Peppermint essential oil

Its major constituents are flavonoids and the ess. Oil containing mainly of Menthol (30-55%) and menthone (14-32%) (together with other monoterpenes as: limonene (13,5%), cineole (3,5-8%), menthofuran (1-8%), isomenthone (1,5-10%) and menthyl acetate (2,8-10%).

The aqueous extract of *Mentha piperita* leaf, at the i.p doses 200 and 400 mg/kg, showed significant analgesic effects against both acetic acid-induced writhing and hot plate induced thermal stimulation in mice, with protection values of 51.79% and 20.21% respectively (Taher, 2012).
A significant antiviral activity was reported in aqueous extracts of peppermint leaves towards Influenza A, Newcastle disease virus, Herpes simplex virus and Vaccinia virus, in egg and cell culture systems (Herrmann & Kucera, 1967). The antibacterial and antifungicidal activity was demonstrated in several studies, especially with peppermint oil. The inhibition of the growth of *Salmonella typhimurium*, *Staphylococcus aureus* and *Vibrio parahaemolyticus* were achived with addition of ground leaves to the agar medium at concentrations of 0,1-2,0% (w/v) (Aktug & Karapinar, 1986). On another study was observed the reduction of the number of plaques of the rinderpest virus with aqueous and ethanol extracts of the leaves of *Mentha piperita* , at concentrations of 4-8mg/ml (Alwan et al, 1988).
In a study by Baszczyk at al. (2000), extracts of 56 widely used dried Chinese medical plants or their parts (TCD) (were screened for their antimycotic properties against pathological phyla of *Aspergillus fumigates, Candida albicans, Geotrichum candidum* and *Rhodotorula rubra*. Herba Menthae (*Mentha haplocalyx Briq., Mentha piperita* L.) extract has antimycotic properties against all screened fungi phyla.
Peppermint oil showed antimicrobial and antiplasmid activity, demonstrating a synergistic additive interaction with oxytetracycline (Schelz et al. 2006).

The study from Mimica-Dukic et al (2003), described the antimicrobial activity and free radical scavenging capacity (RSC) of essential oils from *Mentha piperita* L. in particular against multiresistant strain of *Shigella* sonei and *Micrococcus flavus* ATTC 10240. All tested oils showed significant fungistatic and fungicidal activity, considered higher than those of Bifonazol.

Renoprotective action

A study was carried out to evaluate the renoprotective effect of *Mentha piperita* against gentamicin induced nephrotoxicity. Fresh plant leaves of *M. piperita* were collected from, Pakistan. A total of 24 male rabbits were divided into four groups of 6 each and each group was treated independently , group C with 0.9% saline only 2 ml/kg (i.m) for 21 days, group G with gentamicin 80 mg/kg (i.m) for 21 days, group GM-pi with gentamicin 80 mg/kg (i.m) + *M. piperita* 200 mg/kg (p.o) for 21 days and the group M-pi with *M. piperita* 200 mg/kg (p.o) for 21 days. Three rabbits in each group were sacrificed on day 21 of study period for examination of the kidneys. Histological examination of the kidneys of Group G showed proximal tubular necrosis with loss of cellular pattern.
Glomerular atrophy and ruptured tubules with hydropic changes were also observed while in case of Group C animals' normal tubules with no evidence of necrosis and normal glomeruli or hydropic changes were observed. Groups GM-pi and M-pi also showed normal histology with no common abnormality or significant toxicity. Significant rise in the serum creatinine, blood urea nitrogen and serum uric acid with fall in creatinine clearance were observed in Group G animals

when compared with control, which was reversed to almost control values in the extract treated animals. The authors refer that it showed the protective role of *M. piperita* against toxic effects of gentamicin on kidney. They concluded that concurrent administration *M. piperita* successfully prevented renal damage associated with gentamicin, explored by various biochemical and histological examinations. Further, the study also shows that concomitant use of ***M. piperita* does not decline the efficacy of gentamicin** with respect to its antibacterial activities (Naveed et al., 2014)

Oregano essential oil

Mainly consists of Polyphenolic components, flavonoids and coumarins (such as salvianolic acid, in addition to the known depsides rosmarinic acid and rosmarinic acid methylester, monoterpenes: caffeic acid; flavonoids: apigenin, kaempferol, quercetin, eriodictyol, taxifolin, narigenin etc) and triterpenes such as oleanolic and ursolic acid while its ess oil comprises of monoterpenes: carvacrol, γ-terpinene and p-cymene etc

Antimicrobial ability

Origani dictamni herba and preparations

Origanum dictamnus and its close relatives, *Origanum vulgare* and *Origanum majorana* proved very active against the used *Helicobacter* strains. The minimal inhibition concentration (MIC) was also identified for the extract (around 2.50 mg/ml) (Stamatis *et al.* 2003).

