.

Indrayan A K, Bhojak N K, Kumar N , Shatru A and Gaura A. Chemical composition and antimicrobial activity of the essential oil from the rhizome of *Canna indica* Linn. *Indian Journal of Chemistr*, 50, 2011, 1136-1139.

Jafari S, Amanlou M, Borhan-Mojabi K, and Farsam H. Comparative study of *Zataria multiflora* and *Anthemis nobelis* extracts with *Myrthus communis* preparation in the treatment of recurrent aphthous stomatitis. *Daru*, 11(1), 2011, 301.

Jagannath R. Phytochemical and pharmacological screening on roots of *Capparis spinosa* F (capparidaceae). MSc thesis, HKES College of Pharmacy, Gulbarge, 2010.

Jamil M, ul Haq I, MirzaB and Qayyum M. Isolation of antibacterial compounds from *Quercus dilatata* L. through bioassay guided fractionation . *Annals of Clinical Microbiology and Antimicrobials*, 11, 2012, 1-11.

Jani S, Shukla V J, Harisha C R . Phytochemical and pharmacognostical investigation on *Ammania baccifera Linn* (Stem and Leaf). *International Journal of Pharmaceutical and Biological Archives*, 3(4), 2012, 884-887.

Jigna P, Nehal K and Sumitra C. Screening of some traditionally used medicinal plants for potential antibacterial activity. *Indian Journal of Pharmaceutical Science*, 68(6), 2006, 832-834.

Kabelik J. Antimikrobielle Eigenschaften des Knoblauchs. *Pharmazie*, 25, 1970, 266-270.

Kanak S and Verma Anita K. Evaluation of antimicrobial and anticancer activities of methanol extract of *in vivo* and *in vitro* grown *Bauhinia variegata* L. *International Research Journal of Biological Sciences*, 1(6), 2012, 26-30.

Khare CP. Indian medicinal plants, an illustrated dictionary. Springer Science and Business Media, LLC, 2007.

Kurdekar RR, Hegde GR and Hebbar SS. Antimicrobial efficacy of *Bridelia retusa* (Linn.) Spreng. and *Asclepias curassavica* Linn. *Indian Journal of Natural Products and Resources*, 3(4), 2012, 589-593.

Mahady GB, Pendland SL, Stoia A, Hamill FA, Fabricant D, Dietz BM and Chadwick LR. *In vitro* susceptibility of *Helicobacter pylori* to botanical extracts used traditionally for the treatment of gastrointestinal disorders. *Phytother Res*, 19(11), 2005, 988-991.

Mahasneh AM, Abbas JA and Aqlah AA .Antimicrobial activity of extracts of herbal plants used in the traditional medicine of Bahrain. *Phytotherapy Res*, 10, 1996, 251-253.

Mahmoud MJ, Jawad AL, Hussain AM, Al-Omari M and Al-Naib A. *In vitro* antimicrobial activity of *Salsola rosmarinus* and *Adiantum capillus-veneris. Int J of Crude Drug Research*, 27, 1989, 14-16.

Mathur A, Verma SK, Purohit R, Singh SK, Mathur D, Prasad G and Dua VK. Pharmacological investigation of *Bacopa monnieri* on the basis of antioxidant, antimicrobial and anti-inflammatory properties. *J Chem Pharm. Res*, 2(6), 2010, 191-198.

May G and Willuhn G. Antiviral activity of aqueous extracts from medicinal plants in tissue cultures. *Arzneim-Forsch*, 28(1), 1985, 1-7.

Mert T, Fafal T, Kıvçak B and Oztürk, HT. Antimicrobial and cytotoxic activities of the extracts obtained from the flowers of *Alcea rosea* L. *Hacettepe University Journal of the Faculty of Pharmacy*, 30(1), 2010, 17-24.

Muhaidat RM, Al-Qudah MA, Al-Shayeb AS, Jacob JH, Al-Jaber HI, Hussein EI, Al-Tarawneh IN and Abu Orabi ST. Chemical profile and antibacterial activity of crude fractions and essential oils of Capparis ovata Desf. and Capparis spinosa L. (Capparaceae). *Int J Integ Biol*, 14(1), 2013, 39-47.

Naema NF, Dawood B and Hassan *S.* A study of some Iraqi medicinal plants for their spasmolytic and antibacterial activities. *Journal of Basrah Researches*, 36(6), *2010, 67-73.*

Natarajan D, Lavarasan RJ, Chandra babu S, Sahib MACS, Refai T and Thameemul-Ansari LH. Antimicrobial studies on methanolic extract of *Benincasa hispida*. *Ancient science of life*, 2003, 98-100.

