

Review on composition and antimicrobial effects of *Teucrium polium* L.) grown in Iran and comparison with the around the world

R. Mahmoudi (PhD)^{*1}, M. Kazeminia (MSc)², A. Kaboudari (DVM)³

1. Health Products Safety Research Center, Qazvin university of Medical Sciences, Qazvin, I.R.Iran

2. Faculty of Public Health, Qazvin University of Medical Sciences, Qazvin, I.R.Iran

3. Faculty of Veterinary Medicine, University of Tabriz, Tabriz, I.R.Iran

J Babol Univ Med Sci; 19(2); Feb 2017; PP: 54-64

Received: Oct 11th 2016, Revised: Nov 26th 2016, Accepted: Jan 15th 2017.

ABSTRACT

BACKGROUND AND OBJECTIVE: *Teucrium polium* plant from Lamiaceae family and evolvable in a range of climate types and used in traditional medicine to treat diseases and also has antimicrobial effects is significant. This paper was done to compare the antimicrobial effects *T. polium* plants grown in Iran with the around of the world.

METHODS: In this review study using keywords Essential oil, Medicinal Plants and *Teucrium* searching was done in the databases Pubmed, Science Direct, Elsevier, SID, Magiran, Google Scholar, Food and Agriculture Organization of the United Nations (FAO) and World Health Organization (WHO).

FINDINGS: A total of 269 articles were identified with the desired subject of who 86 were selected for further investigation. Failure to select other articles, was away from the goal the finding of this study showed that the α -Pinene, β -Pinene, Spathulenol, Verbenene, β -Myrcene were the main components of *T. polium* essential oil was grown in Iran. Amount of MIC, MBC value against pathogenic bacteria and inhibition diameter of *T. polium* was grown in Iran In comparison with the elsewhere in the world was not significant.

CONCLUSION: *T. polium* plant can be used as an effective antimicrobial compounds. The dose should be determined in various experiments and controlled manner taking the risk of toxicity occurs.

KEY WORDS: *Teucrium polium*, Medicinal Plants, Essence.

Please cite this article as follows:

Mahmoudi R, Kazeminia M, Kaboudari A. Review on composition and antimicrobial effects of *Teucrium* (*Teucrium polium* L.) grown in Iran and comparison with the around the world. J Babol Univ Med Sci. 2017;19(2):54-64.

* Corresponding author: R. Mahmoudi (PhD)

Address: Health Product Safety Research Center, Qazvin university of Medical Sciences, Qazvin, I.R.Iran

Tel: +98 28 33369581

E-mail: r.mahmodi@yahoo.com

Introduction

Food contaminated with pathogenic microorganisms often been described as the primary source of many diseases in humans. Growth and survival of microorganisms in food products will lead to corruption and loss of quality (1). Now 30 percent of the world's population in industrialized countries suffer from diseases of food origin of the food safety issue is very important in public health (2). Due to the adverse effects of chemical preservatives, particularly carcinogenic potential and toxicity to humans as well as antimicrobial agents abundant in plants there is a growing interest in the use of natural preservatives derived from natural sources (3-5).

Essential oils and plant extracts with varied combinations of biological and physiological compounds have very high potency for use as new medicinal compounds in the field of health and treatment of human diseases and animal and, also due to have antimicrobial compounds, especially against gram-positive pathogenic bacteria and gram-negative bacteria, anti-cancer, antioxidant and free radical agents are considered as an important source of natural scrubber for medical use and food items (6-17).

Teucrium plant belongs to the Labiatae family and is abundant in Southwest Asia, Europe and North Africa. Years ago it was used in various applications as a known medicinal plant and its application as a drug is estimated to the time of Hippocrates and Galen and as a diuretic, diaphoretic, tonic, analgesic, antipyretic and anorexia was used but now with growing knowledge other properties of Teucrium, including anti-spasmodic, anti-inflammatory, anti-hypertensive, hypoglycemic, anti-cancer, anti-microbial and anti-oxidant were revealed.

In addition, due to the impact of antibiotics in small quantities and at microgram against the pathogen, therefore in the plants will also try to determine antioxidant and antimicrobial activities by the screening and evaluation and those with stronger effects be identified and by the use of lower concentration of them, the specification applies and performance are used (28-18, 11, 3). One of the most important factors affecting the rate and the chemical composition of medicinal plants are geography, habitat, and weather conditions and the harvest season, therefore same plants grown in different geographical areas may be very different in the amount and type of active components(3). Teucrium plant as one of the most commonly used herbs in traditional medicine is

widely used, the major effectiveness of this medicinal plant is more relevant to its flowering branches. Limited studies have been done regarding the effects and antimicrobial properties of essential oils and plant extracts of Teucrium, so we decided to review the composition and properties of the antimicrobial activity of this plant. In addition, what distinguishes this article with other articles, the antimicrobial properties of grown plant in Iran will be compared with the rest of the world.

Botany: Teucrium which is known in Arabic language as Hashishat-al-rih is belonged to the family of Lamiaceae, including more than 300 species. Its height is 10 to 30 cm with the appearance of white cotton, and is visible usually in areas of rocky and Sand prairie and this plant is evolvable in a range of climate types, including European countries, North Africa and Southwest Asia, including Iran (29, 6, 3).

