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REVIEW ARTICLE

Mentha pulegium: Medicinal uses, Anti-Hepatic, Antibacterial, Antioxidant effect and Analysis of Bioactive Natural Compounds: A Review

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ABSTRACT:
Mentha pulegium is a species of flowering plant in the family Lamiaceae native to Europe, North Africa and the Middle East. Crushed pennyroyal leaves exhibit a very strong fragrance similar to spearmint. A large number of the recipes in the Roman cookbook of Apicius call for the use of pennyroyal, often along with such herbs as lovage, oregano and coriander. 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. Consumption can be fatal to infants and children. Pennyroyal leaves, both fresh and dried, are especially noted for repelling insects. Pennyroyal essential oil should never be taken internally because it is highly toxic; even in small doses, consumption of the oil can result in death. Antioxidative activities of the essential oil, methanol and water extracts of Iranian pennyroyal in vegetable oil during storage were evaluated. 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.

KEYWORDS: *Mentha pulegium*, Anti-Hepatic, Antibacterial, Antioxidant, Bioactive Compounds.

1.INTRODUCTION

Mentha pulegium, commonly (European) pennyroyal, or pennyrile, also called squaw mint, mosquito plant and pudding grass. Pennyroyal is a traditional culinary herb, folk remedy, and abortifacient[1-4]. The essential oil of pennyroyal is used in aromatherapy, and is also high in pulegone, a highly toxic volatile organic compound affecting liver and uterine function. Pennyroyal was commonly used as a cooking herb by the Greeks and Romans. The ancient Greeks often flavored their wine with pennyroyal. 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. The leaves of the plant were used to flavor pudding[2-6].

Even though pennyroyal oil is extremely poisonous, people have relied on the fresh and dried herb for centuries. Early settlers in colonial Virginia used dried pennyroyal to eradicate pests. Pennyroyal was such a popular herb that the Royal Society published an article on its use against rattlesnakes in the first volume of its Philosophical Transactions in 1665[7-11]. It has been traditionally employed as an emmenagogue (menstrual flow stimulant) or as an abortifacient. Pennyroyal is also used to settle an upset stomach and to relieve flatulence. 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[12-19]. However, when treating infestations such as fleas, using the plant's essential oil should be avoided due to its toxicity to both humans and animals, even at extremely low levels[20-29]. The metabolite menthofuran is thought to be the major toxic agent. Complications have been reported from attempts to use the oil for self-induced abortion. For

example, in 1978, an 18-year-old pregnant woman from Denver, Colorado, died within one week after consuming one ounce of concentrated Pennyroyal oil in an attempt to self-induce abortion. There are numerous studies that show the toxicity of pennyroyal oil to both humans and animals[30-33].

1. *Mentha pulegium*: 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*, whilst in *M. pulegium* the luteolin-7-rutinoside, diosmin, and apigenin and respective derivatives were most representative polyphenols Table 1.

Table 1. Major phytochemical compounds identified in *Mentha pulegium*.

Part of plant	System	Effects	Preparation	References
leaves	Human food and beverage	flavor pudding	fresh or dried	4
		teas	fresh or dried	6
	Medicinal	emmenagogue	Water extract	6
		abortifacient	Water extract	6
		colds, influenza, abdominal cramps, and to induce sweatin	fresh or dried	7
		relieve flatulence	fresh or dried	8
		smallpox and tuberculosis	fresh or dried	8
		promoting latent menstruation	fresh or dried	8
	Biological And pharmaceutical	repelling insects	fresh or dried	7
		treating infestations	fresh or dried	9
		Metabolic effect	tea	23
	Treatment	Acaricidal effects		25
		Hepatotoxicity effect		26
		Anti-Hepatic effect		27
		Antibacterial effect		28
		Antioxidant effect		29
	Pharmacological and biological Activities	Anti-steel corrosion effect		31
		Relaxant effects		32
		Spasmolytic effect		33
		Anti-genotoxic effects		35
		Antimicrobial effect		34
		Anti-myometrium effect		37

2. 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* [34-37].

3. 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 [38-41].

4. Antibacterial effect:

Benefits and phytochemicals of this plant was evaluated. Results showed consistent evidence that *Pterospartum tridentatum* 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.

5. 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.

6. Hepatotoxicity effect:

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[42-46].

7. Antioxidant effect:

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. 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. 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 [47-50]. 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.

8. 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.

9. 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 precontracted 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[51].

10. 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[52].

11. Anti-genotoxic effects:

Anti-oxidant capacity, anti-oxidant activity and anti-genotoxic effects of methanolic 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[53].

12. 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. 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[54].

13. Anti-myometrium effect:

The effects of the essential oil of *Mentha pulegium* L. were assessed on the isolated rat myometrium. Studies 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 [55-57].

CONCLUSION:

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. *Mentha pulegium* can be considered as a source of gallocatechin.

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