# Salmonellosis Phytotherapy: A review on Iranian most important medicinal plants affecting on *Salmonella*

Mahmoud Rafieian-kopaei<sup>1</sup>, Mahmoud Bahmani<sup>2</sup>, Abolfazl Abaszadeh<sup>3</sup>, Hassan Hassanzadazar<sup>4</sup>, Setareh Soroush<sup>2\*</sup>, Farzad Kazemzadeh<sup>5</sup>

<sup>1</sup>Medical Plants Research Center, Shahrekord University of Medical sciences, Shahrekord, Iran <sup>2</sup>Razi Herbal Medicines Research Center, Lorestan University of Medical Sciences, Khorramabad, Iran <sup>3</sup>Department of Surgery, School of Medicine, Lorestan University of Medical Sciences, Khorramabad, Iran <sup>4</sup>School of Public Health, Zanjan University of Medical Sciences, Zanjan, Iran

<sup>5</sup>Clinical Microbiology Research Center, Ilam University of Medical Sciences, Ilam, Iran

# \*Corresponding author:E-Mail:setareh.soroush@gmail.com

# ABSTRACT

Salmonella are isolated from diarrheal diseases, typhoid fever, bacteriemia and enterocolitis. Salmonellarelated diseases are major health problem in most of countries. Scientific research approach has been to achieve plants bioactive substances due to drug resistance and side effects of chemical antimicrobial drugs. Plants can be considered as a source of potentially useful chemicals but only a fraction of them have been used in medicine. We aimed in this review article to present anti Salmonella effects of Iranian native medicinal plants. The information was obtained using key words including Salmonellosis, Salmonella, medicinal plant, essential oil, searching scientific databases scientific information database (SID), Magiran, Google scholar, Blackwell, Wiley, Springer and Sciencedirect. Ten plant families of native medicinal plants of Iran were found to be effective on Salmonella including Thymus multiflora, Thymus vulgaris, Hibiscus sabdariffa, Ferulago angulata, Avicennia marina, Crocus sativus L, Cordia myxa L, Ziziphora clinopodioides, Allium sativum, Teucrium polium L, Satureia hortensis L, Anethum graveolens and Vaccinium arctostaphylosplants. Phenolic compounds, flavonoids and tannins, such as thymol, carvacrol and coumarin have been isolated from the most anti salmonellosis plants. Carvacrol is common antioxidant and bioactive compound in all of these plants. Most used medicinal plants as anti-Salmonella plants can be produced and entered in pharmaceutical market as anti-Salmonella drugs.

KEY WORDS: Salmonella, Medicinal plants, Essential oil, Iran

# **1. INTRODUCTION**

Salmonella group comprising over 2,300 serotypes adapted to growth in human and animal's body and can cause wide range of diseases. Salmonella Typhi and S. Paratyphi limited to human and cause enteric fever. Enteric fever is a global health problem and affects approximately 13-17 million people worldwide with six million deaths, annually (Lesser and Miller, 2005). Salmonella enteric fever is endemic in Indian Subcontinent, Central and South America and Asia with rapid population growth, increasing urbanization, improper disposal of human excreta and restricted water resources. Salmonella are isolated from diarrheal diseases, typhoid fever, bacteriemia and enterocolitis. Salmonella-related diseases are major health problem in the world, especially in developing countries, including Iran (Nordmann, 2008). Infectious disease is the major cause of mortality, especially in third world countries. Due to high cost and probably resistant to available antibiotics and their side effects during long therapeutic period, some of them may be more dangerous than the disease (Fatholahzadeh, 2009; Asadollahi, 2012; Taherikalani, 2011; Emaneini, 2009; Jabalameli, 2011; Soroush, 2010; Taherikalani, 2008; Pakzad, 2011; Shahsavan, 2012; Haghi-Ashteiani, 2007; Khoramrooz, 2012; Asadollahi, 2011; Akbari, 2010; Jabalameli, 2012; Sahebekhtiari, 2011; Kalantari, 2007; Nakhjavani, 2013). Salmonella diseases occur in humans in the form of food infection, gastroenteritis, typhoid fever and sometimes septicemia. Animal foods suitable place for Salmonella serotypes and are important as a source for human non typhoid salmonellosis such as poultry meat and meat products. S. typhimurium and S. typhi are human compatible serotypes with no diseases in non-human hosts. Pathogenic bacteria become resistant to antibiotics and antimicrobials drugs by different mechanisms such as: changing of permeability to drugs, efflux pump, using secondary metabolic pathways, changing of drugs receptors and producing of destructive enzymes (Oussalah, 2005).