Moreover the methanol extract and especially the isolated polar compounds from *Origanum dictamnus* (salvianolic acid (1), rosmarinic acid methyl ester (3), thymoquinone (4), thymoquinol 2-O-β-glucopyranoside (5); oresbiusin A (6), -caffeic acid (7); eriodictyol (11), taxifolin (12), naringenin (13) and 12-hydroxyjasmonic acid (14) showed MIC values 0.012-0.22 millimol/ml) and have been proved active against the Gram-negative clinical strains *Acinetobacter haemolyticus*, *Empedobacter brevis*, *Pseudomonas aeruginosa* and *Klebsiella pneumonia* (Chatzopoulou *et al.* 2010).

Antioxidant activity

Studies conducted for various plants of Lamiaceae family and among them *Origanum sp.* by the Umezawa method have shown that its methanol extract has antioxidant action identical with α-tocopherol (the antioxidant activity in relation to α-tocopherol, is estimated in α-tocopherol units according to the ration Δ A sample/ Δ A tocopherol where Δ A sample is the absorption of the control – absorption of the sample solution and Δ A tocopherol is the absorption of the control-absorption of the solution containing tocopherol) (Couladis *et al.* 2003 The oil of the plant when given to rats induces the activity of glutathione S-transferase (GST) in some tissues. This particular enzyme is considered to possess protective role against chemical mutagens (Lam & Zheng 1991). The traditional use for relief of minor skin inflammations and bruises is well known traditionally (Bazaios 1982; Platakis 1975; Zaharopoulos 1980)

Tea tree essential oil

Melaleuca alternifolia (Maiden and Betch) Cheel, *M. linariifolia* Smith, *M. dissitiflora* F. Mueller and/or other species of *Melaleuca*, members of the botanical family Myrtaceae, well known as *"Tea Tree"* (Saller *et al.* 1998). The chemical composition of TTO (tea tree oil)

consists of 42.35% terpinen-4-ol, 20.65% γ-terpinene, 9.76% α-terpinene, 3.71% terpinolene, 3.57% 1,8-cineole etc (Bozzuto *et al.* 2011).
The oil exhibits a broad spectrum of antimicrobial activity *in vitro* although its efficacy *in vivo* remains relatively unsubstantiated. Antibacterial activity against *Staphylococcus aureus,* both methicillin-susceptible (MSSA) and -resistant (MRSA) has been demonstrated (Carson *et al.* 1996).
MIC values: *Streptococcus* spp. (0.03-0.12%), vancomycin-resistant enterococci (VRE) (0.5-1%), *Acinetobacter baumannii* (0.06-1 %), *Escherichia coli* (0.12-0.25%), *Klebsiella pneumoniae* (0.12-0.5%), *Candida albicans* (0.12-0.25%), other *Candida* species (0.120.5%) and ***Malassezia furfur*** **(0.12-0.25%). The wide range of organisms susceptible to TTO suggests that it may be useful for skin antisepsis**. (Carson *et al.* 1998; Longbottom *et al.* 2004).

