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Study of pharmacological effect of *Mentha pulegium*: A review

Sepideh Miraj[1] and Sadegh Kiani[2*]

[1]*Assistant Professor, Fellowship of Infertility, Cellular and Molecular Research Center, Shahrekord University of Medical Sciences, Shahrekord, Iran*
[2]*Student of Nursing, Islamic Azad University, Shahrekord Branch, Shahrekord, Iran*

ABSTRACT

Mentha pulegium, commonly pennyroyal, also called squaw mint, mosquito plant and pudding grass[1], is a species of flowering plant in the family Lamiaceae native to Europe, North Africa, and the Middle East.The aim of this study was to overview its therapeutic effects than its nutritive and industrial effects. This review article was carried out by searching studies in PubMed, Medline, Web of Science, and Iran Medex databases .The initial search strategy identified about 128 references. In this study, 113 studies was accepted for further screening and met all our inclusion criteria [in English, full text, therapeutic effects of Mentha pulegium and dated mainly from the year 1964 to 2015.The search terms were "Mentha pulegium.", "therapeutic properties", "pharmacological effects". It is commonly used for itsmetabolism, Acaricidal effects, hepatotoxicity, anti-hepatic, antibacterial activity, antioxidant effect, Anti-steel corrosion, relaxant effects, spasmolytic effect, Anti-genotoxic effects, antimicrobial activity, anti-myometrium.Mentha pulegiumlis a plant of high significance.

Keywords: Mentha pulegium L. Phytochemicals, Therapeutic effects, Pharmacognosy, Alternative and complementary medicine.

INTRODUCTION

Mentha pulegium, commonly (European) pennyroyal, also called squaw mint, mosquito plant and pudding grass[1], is a species of flowering plant in the family Lamiaceae native to Europe, North Africa, and the Middle East[2, 3].Crushed pennyroyal leaves exhibit a very strong fragrance similar to spearmint. Pennyroyal is a traditional culinary herb, folk remedy, and abortificient. The essential oil of pennyroyal is used in aromatherapy[4-6], and is also high in pulegone, a highly toxic volatile organic compound affecting liver and uterine function. Although it was commonly used for cooking in the Middle Ages, it gradually fell out of use as a culinary herb and is seldom used as such today[7]. The fresh or dried leaves of the plant were used to flavor pudding. Pennyroyal oil is extremely poisonous .Pennyroyal is used to make herbal teas, which, although not proven to be dangerous to healthy adults in small doses, is not recommended, due to its known toxicity to the liver[8].Consumption can be fatal to infants and children .It has been traditionally employed as an emmenagogue (menstrual flow stimulant) [9, 10] or as an abortificient. Pennyroyal is also used to settle an upset stomach and to relieve flatulence [11,12]The fresh or dried leaves of pennyroyal have also been used when treating colds, influenza, abdominal cramps, and to induce sweating, as well as in the treatment of diseases such as smallpox and tuberculosis, and in promoting latent menstruation. Pennyroyal leaves, both fresh and dried, are especially noted for repelling insects [13-15]. However, when treating

infestations such as fleas [16], using the plant's essential oil should be avoided due to its toxicity to both humans and animals, even at extremely low levels [16-18].

Phytochemical compound
A distinct polyphenol profile between P. tridentatum and M. pulegium was found. Taxifolin, myricetin, ginestin, ginestein, and ginestein derivatives, biochanin A-glucoside, and biochanin A were identified in P. tridentatum[19, 20], whilst in M. pulegium the luteolin-7-rutinoside, diosmin, and apigenin and respective derivatives were most representative polyphenols[21, 22]

Metabolic effect
Cell culture for induction of some secondary metabolites of M. pulegiumwas examined and compares it with native one. The Pulegone was fond more in natural plants than cell culture mass. The most important secondary metabolites were increased by cell culture containing of salicylic acid and yeast extract elicitors in M. pulegone [23].

Acute hepatotoxicity of pennyroyal oil was reviewed. This study presents the investigational tools used in the study of pennyroyal oil, allowing the reader to not only appreciate these methods but also utilize them to tackle and better understand metabolism-based toxicity in their own projects [24].

Acaricidal effects
the acaricidal effects of herb essential oils (pennyroyal, ylangylang, citronella, lemon grass, tea tree, and rosemary) at different doses and exposure times on house dust mites Dermatophgoidesfarinae and D. pteronyssinus were examined. Of these essential oils, the most effective was pennyroyal, which is composed essentially of pulegone (> 99%), at a dose of 0.025 microliter/cm(2), which at an exposure time of 5 min killed more than 98% of house dust mites. The results show that herb essential oils, in particular, pennyroyal was proved to have potent acaricidal activity [25].

Hepatotoxicityeffect
the ability of the specific cytochrome P450 inhibitors disulfiram and cimetidine to mitigate hepatotoxicity in mice exposed to toxic levels of R-(+)-pulegone was assessed and it suggest that R-(+)-pulegone metabolism through CYP1A2 appears to be more important in the development of a hepatotoxic metabolite than does metabolism via CYP2E1[26].