Nath KVS, Rao KNV, Sandhya S *et al. In vitro* antibacterial activity of dried scale leaves of *Allium cepa* linn. *Der Pharmacia Lettre*, 2(5), 2010, 187-192.

Nayak DP, Swain PK , Panda OP , Pattanaik P and Srinivas B. Antimicrobial and anthelmintic evalution of *Chenopodium album*. *IJPWR*, 1(4), 2010, 1-15.

Neamah NF. A Pharmacological evaluation of aqueous extract of *Alhagi maurorum*. *Global Journal of Pharmacology*, 6(1), 2012, 41-46.

Nenaah G. Antimicrobial activity of *Calotropis procera* Ait. (Asclepiadaceae) and isolation of four flavonoid glycosides as the active constituents. *World J Microbiol Biotechnol*, 29(7), 2013, 1255-1262.

Okwu DE and Nnamdi FU. Two novel flavonoids from *Bryophyllum pinnatum and* their antimicrobial Activity. *Pharmceutical Chemistry Journal*, 3(2), 2011, 1-10.

Oladunmoye MK, Adetuyi FC and Akinyosoye FA. Release of sodium and potassium ions by aqueous and ethanolic extract of *Cassia occidentalis* on some selected bacteria. *Trends in Applied Sciences Research*, 2(1), 2007, 85-87.

Oonmetta-aree J, Suzuki T, Gasaluck P, and Eumkeb G. Antimicrobial properties and action of galangal (*Alpinia galanga* Linn.) on *Staphylococcus aureus*. *Lebenson WissTechnol(LWT)*, 39, 2006, 1214-1220.

Parekh J, Jadeja D and Chanda S. Efficacy of aqueous and methanol extracts of some medicinal plants for potential antibacterial activity. *Turk J Biol*, 29, 2005, 203-210.

Park C J, Park C B, Hong S S, Lee H S, Lee S Y and Kim S C. Characterization and cDNA cloning of two glycine- and histidine-rich antimicrobial peptides from the roots of shepherd's purse, *Capsella bursa-pastoris*. *Plant Mol Biol*, 44(2), 2007, 187-197.

Pereira JV, Bergamo DCB, Pereira JO, Franca SC and Va-Sousa YTC. Antimicrobial activity of *Arctium lappa* constituents against microorganisms commonly found in endodontic infections. *Braz Dent J*, 16(3), 2005, 192-196.

Petkov V. Bulgarian traditional medicine: A source of ideas for phytopharmacological investigations . *J Ethnopharmacol*, 15, 1986, 121-132.

Pooter D, Omar HL, Coolsaet MN and Schamp BA, The essential oil of greater galanga (*Alpinia galanga*) from Malaysia. *Phytochemistry*, 24, 1985, 93-96.

Pradeep P, Leena P and Bohra A. *In vitro* antibacterial activity of fronds (leaves) of some important pteridophytes. *Journal of Microbiology and Antimicrobials*, 2(2), 2010, 19-22.

Quazi MA, Nazim S, Afsar S, Siraj S and Patel MS . Evaluation of antimicrobial activity of roots of *Kalanchoe pinnata*. *Int J Pharmacol Bio Sci*, 5(1), 2011, 93-96.

Quist EE. Peanut (*Arachis hypogaea* L.) as a sourse of antihypertensive and antimicrobial peptides . MSc thesis , Graduate Faculty of the University of Georgia, Athens, 2005.

Rabinkov A, Miron T, Konstantinovski L, Wilchek M, Mirelman D, and Weiner L. The mode of action of allicin: trapping of radicals and interaction with thiol containing proteins. *Biochim Biophys Acta*, 1379, 1988, 233-244.

Rahman A, Kim EL, and Kang SC. Antibacterial and antioxidant properties of *Ailanthus altissima* swingle leaves extract to reduce foot borne pathogens and spoiling bacteria . *Journal of Food Safety*, 29, 2009, 499-510.

Rahman S, Fukamiya N, Okano M, Tagahara K and Lee KH. Anti-tuberculosis activity of quassinoids. *Chem Pharm Bull* (Tokyo), 45(9), 1997, 1527-1529.

Ramadan MA and Safwat NA. Antihelicobacter activity of a flavonoid compound isolated from *Desmostachya Bipinnata*. *Australian Journal of Basic and Applied Sciences*, 3(3), 2009, 2270-2277.

Rao RR, Rao SS, Natarajan S and Venkataraman PR. Inhibition of *Mycobacterium tuberculosis* by garlic extract. Nature (London), 1946, 157.

Rattanachaikunsopon P, and Phumkhachorn P. Diallyl sulfide content and antimicrobial activity against food-borne pathogenic bacteria of chives (*Allium schoenoprasum*). *Biosci Biotechnol Biochem*, 72(11), 2008, 2987-2991.