Antibiotics are the most prescribed drugs in the infectious diseases witch confront with pathogens by removing or stopping their proliferation. Major problems of antibiotics are their irreparable side effects and microbial resistance. Therefore, It seems using of new drugs or medicinal plants with fewer side effects is necessary (Kokoska, 2002). Undoubtedly, one of the most ancient human approaches is use of herbs to treat diseases. A close relationship between people and plants has always been during the development of the human civilization. Due to drug resistance and side effects of chemical anti-bacterial drugs, scientific researches tendency increased on natural resources in recent decades, including several studies on antibacterial activity of various plants (Lin, 1999; Bahmani, 2012, 2013, 2014, 2015; Delfan, 2014; Amirmohammadi, 2014; Eftekhari, 2012; Gholami-Ahangaran, 2013; Forouzan, 2012;

Journal of Chemical and Pharmaceutical Sciences

Gholami-Ahangaran, 2012). Antibacterial effects of plant extracts and their active ingredients have well known and widely used in traditional medicine to control of bacterial growth and food spoilage (Bahmani, 2014, 2015; Delfan, 2014; Asadi-Samani, 2014; Saki, 2014; Sewell and Rafieian-Kopaei, 2014; Asadbeigi, 2014; Karamati, 2014).

In recent decades, scientific research approach has been to achieve plants bioactive substances due to drug resistance and side effects of chemical antimicrobial drugs. Plants can be considered as a source of potentially useful chemicals but only a fraction of them have been used in medicine.

## 2. MATERIALS AND METHODS

The information was obtained using key words including Salmonellosis, *Salmonella*, medicinal plant, essential oil, searching scientific databases scientific information database (SID), Magiran, Google scholar, Blackwell, Wiley, Springer and Sciencedirect.

## 3. RESULTS

Ten plant families of native medicinal plants of Iran were found to be effective on, including *Thymus* multiflora, *Thymus vulgaris*, *Hibiscus sabdariffa*, *Ferulago angulata*, *Avicennia marina*, *Crocus sativus L*, *Cordia myxa L*, *Ziziphora clinopodioides*, *Allium sativum*, *Teucrium polium L*, *Satureia hortensis L*, *Anethum graveolens and Vaccinium arctostaphylosplants*. Effective Medicinal plants against *Salmonella* are listed in Table 1. Most used medicinal plants as anti-*Salmonella* compound has belonged to Lamiaceae family (31% of plant families).