The healing properties of this plant in last years has reported by Socrates and Galen, Teucrium is a perennial plants. This plant has more than 340 species worldwide and 12 species have been identified in Iran (30, 12).

Methods

In this simple review study, keywords including Teucrium, herbs, essential oils, Essential oil, Medicinal Plants and Teucrium and the databases such as Pubmed, Science Direct, Elsevier, SID, Magiran, Google Scoolar, Food and Agriculture Organization of the United Nations (FAO) and WorldHealth Organization (WHO) were used.

Results

A total of 269 papers on the subject were detected and articles reviewing components and the antimicrobial effect of essential oils and extract of TP using MIC (Minimum Inhibitory Concentration) method, MBC (Minimum Bactericidal Concentration) method and the inhibitory zone tested were selected which consisting of 86 paper. Failure to select other articles, being away from the goal and was unrelated to other models.

Plant oils of Teucrium: Teucrium derived compounds which were most frequent in various studies, as follows (40-31V 26, 16, 13, 3, 1): Verbenene, Beta – pinene, Beta – Myrcene, Benzene,1-methyl, Benzene, Bicyclogermacrene, 2,4 Heptadienal, Germacrene D,

Germacrene B, Bicyclo [3.1.1] hept-3-en-2-one, 4,6,6-trimethyl, 1,6,10-Dodecatriene, 7,11-dimethyl-B-methylen, Sesquisabinene hydrate, Trans-Pinocarveol Bicyclo-heptanol, o-Menth-8-eno, Spathulenol, 1H-3a, 7-Methanoazulene, 1,3-Cyclooctadiene, Alpha-Pinene, Bicyclohexene, 4-methylene, Camphene-bicycloheptane, Linalool, 7-Methanoazulene, Limonene, Camphor, Germacrene-1,5-Cyclodecadiene, Filifolone, Carvacrol, Phenol, 2,3,3-trimethyl-3-cyclopentene acetaldehyde, Bicycloheptan-2-one, 6,6-

dimethyl, 3-Cyclohexene-1-methanol, alpha., 4-dimethyl, Naphthalene, Menthone & Beta-bisabolene Cyclohexene.

According to studies, Teucrium plant can be used as an effective antimicrobial compounds. The dose should be determined in different experiments and in a controlled manner avoiding the risk of toxicity.

Effects of Teucrium: In this study, the effect of this plant on the transferred microbes from foods was tested (tables 1, 2).

Table 1. Minimum Inhibitory Concentration and Minimum Bactericidal Concentration growth of microbial strains against Teucrium oil

Source	antibiotic Zone diameter Growth inhibition	MBC (mg/ml)	MIC (mg/ml)	identified active compounds	Type of Compound	Tested microorganism
Tabatabaei Yazdi et al (41)(1392)	-*	32	8	α -pinene, β -pinene & β -caryophyllene	Ethanollic extract	<i>Streptococcus pyogenes</i>
Tabatabaei Yazdi et al (41)(1392)	-	64	16	α -pinene, β -pinene & β -caryophyllene	Ethanollic extract	<i>Staphylococcus epidermidis</i>
Tabatabaei Yazdi et al (41)(1392)	-	64	16	α -pinene, β -pinene & β -caryophyllene	Ethanollic extract	<i>Staphylococcus aureus</i>
Tabatabaei Yazdi et al (41)(1392)	-	128	32	α -pinene, β -pinene & β -caryophyllene	Ethanollic extract	<i>Escherichia coli</i>
Tabatabaei Yazdi et al (41)(1392)	-	128	32	α -pinene, β -pinene & β -caryophyllene	Ethanollic extract	<i>Pseudomonas aeruginosa</i>
Tabatabaei Yazdi et al (41)(1392)	-	64	16	α -pinene, β -pinene & β -caryophyllene	Watery extract	<i>Streptococcus pyogenes</i>
Tabatabaei Yazdi et al (41)(1392)	-	128	32	α -pinene, β -pinene & β -caryophyllene	Watery extract	<i>Staphylococcus epidermidis</i>
Tabatabaei Yazdi et al (41)(1392)	-	128	32	α -pinene, β -pinene & β -caryophyllene	Watery extract	<i>Staphylococcus aureus</i>
Tabatabaei Yazdi et al (41)(1392)	-	256	64	α -pinene, β -pinene & β -caryophyllene	Watery extract	<i>Escherichia coli</i>
Tabatabaei Yazdi et al (41)(1392)	-	256	64	α -pinene, β -pinene & β -caryophyllene	Watery extract	<i>Pseudomonas aeruginosa</i>
Nadimi et al (42)(2013)	-	8	4	-*	Ethanollic extract	<i>Candida albicans</i> NCPF 3153
Nadimi et al (42)(2013)	-	8	4	-	Ethanollic extract	<i>Candida albicans</i> ATCC 1677
Nadimi et al (42)(2013)	-	16	8	-	Ethanollic extract	<i>Candida albicans</i> ATCC 62061
Nadimi et al (42)(2013)	-	32	16	-	Watery extract	<i>Candida albicans</i> NCPF 3153
Nadimi et al (42)(2013)	-	-*	-**	-	Watery extract	<i>Candida albicans</i> ATCC 1677
Nadimi et al (42)(2013)	-	-	-	-	Watery extract	<i>Candida albicans</i> ATCC 62061
Samak et al (43)(2010)	-	-	16/64	caffeic, ferulic & 4-hydroxybenzoic	TP essences from Vošac area	<i>Staphylococcus aureus</i> ATCC 6538
Samak et al	-	-	16/64	caffeic, 4-coumaric &	TP essences	<i>Staphylococcus</i>