Riaz M, rasool N, Rasool S, Bukhari IH, Zubair M, Noreen M and Abbas M. Chemical analysis, cytotoxicity and antimicrobial studies by snapdragon: A medicinal plant. *Asian Journal of Chemistry*, 25(10), 2013, 5479-5482.

Ross I A. Medicinal Plants of the world: Chemical Constituents, Traditional and Modern Medicinal Uses, Humana Press, Totowa, 2001, 1-9.

Rücker G, Mayer R and Lee KR. Peroxides as plant constituents. 6. Hydroperoxides from the blossoms of Roman camomile, *Anthemis nobilis* L. *Arch Pharm*,322(11), 1989, 821-826.

Saderi H, Owlia P, Hosseini A and Semiyari H. Antimicrobial effects of chamomile extract and essential oil on clinically isolated *Porphyromonas gingivalis* from periodontitis. *Acta Hort*, 6, 2005, 680.

Sadiq IS, Shuaibu M, Bello AB, Tureta SG, Isah A, Izuagie T, Nasiru S and Kamaru MB. Phytochemistry and antimicrobial activities of *Cassia occidentalis* used for herbal remedies. *Journal of Chemical Engineering*, 1(1), 2012, 38-41.

Sagar K and Vidyasagar GM. Antimicrobial activity of α-(2-hydroxy-2-methylpropyl)-ω-(2-hydroxy-3-methylbut-2-en-1-yl) polymethylene from *Casalpinia bonducella* flem. *Indian journal of pharmaceutical Science*, 72(4), 2010, 497-500.

Saleh TA, Al-Jboori WM and Al-Muhammadi AF Effect of Turnsoles Chrozophora tinctoria L. Extracts on Some Pathological Bacteria Types. *Al-Anbar Journal of Agricultural Sci*, 7(1), 2009, 369-378.

Samy RP and Chow VTK. Pilot study with regard to the wound healing activity of protein from *Calotropis procera* (Ait.) R. Br. *Evidence-Based Complementary and Alternative Medicine* 2012, 10.1155/2012/294528.

Seidler-Łożykowska K, Kędzia B, Karpińska E and Ja Bocianowski J. Microbiological activity of caraway (*Carum carvi* L.) essential oil obtained from different origin. *Acta Scientiarum. Agronomy*, 35(4), 2013, 495-500.

Semyari1 H, Owlia P, Farhadi S and Saeed Tabrizi M. Evaluation of anti-microbial effect of *Ammi visnaga* against oral streptococci. *Journal of Microbiology and Antimicrobials*, 3(5), 2011, 126-129.

Sharma RN, Saxena VK. *In vitro* antimicrobial efficacy of leaves extracts of *Bauhinia variegata* Linn. *Asian J Chemistry*, 8(4), 1996, 811-812.

Sharma VD. Antibacterial property of *Allium sativum. In vivo* and *in vitro* studies. *Indian Journal of experimental Biology*, 15, 1980, 466-469.

Shayan S and Saeidi S. Antibacterial and antibiofilm activities of extract *Capsicum annuum* L on the growth and biofilm. *International Research Journal of Applied and Basic Sciences*, 5 (4), 2013, 513-518.

Shin S, Park C E, Baek N I, Chung I C and Park C H. Betulinic and oleanolic acids isolated from *Forsythia suspensa* VAHL inhibit urease activity of *Helicobacter pylori*. *Biotechnology and Bioprocess Engineering*, 14(2), 2009, 140-145.

Shirkani A, Mozaffari M and Zarei M. Antimicrobial effects of 14 medicinal plant speices of dashti in Bushehr province. *Iranian south Medical Journal*, 17(1), 2014, 49-57.

Singh G, Kapoor IPS, Pandey SK *et al.* Studies on essential oils: part 10: Antibacterial activity of volatile oils of some spices. *Phytother Res*, 16, 2001, 680-682.

Singh M, Singh N, Khare PB and Rawat AKS. Antimicrobial activity of some important Adiantum species used traditionally in indigenous systems of medicine. *J Ethnopharmacol*, 115, 2008, 327-329.

Singh PK, Dwevedi AK and Dhakre G. Evaluation of antibacterial activities of *Chenopodium album* L. *International Journal of Applied Biology and Pharmaceutical Technology*, 2(3), 2011, 398-401.

Sipailiene A, Venskutonis PR, Sarkinas A and Cypiene V. Composition and antimicrobial activity of celery (*Apium graveolens*) leaf and root extracts obtained with liquid carbon dioxide, 2005 .

Small LD, Bailey JH and Cavalitto CJ. Alkylthiosulphinates. *Journal of the American Chemical Society*, 69, 1949, 1710.