Scientific name	Plant Family	Farsi	Discussion
		name	
Thymus multiflora	Lamiaceae	Avishan shirazi	Antibacterial property of thyme essential oil (EOs) on the growth of Salmonella typhimurium in the soup was significant and correlation coefficient between logarithmic number of Salmonella and EOs concentration was 02- 0.4 (Mosavai, 2010).
Thymus vulgaris	Lamiaceae	Avishan baghi	Obtained results showed that the number of <i>Salmonella enteritidis</i> in sauce samples containing different concentration of Thymus extract in comparing with control sample had significant difference, statistically. Samples containing 0.1 and 0.2% extract had the same effect on <i>Salmonella enteritidis</i> (Zabetian-Hosseini, 2010).
Hibiscus sabdariffa	Malvaceae	Chai torsh	Salmonella Enteritidis showed low sensitivity to the hibiscus extracts. Most significant antimicrobial effect on the bacteria showed in Concentrations of 30 and 40 mg/ml (Tabatabaei-Yazdi, 2015).
Ferulago angulate	Apiaceae	Chavill	Results of a study by disk diffusion method showed that ethanol extract of Chavill had MIC and MBC on S.typhimurium (PTTC 1609), 64 and 32 mg/ml, respectively (Tabatabaei-Yazdi, 2014).
Avicennia marina	Acanthaceae	Harra	The Methanol extract of mangrove plant has shown quite anti-Salmonella effect in a 2 mg/ml dose in vitro. The ethanol extract of the leaves of mangrove in concentrations of 20, 25, 30, 35 and 40 mg were quite effective against salmonella (Alizadeh Behbahani, 2014).
Crocus sativus L.	Iridaceae	Zafaran	MIC of saffron's methanol extract for salmonella typhimurium was 40 mg/ml. It was found inhibition diameter of aqueous extract of saffron on <i>S.</i> <i>typhimurium</i> was up to 20 mm, for ethanol extract of saffron up to 21 mm and 20 mm for methanol extract (Gandomi NasrAbadi, 2012).
Cordia myxa L.	Boragaceae	Sepstan	MIC and MBC of Methanol extract of Cordia myxa L. on <i>Salmonella typhi</i> were 32 and 256 mg/ml, respectively (Pirnia, 2015).
Allium sativum	Liliaceae	Sir	Garlic accelerates the process of improving clinical symptoms of intestinal infection with Salmonella

# Table.1.Effective medicinal plants native to Iran used against Salmonella

ISSN: 0974-2115

www.jchps.com		Journal of Chemical and Pharmaceutical Sciences	
			typhimurium in contaminated rabbits. Clinical trials
			is recommended for investigation antibacterial
			effects of medicinal plant (Jalali, 2008).
Ziziphora clinopodioides	Lamiaceae	Kakuti	The minimum inhibitory and bactericidal
			concentrations of Ziziphora was determined 250 µg /
			1 on Salmonella entritidis (Anonymm, 2007).
Teucrium polium L.	Lamiaceae	Kalpooreh	Results showed a bactericidal effect of T. polium on
			Salmonella typhi and its inhibition diameter was 22
			mm and 17 mm when tetracycline was used
			(Moghtader, 2013).
Satureia hortensis L	Labiatae	Marzeh	Mice treated with ethanol extract of Satureia
			hortensis L. and Anethum graveolens alone and in
Anethum graveolens	Umbelliferae	Shvid	combination with neutral supernatant of probiotics
Inemum graveolens	Ombernierae	Sirvia	compared with control group was showed significant
			decrease in shedding and colonization of Salmonella
			typhimurium, respectively (Anonyme, 2013).
Vaccinium arctostaphylos	Ericaceae	Siahdar	Salmonella typhi strain were sensitive to aqueous and
			methanol extract of Vaccinium arctostaphylos.
			Extracts inhibition diameter on bacteria was 6.6 -26.6
			mm. MIC and MBC values were between 50 - 200
			mg/ml and 100 - 400 mg /ml, respectively (Moeini,
			2015)

# DISCUSSION

Medicinal plants and their compounds have fewer side effects due to natural origin and compatibility with the body systems and are considered as an alternative to chemical antibiotics because of microbial resistance to this class of drugs (Kasra Kermanshahi, 2008; Mitscher, 1972). According to reliable reports in the scientific literature, different compositions of herbs, spices, fruits, vegetables, leaves, bark and animal tissue have antimicrobial properties (Bart, 2004; Cowan, 1999; Gould, 1996; Lemay, 2002; Roler, 1999; Smith–Palmer, 2001).

Many studies have been implemented in relation to antibacterial effects of Lamiaceae essential oils and their known compounds including carvacrol and thymol (Kim, 1995; Nickavar, 2005; Sacchetti, 2005; Yang, 2001). Phytochemicals studies show effective antimicrobial compounds in *Thymus vulgaris* extract are Flavonoids such as Apigenin, Naringenin, Luteolin, and essential oils with Carvacrol and Thymol (Behnia, 2008). The main component of *Thymus multiflora* essential oil is Thymol, with antimicrobial properties. Antimicrobial mechanism of essential oils is due to their reaction with microorganism's cell membrane and changing its permeability to compounds such as potassium ion and hydrogen (Smith-Palmer, 1998).