(43)(2010)	-	-	-	-	ferulic	from Vošac area	<i>aureus</i> ATCC 6538
Samak et al (43)(2010)	-	-	-	۴/۱۶	Salicylic, gentisic & ferulic	TP leaf oil from Ucka area	<i>Staphylococcus aureus</i> ATCC 6538
Samak et al (43)(2010)	-	-	-	۲۵	Salicylic, gentisic & ferulic	TP leaf oil from Ucka area	<i>Bacillus subtilis</i> NCTC 8236
Samak et al (43)(2010)	-	-	-	۴/۱۶	Salicylic, gentisic & ferulic	TP leaf oil from Snjež'nica area	<i>Bacillus subtilis</i> NCTC 8236
Samak et al (43)(2010)	-	-	-	۱/۵۶	caffeic, 4-coumaric & ferulic	TP leaf oil from Sušanjan area	<i>Bacillus subtilis</i> NCTC 8236
Samak et al (43)(2010)	-	-	-	۵۰	Salicylic, gentisic & ferulic	TP leaf oil from Snjež'nica area	<i>Bacillus subtilis</i> NCTC 8236
Darabpour et al (44)(2010)	VA ۲۲	TE Resistant	-	۴۰	-	Ethanollic extract	<i>Staphylococcus aureus</i>
Darabpour et al (44)(2010)	NB ۲۴	CL Resistant	-	۱۰	-	Ethanollic extract	<i>Bordetella bronchiseptica</i>
Darabpour et al (44)(2010)	NB ۱۲	CL Resistant	>۲۰۰	۴۰	-	Methanollic extract	<i>Salmonella typhi</i>
Darabpour et al (44)(2010)	ME ۲۳	OX Resistant	۱۰	۱۰	-	Methanollic extract	<i>Bacillus anthracis</i>
Balmaki et al (33)(2013)	SXT ۶	CL ۶	-	۵	Germacrene D, β-pinene & Carvacrol	Essence of TP	<i>Bacillus cereus</i> ATCC 11778
Balmaki et al (33)(2013)	SXT ۲۰	CL ۳۰	-	۵	Germacrene D, β-pinene & Carvacrol	Essence of TP	<i>Enterococcus faecalis</i> ATCC 29212
Balmaki et al (33)(2013)	SXT ۱۷	CL ۴۰	-	۴	Germacrene D, β-pinene & Carvacrol	Essence of TP	<i>Escherichia coli</i> ATCC 25922
Balmaki et al (33)(2013)	SXT ۶	CL ۶	-	-	Germacrene D, β-pinene & Carvacrol	Essence of TP	<i>Pseudomonas aeruginosa</i> ATCC 27853
Balmaki et al (33)(2013)	SXT ۱۶	CL ۲۳	-	۳	Germacrene D, β-pinene & Carvacrol	Essence of TP	<i>Staphylococcus aureus</i> ATCC 25923
Akin et al (45)(2010)	-	-	-	-	-	Essence of TP	<i>Bacillus cereus</i> ATCC 14579
Akin et al (45)(2010)	-	-	-	۱۰	-	Essence of TP	<i>Staphylococcus aureus</i> ATCC 25923
Akin et al (45)(2010)	-	-	-	۷	-	Essence of TP	<i>Salmonella typhimurium</i> ATCC 14028
Akin et al (45)(2010)	-	-	-	۳	-	Essence of TP	<i>Escherichia coli</i> ATCC 25922
Zare et al (3)(2011)	-	-	-	۶۲	Bicyclodecene, Iso aromadendrene epoxide & 1,3-Cyclooctadiene	Essence of TP	<i>Salmonella typhimurium</i> ATCC 13311
Zare et al (3)(2011)	-	-	-	۳۱/۵۰	Bicyclodecene, Iso aromadendrene epoxide & 1,3-Cyclooctadiene	Essence of TP	<i>Salmonella dublin</i> RTCC 1618
Zare et al (3)(2011)	-	-	-	۱۵/۲۵	Bicyclodecene, Iso aromadendrene epoxide & 1,3-Cyclooctadiene	Essence of TP	<i>Salmonella enteridis</i> ATCC 13076
Zare et al (3)(2011)	-	-	-	۳۱/۵۰	Bicyclodecene, Iso aromadendrene epoxide & 1,3-Cyclooctadiene	Essence of TP	<i>Pseudomonas arizonae</i> RTCC 1472
Zare et al (۳) (۲۰۱۱)	-	-	-	۷/۱۲	Bicyclodecene, Iso aromadendrene epoxide & 1,3-Cyclooctadiene	Essence of TP	<i>Bacillus cereus</i> RTCC 1042
Zare et al (۳) (۲۰۱۱)	-	-	-	۶۲	Bicyclodecene, Iso aromadendrene epoxide & 1,3-Cyclooctadiene	Essence of TP	<i>Escherichia coli</i> ATCC 43894
Shahba et al (۴۶) (۲۰۱۴)	-	-	۱۰	۳, ۱۲	-	Watery extract	<i>Enterococcus faecalis</i>