ANTIFUNGAL ACTIVITY

The antifungal activity of TTO are very wellknown as Mondello *et al.* (2003) investigated the *in vitro* antifungal activity against clinical isolates pathogenic yeasts: in vitro against *Candida albicans* resistant to fluconazole and/or itraconazole, and *in vivo* activity in an experimental vaginal infection using fluconazole–itraconazole-susceptible or -resistant strains of *C. albicans.* Liu X *et al.* 2009).
Antimycotic properties of TTO and its principal components were compared with the activity of 5-fluorocytosine and amphotericin B. The majority of the organisms were sensitive to the essential oil, with TTO and terpinen-4-ol being the most active oils showing antifungal activity at MIC values lower than other drugs (Oliva *et al.* 2003). The *in vitro* activities of TTO against *Malassezia* species was shown. *M. furfur* was the least susceptible species. *M. sympodialis*, *M. slooffiae*, *M. globosa*, and *M. obtusa* showed similar susceptibilities (Hammer *et al.* 2000).
Carson *et al.* (2006) summarised the antifungal activity of TTO against several fungal species published by many researchers. The MICs values were 0.03 and 0.5% and fungicidal concentrations from 0.12 to 2%.
ANTISEPTIC AND DISINFECTANT ACTIVITY Effective skin antisepsis and disinfection are key factors in preventing many healthcare-acquired infections associated with skin microorganisms, particularly *Staphylococcus epidermidis*. The antimicrobial efficacy of chlorhexidine digluconate, a widely used antiseptic in clinical practice, alone and in combination with TTO was studied. Chlorhexidine digluconate exhibited antimicrobial activity against *S. epidermidis* in both suspension and biofilm (MIC 2–8 mg/L) as well as TTO (2–16 g/L), but no synergistic effect was found for combination of chlorhexidine digluconate with TTO (Karpanen *et al.* 2008).
An investigation was carried out to determine the effect of Burnaid, a commercial TTO preparation, against *Enterococcus faecalis* ATCC29212, *S. aureus* ATCC29213, *E. coli* ATCC25922 and *Pseudomonas aeruginosa* ATCC27853.The organisms were suspended in sterile saline (density of 0.5 McFarland Standard) and inoculated onto horse blood agar (*E. faecalis* and *S. aureus*) or
ANTIPROTOZOAL ACTIVITY – Carson *et al.* (2006) reported that TTO has antiprotozoal activity. TTO caused a 50% reduction in growth of the protozoa *Leishmania major* and *Trypanosoma brucei* at concentrations of 403 mg/ml and 0.5 mg/ml, respectively.

Thyme essential oil

Numerous pharmacological activities are reported for thyme extr and ess oil as well as for the for the isolated compound thymol and/or carvacrol, proving in vitro antibacterial (against Gram-positive, Gram-nagative bacteria, some anaerobes and some of them were clinicaly isolates as multi-drug resistant strains), antifungal (against medically important yeasts, moulds, and dermatophyes) and pediculicidal activity.

Definition Essential oil obtained from the aerial parts of *Thymus vulgaris* L., *T. zygis* Loefl. ex. L. or a mixture of both species consists mainly of thymol, p-cymene, carvacrol etc (Takeuchi et al. 2004, Kitajima et al. 2004, Stahl 1991). —p-Cymene: 14.0 – 28.0%, γTerpinene: 4.0-12.0%, Thymol: 37-55%, and Carvacrol: 0.5-5.5.%.

Antibacterial activity

The extr and ess. oil exerts a strong antibacterial activity on Gram-positive and Gramnegative bacteria. The activity is mainly attributed to thymol and carvacrol (numerous articles published, e.g., Simeon de Buochberg et al. 1976, Janssen et al. 1986, Menghini et al. 1987, Patakova et al. 1974, Allegrini et al. 1972, Janssen 1989, Farag et al. 1986, Lens-Lisbonne et al. 1987, Vampa et al. 1988, Chalchat et al. 1991, Dorman et al. 2000, Hersch-Martinez et al. 2005).