Effective components of *Ferulago angulate* are phenolic compounds such as Thymol, Carvacrol, Eugenol and Coumarin. It's known that Carvacrol prevent the proliferation of cells and kill the pathogenic bacteria through destruction of cell membranes, effects on intracellular PH homeostasis and disturbance in the inorganic ions balance (Madureira, 2005).

A. marina has aliphatic acids and alcohols, alkaloids, carotenoids, tannins, terpenes, glycosides and etc compounds (Chen, 2008). Phytochemical analysis of *Cordia myxa* L show that this plant contains flavonoids such as rutin, phenolic derivatives, terpenes, coumarin, Pyrrolizidine alkaloids such as macrophiline, sterols and saponins (Jamkhande, 2013). Allicin is active ingredient and pharmaceutical composition of Allium sativa (Gomaa and Hashish, 2003). Pulegone is active ingredient of a number of Lamiaceae family plants such Ziziphora clinopodioides (Sajadi, 2003; Babakhanloo, 1998; kugel, 1991). Teucrium polium L. plant analysis show that Carvacrol, βcaryophyllene,  $\gamma$ -cadinene,  $\alpha$ -humulene, Germacrene D and is Caryophyllene oxide are active ingredients (Aburjai, 2006; Cakir, 1998). Satureia hortensis L. containing carvacrol and main active compounds of Anethum graveolens are Flavonoides such as quercetin 3-O-beta-d-glucuronide and isorhamnetin 3-O-beta-D-glucuronide (Sefidkon, 2005; Abbasi, 2005; Singh, 2005; Misaghi, 2007; Ogunbanwo, 2003; Mahboubi and Haghi, 2008; Delaquis, 2002). Vaccinium arctostaphylos contains phenolic compounds, anthocyanins, myricetin, thymol and carvacrol (Guha, 2013; Pervin, 2013; Puupponen-Pimiä, 2005; Puupponen-Pimiä, 2001). Phenolic compounds, flavonoids and tannins, such as thymol, carvacrol and coumarin have been isolated from the most anti salmonellosis plants including Thymus multiflora (common thyme), Thymus vulgaris (Garden thyme), Hibiscus sabdariffa (hibiscus), Ferulago angulate (Chavill), Avicennia marina (mangrove), Crocus sativus L. (saffron), Cordia myxa L. (Wild Iris), Ziziphora clinopodioides (Ziziphora radish), Allium sativa (garlic), Teucrium polium L. (poly germander), Satureia hortensis L. (savory), Anethum graveolens (dill) and Vaccinium arctostaphylos (Vaccinium). Carvacrol is common antioxidant and bioactive compound in all of these plants.

July – September 2016

#### www.jchps.com CONCLUSION

The active ingredients of plant extracts and essential oils with antimicrobial properties can be considered as effective anti-*Salmonella* and anti-pathogenic bacterial compounds after separation and complementary pharmaceutical studies. Most used medicinal plants as anti-*Salmonella* compound has belonged to Lamiaceae family (31% of Iranian native plant families). Active ingredients of Lamiaceae medicinal plants can be produced and entered in pharmaceutical market as anti-*Salmonella* drugs.

# REFERENCES

Abbasi KH, Sefidkon F, Yamini Y, Comparison of oil content and composition of two Satureja species (Satureja hortensis L, and Satureja rechingeri Jamzad) by hydrodistillation and supercritical fluid extraction, Iran J Med Aromat Plant, 21(3), 2005, 307-18.

Aburjai T, Hudaib M, Cavrini, V, Composition of the essential oil from Jordanian germander (*Teucrium polium* L), *J Essent Oil Res*, 18, 2006, 97-99.

Akbari M, Niakan M, Taherikalani M, Feizabadi MM, Azadi NA, Soroush S, Emaneini M, Abdolkarimi A, Maleki A, Hematian A, Rapid identification of Iranian Acinetobacter baumannii strains by single PCR assay using BLA oxa-51 -like carbapenemase and evaluation of the antimicrobial resistance profiles of the isolates, Acta Microbiol Immunol Hung, 57(2), 2010, 87-94.