Shahba et al (۴۶) (۲۰۱۴)	-	۲۰	۱۰	-	Ethanollic extract	<i>Enterococcus faecali</i>
Shahba et al (۴۶) (۲۰۱۴)	-	۱۰	۲	-	Watery extract	<i>Pseudomonas</i>
Shahba et al (۴۶) (۲۰۱۴)	-	۲۰	۲۰	-	The ethyl acetate extract	<i>Pseudomonas</i>

*Not mentioned, ** Activity did not arise, NCTC: National Collection of Type Cultures, London, UK, ATCC: American Type Culture Collections, Rockville, USA, RTCC: Razi Type Culture Collection, PTCC: Pasture Type Culture Collection

VA: Vancomycin 30 mcg; TE: Tetracycline 30 mcg; NB: Novobiocin 30 mcg; CL: Colistin 10 mcg; ME: Methicillin 5 mcg; OX: Oxacillin 1 mcg.

Table 2. The average zone diameter of growth inhibition of microbial strains in front of the essence of TP (mm)

Source	Antibiotic		concentration				Identified active compound	Type of compound	Tested microorganism
	diameter of growth inhibition		diameter of growth inhibition						
Teimouri et al (۳۰) (۲۰۱۲)	Chloramphenicol	Gentamicin	۲۵	۵۰	۷۵	۱۰۰	Tannins, Saponin , α -pinene & β -pinene	Methanolic extract	<i>Staphylococcus aureus</i> PTCC 1454
Teimouri et al (۳۰) (۲۰۱۲)	Chloramphenicol	Gentamicin	۲۵	۵۰	۷۵	۱۰۰	Tannins, Saponin , α -pinene & β -pinene	Methanolic extract	<i>Bacillus subtilis</i> PTCC 1447
Teimouri et al (۳۰) (۲۰۱۲)	Chloramphenicol	Gentamicin	۲۵	۵۰	۷۵	۱۰۰	Tannins, Saponin , α -pinene & β -pinene	Methanolic extract	<i>Klebsiella pneumoniae</i>
Teimouri et al (۳۰) (۲۰۱۲)	Chloramphenicol	Gentamicin	۲۵	۵۰	۷۵	۱۰۰	Tannins, Saponin , α -pinene & β -pinene	Methanolic extract	<i>Escherichia coli</i> PTCC 1335
Samak et al (۴۳) (۲۰۱۰)	-	-	-	-	۷۵	۵۰	Salicylic, gentisic & ferulic	TP leaf oil from Snježnica area	<i>Bacillus subtilis</i> NCTC 8236
Samak et al (۴۳) (۲۰۱۰)	-	-	-	-	۷۵	۲۵	Salicylic, gentisic & ferulic	TP leaf oil from Ucka area	<i>Bacillus subtilis</i> NCTC 8236
Balmaki et al (۳۳) (۲۰۱۳)	SXT	CL	-	-	۷۵	۱۵	Germacrene D, β -pinene & Carvacrol	The essence of TP	<i>Bacillus cereus</i> ATCC 11778
Balmaki et al (۳۳) (۲۰۱۳)	SXT	CL	-	-	۷۵	۱۵	Germacrene D, β -pinene & Carvacrol	The essence of TP	<i>Enterococcus faecalis</i> ATCC 29212
Balmaki et al (۳۳) (۲۰۱۳)	SXT	CL	-	-	۷۵	۱۶	Germacrene D, β -pinene & Carvacrol	The essence of TP	<i>Escherichia coli</i> ATCC ۲۵۹۲۲
Balmaki et al (۳۳) (۲۰۱۳)	SXT	CL	-	-	۷۵	۶	Germacrene D, β -pinene & Carvacrol	The essence of TP	<i>Pseudomonas aeruginosa</i> ATCC 27853
Balmaki et al (۳۳) (۲۰۱۳)	SXT	CL	-	-	۷۵	۱۶	Germacrene D, β -pinene & Carvacrol	The essence of TP	<i>Staphylococcus aureus</i> ATCC 25923
Moghtader et al (۴۷) (۲۰۱۳)	Tetracycline	-	-	-	۲۸	-	α -pinene, β -pinene & Linalool	The essence of TP	<i>Staphylococcus aureus</i> PTCC 1431
Moghtader et	Tetracycline	-	-	-	۲۵	-	α -pinene, β -pinene	The essence of	<i>Staphylococcus</i>