MIC (depending on the thyme oil tested) from 6.25 to 100 µg/mg *Bacillus cereus, B. subtilis, S. aureus, S. epidermidis, E. faecalis, E coli, K. pneumonaie, P. vulgaris, P. aeruginosa, Salmonella* Typhi Mancini et al. 2015 *Acinetobacter baumannii, Klebsiella pneumoniae, Pseudomonas aeruginosa* (multi-drug resistant isolates) MIC 0.25-4 %v/v Sakkas et al. 2016
Antifungal activity- **Anti-dermatophytal activity of thyme oil or/and thymol** The essential oil is highly antifungal, when tested on fungi and yeasts, e.g. *Candida albicans*. This activity is mainly attributed to phenol compounds thymol and carvacrol.
Thymol interferes with the formation and viability of hyphae and induces morphological alterations in the envelope of *Candida albicans* (Braga et al. 2007), *Aspergillus flavus* and *A. niger* (Paster et al. 1990) and at concentrations of <= 500 ppm completely inhibits dose-dependently fungal growth and mycotoxin production of *Aspergillus flavus*, *A. parasiticus*, *A. ochraceus* and *Fusarium moniliforme* (Soliman & Badeaa 2002, Bogavac et al. 2015. Chaftar et al. 2016 Horváth et al. 2016 Kumar et al. 2016)
against *Trichophyton mentagrophytes*, *T. rubrum* and *T. tonsurans in vivo against* on 2months old Wistar rats. During the 37-day observation period the oil – treated rats were cured (Sokovic et al. 2008). In dilution assays thyme oil showed much higher antifungal potency than the commercial fungizide bifonazole (Sokovic et al. 2009; Tullio et al. 2007; Chaftar et al. (2016).
Anti-inflammatory activity— Thyme oil inhibits prostaglandin biosynthesis, thymol was less active in the COX-inhibition test (Wagner et al. 1986). thymol may have a helpful effect in the control of inflammatory processes present in many infections (Braga et al. 2006). modulation of infamatory response (Fachini-Queiroz et al. 2012. Carvacrol showed reduction of IL-1b and TNF-a at the proetin and mRNA levels. Thymol also modulate inflammatory response of stimulated mouse macrophages with reduciotn of IL-1b expression (Gholijani et al. 2015).
Wound healing After topical treatment of burned rats with thyme oil (1:1 diluted with olive oil) an increase in the formation of new tissue could be observed (Dursun et al. 2003).
Insecticidal actions Thyme oil is lethal against adult *Oryzaephilus surinamensis*, *Rhyzopertha dominica* and *Sitophilus oryzae* (Shaaya et al. 1991). Good insecticidal activity (>90%) against larvae of *Lycoriella ingenua* was achieved with thyme oil at 30 x 10^{-3} mg/1 air. (Jeong et al. 2008).

Mosquito control Thymol and carvacrol are potent repellents in concentrations of about 0.05% in topical treatment (Choi et al. 2002, Park et al. 2005).
Antihelmintic actions Thyme oil in solutions of 1:2000 caused the death of ascarides in vitro. Non-phenolic constituents demonstrated less activity (Akacic & Petricic 1956).
Antiparasitic Thyme oil is effective against *Trypanosoma cruzi*. Thymol may be the main component responsible for the trypanocidal activity (Santoro et al. 2007).

Mastic oil essential oil & water

mastix is the dried resinous exudate obtained from stems and branches of *Pistacia lentiscus* L. with a content of minimum 10 ml/kg of essential oil (anhydrous drug), is an oleoresin obtained from mastic tree (*Pistacia lentiscus* L.). It is also often referred to in the literature as Chios Mastic Gum (CMG) from its main origin, the Greek island of Chios. It consists of i) Natural polymer identified as cis-1,4-poly-β-myrcene (van den Berg *et al*. 1998), ii)Triterpenes of oleanane and lupane skeleton type such as mastic acid, isomastic acid, oleanolic acid, tirucallol etc (PDR 2007), iii) Monoterpene hydrocarbons, 20% oxygenated monoterpenes and sesquiterpenes as well as iv)of Polyphenols, phytosterols **Mastic water** has been also referred to in the literature (Perikos 1986; TopitsoglouThemeli *et al*., 1984; 1985; Vlastos et al., 2013). Mastic water is a flavouring water obtained in large quantities together with mastic oil during the steam distillation of mastic resin. It is a 100% natural aqueous extract that contains all the water soluble components of mastic gum as well as a small amount (0.5–1% V/V) of mastic oil

Antimicrobial activity of mastic, mastic oil

Several studies have been conducted to investigate mastic's antimicrobial properties, Mastic resin has been proven to have a wide range of antimicrobial activity against Grampositive (+) and Gram-negative (-) bacteria, as well as in other pathogenic microorganisms. (Iaouk 1996;)

The antibacterial activity of **mastic oil** can be attributed to the combination of several components rather than to one particular compound. It is also interesting to note that different bacteria are susceptible or not to different compounds of the essential oil. (Tassou & Nychas 1995; Magiatis *et al*., 1999; Koutsoudaki *et al*., 2005).
Very recently pistacia's lentiscus extracts and fractions (neutral, acidic, powder and essential oil) have been assayed against several strains of *Malassezia* fungi (human and veterinary pathogenic ones) were they exerted very promising strong activities. (Velegraki et al. 2016)
Velegraki A., K Graikou, H Damianakos, S Kritikou, E Smyrnioudis, **I Chinou** Antifungal activity of *Pistacia lentiscus* L. growing in the island of Chios-Greece against *Malassezia* sps Planta Med 2016; 82(S 01): S1-S381 DOI: 10.1055/s-0036-1596885

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