Alizadeh Behbahani B, Tabatabaei Yazdi F, Shahidi F, Mohebbi M, Zanganeh H, Investigation of the Minimum Inhibitory Concentration (MIC) and Minimum Bactericidal Concentration (MBC) of the Aqueous and Ethanolic Avicennia Marina Extracts on Gram Positive and Gram Negative Bacteria "*in vitro*", Sadra Medical Journal, 2(2), 2014, 123-134.

Amirmohammadi M, Khajoenia SH, Bahmani M, Rafieian-Kopaei M, Eftekhari Z, Qorbani M, In vivo evaluation of antiparasitic effects of Artemisia abrotanum and Salvia officinalis extracts on Syphacia obvelata, Aspiculoris tetrapetra and Hymenolepis nana parasites, Asian Pac J Trop Dis, 4(1), 2014, 250-254.

Anonym, Antimicrobial effect of essential oils *Ziziphora clinopodioiedes* on corruption and pathogenic bacteria for food, Journal of Medicinal Plants, 23, 6(3), 2007, 46-51.

Asadbeigi M, Mohammadi T, Rafieian-Kopaei M, Saki K, Bahmani M, Delfan B, Traditional effects of medicinal plants in the treatment of respiratory diseases and disorders, an ethnobotanical study in the Urmia, Asian Pac J Trop Med, 7(1), 2014, S364-S368.

Asadi-Samani M, Bahmani M, Rafieian-Kopaei M, The chemical composition, botanical characteristic and biological activities of Borago officinalis, a review, Asian Pac J Trop Med, 7(1), 2014, 22-28.

Asadollahi K, Taherikalani M, Maleki A, Alizadeh E, Valadbaigi H, Soroush S, Maleki H, Asadollahi P, Emaneini M, Diversity of aminoglycoside modifying enzyme genes among multidrug resistant Acinetobacter baumannii genotypes isolated from nosocomial infections in Tehran hospitals and their association with class 1 integrons, Acta Microbiol Immunol Hung, 58(4), 2011, 359-370.

Asadollahi P, Akbari M, Soroush S, Taherikalani M, Asadollahi K, Sayehmiri K, Maleki A, Maleki MH, Karimi P, Emaneini M, Antimicrobial resistance patterns and their encoding genes among Acinetobacter baumannii strains isolated from burned patients, Burns, 38(8), 2012, 1198-1203.

Babakhanloo P, Mirza M, Sefidkan F, Barazandeh MM, Asgari F, Chemical Components of Essential Oil of *Ziziphora tenuir*, Medical Plants Research Journal, 2, 1998, 115-120.

Bahmani M, Abbasi J, Mohsenzadegan A, Sadeghian S, Gholami Ahangaran M, Allium sativum L, the anti-immature leech (Limnatis nilotica) activity compared to Niclosomide, Comp Clin Pathol, 22, 2013, 165–168.

Bahmani M, Banihabib EKH M, Rafieian-Kopaei M and Gholami-Ahangaran M, Comparison of Disinfection Activities of Nicotine with Copper Sulphate in water Containing Limnatis nilotica, Kafkas Univ Vet Fak Derg, 21 (1), 2015, 9-11.

Bahmani M, Farkhondeh T and Sadighara P, The anti-parasitic effects of Nicotina tabacum on leeches, Comp Clin Pathol, 21(3), 2012, 357-359.

Bahmani M, Golshahi H, Mohsenzadegan A, Ghollami- Ahangarani M, Ghasemi E, Comparative assessment of the anti-Limnatis nilotica activities of Zingiber officinale methanolic extract with levamisole, Comp Clin Pathol 22(4), 2013, 667-670.

Journal of Chemical and Pharmaceutical Sciences

Bahmani M, Karamati SA, Banihabib EKh, Saki K, Comparison of effect of nicotine and levamisole and ivermectin on mortality of leech, Asian Pac J Trop Dis, 4(1), 2014, 477-480.