al (۴۷)(۲۰۱۳)	۲۱		&Linalool	TP	<i>epidermidis</i> PTCC 1436
Moghtader et al (۴۷)(۲۰۱۳)	Tetracycline ۱۶	۱۲	α -pinene, β -pinene &Linalool	The essence of TP	<i>Streptococcus faecalis</i> PTCC 1237
Moghtader (۲۰۱۳) et al(۴۷)	Tetracycline ۲۲	۲۶	α -pinene, β -pinene &Linalool	The essence of TP	<i>Pseudomonas aeruginosa</i> PTCC 1430
Moghtader et al (۴۷)(۲۰۱۳)	Tetracycline ۱۹	۲۳	α -pinene, β -pinene &Linalool	The essence of TP	<i>Shigella Flexneri</i> 1716
Moghtader et al (۴۷)(۲۰۱۳)	Tetracycline ۱۴	۱۵	α -pinene, β -pinene &Linalool	The essence of TP	<i>Klebsiella pneumoniae</i> PTCC 1053
Moghtader et al (۴۷) (۲۰۱۳)	Tetracycline ۱۷	۲۲	α -pinene, β -pinene &Linalool	The essence of TP	<i>Salmonella typhi</i> PTCC 1609
Moghtader et al (۴۷) (۲۰۱۳)	Tetracycline ۱۳	۲۱	α -pinene, β -pinene &Linalool	The essence of TP	<i>Serratia marcescens</i> PTCC 1187
Moghtader et al (۴۷)(۲۰۱۳)	Tetracycline ۱۲	۲۷	α -pinene, β -pinene &Linalool	The essence of TP	<i>Escherichia coli</i> PTCC 1533

** Activity did not arise, SXT: sulfamethoxazole-trimethoprim 25 mcg.

Discussion

According to the results of this study, the main phytochemicals compounds of TP grown in Iran, including alpha-pinene, beta-pinene, Verben, beta-myrcene, beta-pinene, Spathulenol, as well as in the MIC, MBC and the diameter of the inhibition of growth of TP plant grown in Iran against pathogenic bacteria compared to the rest of the world, no significant difference was observed. Of past, human used therapeutic properties of plants as food additives. Today, many plants are examined annually worldwide due to its therapeutic properties. Some part of the research focuses on determining the antimicrobial properties of medicinal plants, cause of special attention are problems, including bacterial resistance and antibiotic side effects that has been created due to the inappropriate application (48).

In a study, the essential oils of TP had proper effect against *Salmonella typhimurium* bacteria which is an important factor in food poisoning and in another study showed essential oils of TP has a greatest antimicrobial activity against *Bacillus cereus* (16, 1). Several studies have shown that this herb has antibacterial, anti-inflammatory, antispasmodic and anti-oxidant properties (50, 49).

More than 2000 years, this plant is used in traditional medicine. Diuretic, antipyretic, anti-seizure, anti-diabetic, mosaic, nourishing, anti-obesity and anti-spasmodic, includes the use of the plant. As well as its useful for the treatment of genital-urinary system diseases, delay or absence of menstruation delay and the effect of lowering blood pressure and positive inotropic effect also been reported (51, 29). It's also used in traditional medicine as an analgesic and lipid-lowering drug. In addition, this plant is used as a spice in food and relieve diseases of the stomach and also is used to treat wounds (52, 45).

Another study showed that the plant has the effect of lowering blood sugar, lowering lipids, antipyretics, anti-ulcer and anti-bacteria (53). Keykavusi and colleagues studied the effects of this herb in preventing the growth of *Bacillus cereus* in soup business model. In this study, the essential oil had inhibitory effect on bacterial growth, but reduced admission of soup flavor because of bitter taste. Therefore, it is recommended to use for industrial several methods such as microencapsulation can be used (31). In addition to the positive things about TP, but the use of herbal medicines containing the extract of TP without any practical guide, caused liver toxicity in many cases by

increased blood urea (55, 54, 14). According to the results of various studies, it appears that the beneficial effects of herbal medicines in different patients and their beneficial effects on detoxification of xenobiotics toxicity of drugs should no longer possible to ignore their toxicity. In addition, many studies have demonstrated that increasing the dose of TP resulted in increased vulnerability that undermines the positive performance, therefore, it is recommended that the use of high doses of this plant strictly avoided (56-60). TP has a variety of plant essential oil compounds. The main components of this plant are included α -Pinene, β -Pinene, Spathulenol, Bicyclodecene, b-Caryophyllene and Germacrene B. In various studies, the examined plant is prepared from different areas and climates. Therefore, it would be effective on the type of compounds derived from measuring and this explains the impact of this difference. In addition, the most effective factor genetics cannot be ignored (58) but, as was observed, MIC, MBC and zone diameter of

growth inhibition of the various components of the Teucrium plant against germs had not significant difference. In addition, these compounds have antimicrobial effect on both gram positive and gram negative, hence it can be harvested that plants from different regions have the same function. Also, it is seems that limited studies regarding the antimicrobial effects of essential oils and plant extracts, is due to toxicity at high doses. This has caused the extensive research on the effects of pharmacological and especially the antimicrobial effect of it has not been done. In order to accurately determine the antimicrobial effects and side effects of TP further studies are needed.