Soumya SL and Nair BR. Antifungal efficacy of *Capsicum frutescens* L. extracts against some prevalent fungal strains associated with groundnut storage. *Journal of Agricultural Technology*, 8(2), 2012, 739-750.

Stanojković1 A, Ceković G, Čomić L, Pivić R and Stanojković A. Antibacterial properties of some plants from the family Asteraceae growing wild in Serbia. *LEK SIROV*, 26/27, 2008, 11-20.

Stavri M, Gibbons S. The antimycobacterial constituents of Dill (*Anethum graveolens*). *Phytother Res*, 19, 2005, 938-941.

Sulaiman GM. Antimicrobial and cytotoxic activities of methanol extract of *Alhagi maurorum. Afr J Microbiol Res*, 7(16), 2013, 1548-1557.

Szakiel A, Ruszkowski D, Grudniak A, Kurek A, Wolska KI, Doligalska M and Janiszowska W. Antibacterial and antiparasitic activity of oleanolic acid and its glycosides isolated from marigold (*Calendula officinalis*). *Planta Med*, 74(14), 2008, 1709-1715.

Tachakittirungrod S and Chowwanapoonpohn S. Comparison of antioxidant and antimicrobial activities of essential oils from *Hyptis suaveolens* and *Alpinia galanga* growing in Northern Thailand. *CMU J Nat Sci*, 6, 2007, 31-42.

Tahir L, Chand B and Rahman S. Antibacterial study on *Benincasa hispida* and *Nigella sativa* oil. *J Pharm*, 4 (4), 2013, 121-122.

Tomczykowa M, Tomczyk M, Jakoniuk P and Tryniszewska E. Antimicrobial and antifungal activities of the extracts and essential oils of *Bidens tripartite*. *Folia Histochemica Et Cytobiologica*, 46(3), 2008, 389-393.

Turker A and Usta C. Biological activity of some medicinal plants sold in Turkish Health-food stores. *Biodiversity Ecosyst*, 34(19), 2002, 105-113.

Ulukanli, Z, Ulukanli S, Ozbay H, Ilcim A and Tuzcu M. Antimicrobial activities of some plants from the eastern anatolia region of Turkey. *Int J Pharmacol*, 43, 2005, 334-339.

Upadhyay H C and Thakur J P. Anti- tubercular agents from *Ammannia baccifera* (Linn) . *Med Chem Res*, 22, 2013, 16-21.

Valiei M, Shafaghat A and Salimi F. Chemical composition and antimicrobial activity of the flower and root hexane extracts of *Althaea officinalis* in Northwest Iran. *Journal of Medicinal Plants Research*, 5(32), 2011, 6972-6976.

Watkins F, Pendry B, Sanchez-Medina A and Corcoran Antimicrobial assays of three native British plants used in Anglo-Saxon medicine for wound healing formulations in 10th century. *England. J Ethnopharmacol*, 144(2), 2012, 408-415.

Whitemore BB, Naidu AS. Thiosulfinates. In: Naidu AS (Ed) *Natural Food Antimicrobial Systems*, CRC Press, Boca Raton, Florida, USA, 2000, 265- 380 .

Willis ED. Enzyme inhibition by allicin, the active principle of garlic. *Biochemical Journal*, 63, 1969, 514.

Yamada Y and Azuma K. Evaluation of the *in vitro* antifungal activity of allicin. *Antimicrobial Agents and Chemotherapy*, 11, 1997, 743-749.

Yilmaz BS, Altanlar N, Citoglu GS. Antilisterial activity of Ballota species growing in Turkey. *Ankara Ecz Fak Derg*, 34(3), 2005, 155-164.

Yun S M, Choi B H, Ku H O, Lee M H, Nam H M , Lee K J , Park S W, Jang H J and Son S W. Antimicrobial activities of the flower extract of *Celosia cristata* L. *Planta Med*, 74, 2008, PA31.

Zain ME, Awaad MS, Al-Outhman1 MR and El-Meligy RM. Antimicrobial activities of Saudi Arabian desert plants. *Phytopharmacology***,** 2(1), 2012, 106-113**.**

Zhao CC, Shao JH, Li X, Xu J and Zhang P. Antimicrobial constituents from fruits of *Ailanthus altissima* Swingle. *Arch Pharm Res*, 28(10), 2005, 1147-1151.

Zhu X, Zhang W, Zhao J, Wang J and Qu W. Hypolipidaemic and hepatoprotective effects of ethanolic and aqueous extracts from *Asparagus officinalis Asparagus officinalis* L. by products in mice fed a high-fat diet. *Journal of the Science of Food and Agriculture*, 90(7), 2010, 1129–1135.