Bahmani M, Karamati SA, Hassanzadazar H, Forouzan SH, Rafieian-Kopaei M, Kazemi-Ghoshchi B, Asadzadeh J, Kheiri AGh, Ehsan Bahmani E, Ethnobotanic study of medicinal plants in Urmia city, identification and traditional using of antiparasites plants, Asian Pac J Trop Dis, 4(2), 2014, 906-910.

Bahmani M, Rafieian M, Baradaran A, Rafieian S, Rafieian-kopaei M, Nephrotoxicity and hepatotoxicity evaluation of Crocus sativus stigmas in neonates of nursing mice, J Nephropathol, 3(2), 2014, 81-85.

Bahmani M, Rafieian-Kopaei M, Hassanzadazar H, Saki K, Karamati SA, Delfan B, A review on most important herbal and synthetic antihelmintic drugs, Asian Pac J Trop Med, 7(1), 2014, 29-33.

Bahmani M, Rafieian-Kopaei M, Jeloudari M, Eftekhari Z, Delfan B, Zargaran A, Forouzan SH, A review of the health effects and uses of drugs of plant licorice (Glycyrrhiza glabra L,) in Iran, Asian Pac J Trop Dis, 4(2), 2014, 847-849.

Bahmani M, Saki K, Rafieian-Kopaei M, Karamati SA, Eftekhari Z, Jelodari M, The most common herbal medicines affecting Sarcomastigophora branches, a review study, Asian Pac J Trop Med, 7(1), 2014, 14-21.

Bahmani M, Sarrafchi A, Shirzad H, Rafieian-Kopaei M, Curr Pharm Des, 12, 2015.

Bahmani M, Shirzad HA, Majlesi M, Shahinfard N, Rafieian-Kopaei M, A review study on analgesic applications of Iranian medicinal plants, Asian Pac J Trop Med, 7(1), 2014, 43-53.

Bahmani M, Zargaran A, Rafieian-Kopaei M, Identification of medicinal plants of Urmia for treatment of gastrointestinal disorders, Rev Bras Farmacogn, 24(4), 2014, 448-468.

Bahmani M, Zargaran A, Rafieian-Kopaei M, Saki M, Ethnobotanical study of medicinal plants used in the management of diabetes mellitus in the Urmia, Northwest Iran, Asian Pac J Trop Med, 7(1), 2014, 348-354.

Bahmani, M, Abbasi, J, Mohsenzadegan, A, Sadeghian, S, Gholami-Ahangaran, M, Allium sativum L, the antiammature leech (Limnatis nilotica) activity compared to Niclosomide, Comp Clin Path, 22, 2013,165-168.

Bart S, Essential oils, their antibacterial properties and potential application in foods-a review, *Int, J, Food Microbiol*, 94, 2004, 223 -253.

Behnia M, Haghighi A, Komeylizadeh H, Seyyed Tabaei S.J and Abadi A, Inhibitory Effects of Iranian Thymus vulgaris Extracts on *in vitro* Growth of Entamoeba histolytica, Korean J Parasitol, Vol, 46, No.3, 2008, 153-156.

Cakir A, Duru ME, Harmandar M, Ciriminna R, Passannanti S, Kazlm K, Volatile constituents of *Teucrium polium* L, from Turkey, J Essent Oil Res, 10, 1998, 113-115.

Chen JD, Feng DQ, Yang ZW, Wang ZC, Qiu Y, Lin YM, Antifouling metabolites from the mangrove plant Ceriops tagal, Molecules, 13, 2008, 212-219.

Cowan MM, Plant products as antimicrobial agents, Clinical Microbiology Rev, 12, 1999, 564 – 582.

Delaquis PJ, Stanich B, Mazza A, Girard G, Antimicrobial activity of individual and mixed fractions of dill, cilantro, coriander and eucalyptus essential oils, Int J Food Microbiol, 74(1-2), 2002, 101-109.

Delfan B, Bahmani M, Eftekhari Z, Jelodari M, Saki K, Mohammadi T, Effective herbs on the wound and skin disorders, a ethnobotanical study in Lorestan province, west of Iran, Asian Pac J Trop Dis, 4(2), 2014, 938-942.