Acknowledgments

Hereby, we would like to thank the efforts of Doctor Mohammad Reza Alamouti and Doctor R. Kalhor helped us in this review.

References

1. Mahmoudi R, Zare P, Nosratpour S, Mardani K, Safari A. Hygienic effects of *Teucrium polium* essential oil against *salmonella typhimorium* lt2 in probiotic yoghurt. *Urmia Med J*. 2014;25(8):769-77. [In Persian].
2. Burt S. Essential oils: their antibacterial properties and potential applications in foods—a review. *Int J of food microbiol* 2004;94(3):223-53.
3. Zare P, Mahmoudi R, Ehsani A. Biochemical and antibacterial properties of essential oil from *Teucrium polium* using resazurin as the indicator of bacterial cell growth. *Pharm Sci* .2011;17(3):183-8 .[In Persian]. <https://www.researchgate.net/publication/234008737>.
4. Aburjai T, Darwish RM, Al-Khalil S, Mahafzah A, Al-Abbadi A. Screening of antibiotic resistant inhibitors from local plant materials against two different strains of *Pseudomonas aeruginosa*. *J Ethnopharmacol*. 2001;76(1):39-44.
5. Starakis I, Siagris D, Leonidou L, Mazokopakis E, Tsamandas A, Karatza C. Hepatitis caused by the herbal remedy *Teucrium polium* L. *Eur J Gastroenterol Hepatol*. 2006;18(6):681-3.
6. Ayoubi A, Omid A, Valizade R, Mousaei A. Effect of hydroalcoholic extract of *Aloe vera* and *Teucrium* on serum glucose and lipid profile in streptozotocin diabetic male rats. *J Birjand Univ Med Sci*. 2013;20(2):144-52.
7. Zal F, Vasei M, Rasti M, Vessal M. Hepatotoxicity associated with hypoglycemic effects of *Teucrium polium* in diabetic rats. *Arch Iran Med*. 2001;4(4):188-92.
8. Attarha M, Vakilian K, Rouzbahani N, Bekhradi R. Effect of perineal massage with lavender essence on episiotomy and laceration. 2009. Available from: http://vdresearch.arakmu.ac.ir/webdocument/load.action?webdocument_code=2000&masterCode=7000029
9. Behmanesh F, Pasha H, Sefidgar S, Moghadamnia A, Ebrahimi TA. Lavender and clotrimazol effect on the growth standard strains of *C. Albicans* in vitro conditions. 2010;3(56):26-31. [In Persian].
10. Minooeian Haghighi M, Khosravi A. Inhibition and destruction effects of *cuminum cyminum*, *ziziphora clinopodioides* and *nigella sativa* essences on *aspergillus* cells. *J Babol Univ Med Sci*. 2013;15(6):25-35.
11. Abdollahi M, Karimpour H, Monsef-Esfahani HR. Antinociceptive effects of *Teucrium polium* L. total extract and essential oil in mouse writhing test. *Pharmacol Res*. 2003;48(1):31-5.
12. Mahmoudi R, Zare P, Hassanzadeh P, Nosratpour S. Effect of *Teucrium polium* essential oil on the physicochemical and sensory properties of probiotic yoghurt. *J Food Proc Pres*. 2014;38(3):880-8.
13. Mahmoudi R, Zare P, Nosratpour S. Application of *Teucrium polium* essential oil and *Lactobacillus casei* in yoghurt. *J Ess Oil Bear Plant*. 2015;18(2):477-81.
14. Baradaran A, Madihi Y, Merrikhi A, Rafieian-Kopaei M, Nematbakhsh M, Asgari A, et al. Nephrotoxicity of hydroalcoholic extract of *Teucrium polium* in Wistar rats. *Pak J Med Sci*. 2013;29(1):329-333.
15. Hussain AI, Anwar F, Sherazi STH, Przybylski R. Chemical composition, antioxidant and antimicrobial activities of basil (*Ocimum basilicum*) essential oils depends on seasonal variations. *Food Chem*. 2008;108(3):986-95.
16. Mahmoudi R, Nosratpour S. *Teucrium polium* L essential oil: phytochemical component and antioxidant properties. *Int Food Res J*. 2013;20(4):1697-1701.
17. Houshmand Gh, Goudarzi M, Forouzandeh H, Nazari AV, Nourollahi V. Evaluation of the analgesic effects of *Teucrium* extract on rats using the formalin test. *J Babol Univ Med Sci*. 2015;17(6) 33-9. [In Persian].
18. Galati E, Mondello M, D'Aquino A, Miceli N, Sanogo R, Tzakou O, et al. Effects of *Teucrium divaricatum* Heldr. ssp. *divaricatum* decoction on experimental ulcer in rats. *J Ethnopharmacol*. 2000;72(1):337-42.
19. Suleiman M-S, Abdul-Ghani A-S, Al-Khalil S, Amin R. Effect of *Teucrium polium* boiled leaf extract on intestinal motility and blood pressure. *J Ethnopharmacol*. 1988;22(1):111-6.