Anti-Hepatic effect
Hepatic and neurologic injury developed in two infants after ingestion of mint tea. Examination of the mint plants, from which the teas were brewed, indicated that they contained the toxic agent pennyroyal oil. It is a possible cause of hepatic and neurologic injury in infants, particularly if the infants may have been given home-brewed mint teas [27].

Antibacterial effect
Benefits and phytochemicals of this plant was evaluated. Results showed consistent evidence that Pterospartumtridentatum and Mentha pulegium are an important reservoir of phytochemicals with antiradical activity and antibacterial capacity and thus they might be used in a preventive way or in a combined pharmaceutical and antibiotic therapy against pathogenic bacteria [28].

Antioxidant effect
The metabolite profile of methanolic extracts from two Lamiacea medicinal plants was investigated. The distribution of phenolic compounds in the methanolic extract showed a variation among studied plants. Mentha pulegium can be considered as a source of gallocatechin[29].

In an in vitro study, the most suitable solvent for extraction of antioxidants was investigated and correlation existed between plant growth stage and its antioxidant capacity was examined. The TLC chromatogram of the two extracts showed differences in the number of separated compounds of extracts. HPLC results indicated that the fraction collected with washing buffer (pH = 6) had highest antioxidant activity [30].

Antioxidative activities of the essential oil, methanol and water extracts of Iranian pennyroyal in vegetable oil during storage were evaluated. Water extract was more potent than the methanol extract. Essential oil did not show

considerable antioxidative effect. It seems that water extract of M. pulegium is a potent antioxidant which makes it as a potential antioxidant for oil and oily products during storage [7].

The compounds were also tested for kinase inhibitory activity in an assay involving 24 different kinases. Compounds 1, 2, 3, and the mixture of 4 and 5 were the most potent inhibitors, displaying EC (50) values between 0.64 and 1.4 microg/mL toward individual kinases [2].

Anti-steel corrosion effect
The inhibitory effect of Mentha pulegium extract on steel corrosion in 1 M HCl solution was investigated. The remarkable inhibition efficiency of MPE was discussed in terms of blocking of electrode surface by adsorption of inhibitor molecules through active centres. The adsorption of MPE was found to accord with the Temkinisotherm [31].

Relaxant effects
the relaxant activity of the essential oil of Mentha pulegium L. (EOMP) and pulegone in rat isolated tracheal and bladder smooth muscles was evaluated. The findings suggests that EOMP induced relaxant responses in pre-contracted smooth muscles of rat trachea and bladder, which are likely to be mediated via inhibition of calcium entry, mainly by its major compound, pulegone. These effects are coherent with the popular use of EOMP as an antispasmodic agent [32].

Spasmolytic effect
Organic extracts from aerial parts were evaluated to determine their spasmolytic action on rat isolated ileum test. Findings indicate that dichloromethanic extract of M. pulegium induced its spasmolytic effect through Ca2+-influx blockade, which may explain its traditional use against diarrhea [33].

Anti-genotoxic effects
Anti-oxidant capacity, anti-oxidant activity and anti-genotoxic effects ofmethanolic extract of Mentha pulegium were investigated. A significant decrease in the level of MDA was observed when compared with CCl_4 alone treated group. In addition, anti-genotoxic effect of ME was studied by using sister chromatid exchange (SCE) method. As a result, ME has shown anti-genotoxic effect depend on anti-oxidative effect on human lymphocyte culture [35].

Antimicrobial effect
Two new terpenoidal compounds 1α, 6βdimethyl-5β-hydroxy-4β-(prop-1-en-2-yl)-decahydronaphthalen-2-one (1) and 1-(O-β-D-glucopyranosyl)-2,7-dimethyloct-5-en-3-one (2) were isolated from the chloroformic extract of Mentha pulegium L. Compound 1 displayed moderate anti-microbial effect[34].

The antibacterial activity of Mentha pulegium essential oil on isolates of Klebsiella was investigated. Thirty nine isolates were collected from urine specimens submitted to two educational hospitals in Urmia, Iran. The results suggest the potential use of the Mentha pulegium essential oil for the control of multi-drug resistant Klebsiella sp. infections. However, more adequate toxicological study must be carried out to verify the possibility of using it for fighting microorganisms in human [10].

Antimicrobial activity of flowering aerial parts of Mentha pulegium L. essential oil against different microorganisms was examined and it showed that the oil of Mentha pulegium L. has a potent antimicrobial activity and the Iranian Mentha pulegium L. oil belongs to piperitone/piperitenone type. Further research is required to evaluate the practical values of therapeutic applications [36].

Anti-myometrium effect
The effects of the essential oil of Mentha pulegium L. were assessed on the isolated rat myometrium. Results show that the essential oil of the abortifaceant plant Mentha pulegium exerts an inhibitory effect on the contractile activity of the isolated rat myometrium. This oil shares a common effect with the voltage-dependent calcium channel (VDCC) blocker nifedipine, although ostensibly acting via a different mechanism[37].

Toxicity
Metal exposure through herbal mint teas does not seem to be of health concern, as to most of the studied metals, but regulatory limits for Al contents should be imposed [38].

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