Delfan B, Bahmani M, Hassanzadazar H, Saki K, Rafieian-Kopaei M, Identification of medicinal plants affecting on headaches and migraines in Lorestan Province, West of Iran, Asian Pac J Trop Med, 7(1), 2014, 376-379.

Delfan B, Bahmani M, Rafieian-Kopaei M, Delfan M, Saki K, A review study on ethnobotanical study of medicinal plants used in relief of toothache in Lorestan Province, Iran, Asian Pac J Trop Dis, 4(2), 2014, 879-884.

Eftekhari Z, Bahmani M, Mohsenzadegan A, Gholami-Ahangaran M, Abbasi J, Alighazi N, Evaluating the antileech (Limnatis nilotica) activity of methanolic extract of Allium sativum L, compared with levamisole and metronidazole, Comp Clin Path, 21, 2012, 1219-1222.

Emaneini M, Taherikalani M, Eslampour MA, Sedaghat H, Aligholi M, Jabalameli F, Shahsavan S, Sotoudeh N, Phenotypic and genotypic evaluation of aminoglycoside resistance in clinical isolates of staphylococci in Tehran, Iran, Microb Drug Resist, 15(2), 2009,129-132.

## Journal of Chemical and Pharmaceutical Sciences

Fatholahzadeh B, Emaneini M, Aligholi M, Gilbert G, Taherikalani M, Jonaidi N, Eslampour MA, Feizabadi MM, Molecular characterization of methicillin-resistant Staphylococcus aureus clones from a teaching hospital in Tehran, Jpn J Infect Dis, 62(4), 2009, 309-311.

Fatholahzadeh B, Emaneini M, Feizabadi MM, Sedaghat H, Aligholi M, Taherikalani M, Jabalameli F, Characterisation of genes encoding aminoglycoside-modifying enzymes among meticillin-resistant Staphylococcus aureus isolated from two hospitals in Tehran, Iran, Int J Antimicrob Agents, 33(3), 2009, 264-265.

Forouzan S, Bahmani M, Parsaei P, Mohsenzadegan A, Gholami- Ahangaran M, et al, Anti-parasitic activites of Zingiber officinale methanolic extract on Limnatis nilotica, Glob Vet, 9(2), 2012, 144-148.

Gandomi NasrAbadi H, Azami-Saroukolaei L, Misaghi A, Abbaszadeh S, Shariatifar N, Tayyar-Hashtjin N, Study the antimicrobial activity of aqueous and alcoholic extracts of saffron petals on some pathogenic bacteria in food, Journal of Medicinal Plants, 42, 11(2), 1391, 189-196.

Gholami-Ahangaran M, Bahmani M, Zia-Jahrom N, *In vitro* antileech effects of Vitis vinifera L, niclosamide and ivermectin on mature and immature forms of leech Limnatis nilotica, Glob Vet, 8, 2012, 229-232.

Gholami-Ahangaran M, Bahmani M, Zia-Jahromi N, Comparative and evaluation of anti-leech (Limnatis Nilotica) effect of Olive (Olea Europaea L,) with levamisol and tiabendazole, Asian Pac J Trop Dis, 2(1), 2012, S101-S103.

Gomaa NF, and Hashish MH, Inhibitory effect of garlic (*Allium sativum*) on growth of some microorganisms, Journal of the Egyptian Public Health Association, 78(5-6), 2003, 361-372.

Gould GW, Method for preservation and extention of shelf life, Int, J, Food Microbiol, 33, 1996, 51-64.

Guha S, Cao M, Kane R, Savino A, Zou S, Dong Y, The longevity effect of cranberry extract in Caenorhabditis elegans is modulated by daf-16 and osr-1, AGE, 35(5), 2013, 1559-1574.

Haghi-Ashteiani M, Sadeghifard N, Abedini M, Soroush S, Taheri-Kalani M, Etiology and antibacterial resistance of bacterial urinary tract infections in children's medical center, Tehran, Iran, Acta Med Iran, 45(2), 2007, 153-157.