20. Tariq M, Ageel A, Al-Yahya M, Mossa J, Al-Said M. Anti-inflammatory activity of *teucrium polium*. *Int J Tissue React.* 1988;11(4):185-8.
21. Nadjafi F, Bannayan M, Tabrizi L, Rastgoo M. Seed germination and dormancy breaking techniques for *ferula gummosa* and *teucrium polium*. *J Arid Environ.* 2006;64(3):542-7.
22. Rajabalian S. Methanolic extract of *Teucrium polium* L. potentiates the cytotoxic and apoptotic effects of anticancer drugs of vincristine, vinblastine and doxorubicin against a panel of cancerous cell lines. *Exp Oncol.* 2008;30(2):133-8.
23. Gharaibeh MN, Elayan HH, Salhab AS. Hypoglycemic effects of *teucrium polium*. *J Ethnopharmacol.* 1988;24(1):93-9.
24. De Marino S, Festa C, Zollo F, Incollingo F, Raimo G, Evangelista G, et al. Antioxidant activity of phenolic and phenylethanoid glycosides from *Teucrium polium* L. *Food chem.* 2012;133(1):21-8.
25. Stankovic MS, Niciforovic N, Mihailovic V, Topuzovic M, Solujic S. Antioxidant activity, total phenolic content and flavonoid concentrations of different plant parts of *Teucrium polium* L. subsp. *polium*. *Acta Soc Botanic Poloni.* 2012;81(2):117-22.
26. Ansari M, Alizadeh AM, Paknejad M, Khaniki M, Naeimi SM. Effects of *Teucrium Polium* Honey on Burn Wound Healing Process. *J Babol Univ Med Sci.* 2009; 11(3):7-12.[In Persian].
27. Niazmand S, Erfanian Ahmadpour M, Mousavian M, Saberi Z. The inotropic and chronotropic effects of aqueous ethanol extract from *teucrium polium* L. on guinea pig isolated heart. *J Babol Univ Med Sci.* 2008;10(1):7-13.
28. Ricci D, Fraternale D, Giamperi L, Bucchini A, Epifano F, Burini G, et al. Chemical composition, antimicrobial and antioxidant activity of the essential oil of *Teucrium marum* (Lamiaceae). *J Ethnopharmacol.* 2005;98(1):195-200.
29. Feridoni E, Niazmand S, Harandizadeh F, Hosseini S, Mahmodabadi M. Vasorelaxant effect of hydroalcoholic extract of *teucrium polium* L. On isolated rat aorta. 2012;4(1):35-44. [In Persian].
30. Tabatabaei Yazdi F, Alizadeh Behbahani B. Antimicrobial effect of the aqueous and ethanolic *Teucrium polium* L. extracts on gram positive and gram negative bacteria "in vitro". *J Paramed Sci.* 2013; 4 (4): 56-62.
31. Kabudari A, Mahalleh SFRP. Study of antibacterial effects of *teucrium polium* essential oil on *Bacillus cereus* in cultural laboratory and commercial soup. *Carpathian Food Sci Technol.* 2016; 8(2):176-183.
32. Moghtader M. Chemical composition of the essential oil of *teucrium polium* L. from Iran. *Am-Eurasian J Agric Environ Sci.* 2009;5(6):843-6.
33. Belmekki N, Bendimerad N, Bekhechi C. Chemical analysis and antimicrobial activity of *Teucrium polium* L. essential oil from Western Algeria. *J of Med Plants Res* 2013;7(14):897-902.
34. Djabou N, Paolini J, Desjobert JM, Allali H, Baldovini N, Costa J, et al. Qualitative and quantitative analysis of volatile components of *Teucrium massiliense* L.-identification of 6-methyl-3-heptyl acetate as a new natural product. *Flavour and fragrance J* 2010;25(6):475-87.
35. Muselli A, Desjobert J-M, Paolini J, Bernardini A-F, Costa J, Rosa A, et al. Chemical composition of the essential oils of *Teucrium chamaedrys* L. from Corsica and Sardinia. *J of essential oil Res* 2009;21(2):138-43.
36. Maccioni S, Baldini R, Tebano M, Cioni PL, Flamini G. Essential oil of *Teucrium scorodonia* L. ssp. *scorodonia* from Italy. *Food chem* 2007;104(4):1393-5.
37. Aburjai T, Hudaib M, Cavrini V. Composition of the essential oil from Jordanian germander (*Teucrium polium* L.). *J Essential oil Res.* 2006;18(1):97-9.
38. Eikani MH, Goodarznia I, Mirza M. Comparison between the Essential Oil and Supercritical Carbon Dioxide Extract of *Teucrium polium* L. *J of essential oil Res* 1999;11(4):470-2.

39. Cozzani S, Muselli A, Desjobert JM, Bernardini AF, Tomi F, Casanova J. Chemical composition of essential oil of *Teucrium polium* subsp. *capitatum* (L.) from Corsica. *Flavour and fragrance J* 2005;20(4):436-41.
40. Wassel G, Ahmed S. Chemical composition of the wild Egyptian plant *Teucrium polium* L. *Die Pharmazie*. 1974;29(8):540.
41. Tabatabaei YF, Alizadeh BB, Heidari SM, Mortazavi S. The In vitro Study of Antimicrobial Effect of *Teucrium polium* Extract on Infectious Microorganisms. 2014.
42. Nadimi M, Zia M, Madani M. The effect of aqueous and ethanolic extracts of *Teucrium polium* on *Candida albicans* and two species of *Malassezia*. *Zahedan J of Res in Med Sci (Tabib-E-Shargh)* 2013;15(8):8-24.
43. Šamec D, Gruz J, Strnad M, Kremer D, Kosalec I, Grubešić RJ, et al. Antioxidant and antimicrobial properties of *Teucrium arduini* L.(Lamiaceae) flower and leaf infusions (*Teucrium arduini* L. antioxidant capacity). *Food and chemical toxicol* 2010;48(1):113-9.
44. Darabpour E, Motamedi H, Nejad SMS. Antimicrobial properties of *Teucrium polium* against some clinical pathogens. *Asian pacific J of tropical Med* 2010;3(2):124-7.
45. Akin M, Oguz D, Saracoglu H. Antibacterial Activity of Essential oil from *Thymbra spicata* var. *spicata* L. and *Teucrium polium* (Stapf Brig.). *interventions* 2010;8(9):53-8.
46. Shahba S, Bokaeian M, Mozafari-Sabet NA, Saeidpour-Parizi A, Bameri Z, Nikbin M. Comparison between Antibacterial Effect of *Teucrium Polium* Plant and Common Antibiotics on the Bacteria Causing Urinary Tract Infections. . *Zahedan J of Res in Med Sci (Tabib-E-Shargh)* 2014;16(3):9-44.
47. Moghtader M, Salari H, Farahmand A. Antibacterial Effect *Teucrium polium* criteria on human pathogenic bacteria. *Iranian J of Med microbiol* 2013;7(2):1-7.
48. Gill A, Holley R. Disruption of *Escherichia coli*, *Listeria monocytogenes* and *Lactobacillus sakei* cellular membranes by plant oil aromatics. *Int J of food microbiol* 2006;108(1):1-9.
49. Shahraki MR, Arab MR, Mirimokaddam E, Palan MJ. The effect of *Teucrium polium* (Calpoureh) on liver function, serum lipids and glucose in diabetic male rats. *Iranian Biomedical J* 2007;11(1):65-8.
50. Hasani P, Yasa N, Vosough-Ghanbari S, Mohammadirad A, Dehghan G, Abdollahi M. In vivo antioxidant potential of *Teucrium polium*, as compared to α -tocopherol. *Acta pharmaceutica*. 2007;57(1):123-9.
51. Mousavi S, Shahriari A, Ahangarpour A, Jolodar A. Effect of *Teucrium polium* ethyl acetate extract on energy consumption and obesity parameters in high sucrose diet rats. *Razi J of Med Sci* 2011;18(82):24-31.
52. Couladis M, Tzakou O, Verykokidou E, Harvala C. Screening of some Greek aromatic plants for antioxidant activity. *Phytotherapy Res*. 2003;17(2):194-5.
53. Rasekh H, Khoshnood-Mansourkhani M, Kamalinejad M. Hypolipidemic effects of *Teucrium polium* in rats. *Fitoterapia*. 2001;72(8):937-9.
54. Abu Sitta KH, Shomah MS, Salhab AS. Hepatotoxicity of *Teucrium Polium* L Tea: Supporting Evidence in Mice Models. *Australian J Med Herbalism*. 2009;21(4):106-9.
55. Khleifat. The chronic effects of *Teucrium polium* on some blood parameters and histopathology of liver and kidney in the rat. *Turk J Biology*. 2002;26(2):65-71.
56. Namjoo A, MirVakili M, Shirzad H, Faghani M. Biochemical, liver and renal toxicities of *Melissa officinalis* hydroalcoholic extract on balb/C mice. *J Herb Med Pharmacol*. 2013;2(2):35-40.
57. Kiani MA, Khodadad A, Mohammadi S, Ghayour Mobarhan M, Saeidi M, Jafari SA, et al. Effect of peppermint on pediatrics' pain under endoscopic examination of the large bowel. *J Herb Med Pharmacol*. 2013;2(2):41-4.

58. Nasri H, Ahmadi A, Baradaran A, Nasri P, Hajian S, Pour Arian A, et al. A biochemical study on ameliorative effect of green tea (*Camellia sinensis*) extract against contrast media induced acute kidney injury. *J Renal Inj Prev*. 2014;3(2):47-9.
59. Tamadon MR, Ardalan MR, Nasri H. World kidney day 2013; acute renal injury; a global health warning. *J Parathyroid Dis*. 2013;1(2):27-8.
60. Tavafi M. Antioxidants against contrast media induced nephrotoxicity. *J Renal Inj Prev*. 2014;3(2):55-6.