Jabalameli F, Mirsalehian A, Khoramian B, Aligholi M, Khoramrooz SS, Asadollahi P, Taherikalani M, Emaneini M, Evaluation of biofilm production and characterization of genes encoding type III secretion system among Pseudomonas aeruginosa isolated from burn patients, Burns, 38(8), 2012, 1192-1197.

Jabalameli F, Mirsalehian A, Sotoudeh N, Jabalameli L, Aligholi M, Khoramian B, Taherikalani M, Emaneini M, Multiple-locus variable number of tandem repeats (VNTR) fingerprinting (MLVF) and antibacterial resistance profiles of extended spectrum beta lactamase (ESBL) producing Pseudomonas aeruginosa among burnt patients in Tehran, Burns, 37(7), 2011, 1202-1207.

Jalali MR, Nadoushan MH, Ghosian Moghadam H, Jafari and N, Fallah N, The effect of aqueous garlic extract on clinical manifestations in *Salmonella* typhimorium infected rabbits, Iranian Journal of Medicinal and Aromatic Plants, 24(1), 2008, 74-81,

Jamkhande PG, Barde SR, Patwekar SL, Tidke PS, Plant profile, phytochemistry and pharmacology of Cordia dichotoma (Indian cherry), A review, Asian Pac J Trop Biomed, 3(12), 2013, 1009-1016.

Kalantari N, Taherikalani M, Parvaneh N, Mamishi S, Etiology and antimicrobial susceptibility of bacterial septic arthritis and osteomyelitis, Iran J Public Health , 36(3), 2007, 27-32.

Karamati SA, Hassanzadazar H, Bahmani M, Rafieian-Kopaei M, Herbal and chemical drugs effective on malaria, Asian Pac J Trop Dis, 4(2), 2014, 599-601.

Karamati SA, Hassanzadazar H, Bahmani M, Rafieian-Kopaei M, Herbal and chemical drugs effective on malaria, Asian Pac J Trop Dis, 4(2), 2014, 599-601.

Kasra Kermanshahi RH, Moattar F, Soleimanimanesh AR, Antibacterial effects of Carthamus tinctorius alcoholic and aqueous extracts on number of bacteria, J Shahid Chamran Univ Sci, 15, 2006,18-26.

kguel A, Pooter HD, Buyck LD, The Essential oil of *Calamintha nepta Subsp, glandulosa* and *Ziziphora clinopodioides* from Turkey, Journal of Essential oil Research, 3, 1991, 7-10.

Khoramrooz SS, Mirsalehian A, Emaneini M, Jabalameli F, Aligholi M, Saedi B, Bazargani A, Taherikalani M, Borghaei P, Razmpa E, Frequency of Alloicoccus otitidis, Streptococcus pneumoniae, Moraxella catarrhalis and Haemophilus influenzae in children with otitis media with effusion (OME) in Iranian patients, Auris Nasus Larynx, 39(4), 2012, 369-373.

#### Journal of Chemical and Pharmaceutical Sciences

Kim JM, Marshall MR, Cornell JA, Preston JF and Wel CI, Antibacterial activity of carvacrol, citral and Geraniol agaist *Salmonella typhimurium* in culture medium and fish cube, *J, Food Sci*, 60, 1995, 1364 – 1368.

Kokoska L, Polesny Z, Rada V, Nepovim A, Vanek T, Screening of some Siberian medicinal plants for antimicrobial activity, J Ethnopharmacol, 82(1), 2002, 51-53.

Lemay MJ, Choquette J, Delaquis PJ, Gariepy C, Rodrigue N and Saucier L, Antimicrobial effect of natural preservatives in a cooked and acidified chicken meat model, *International J, Food Microbiol*, 78 (3), 2002, 217 – 26.

Lesser C and Miller S.I, Salmonellosis, 897-901, In Kasper D.L, Fauci AS, Longo D.L, Braunwald E, Hauser S.L, and Jameson J.L, (Eds.), Harrison's Principles of Iinternal Medicine, 16TH ed, Mc Graw-Hill, New york, 2005, 2607.

Lin J, Opoku A, Geheeb-Keller M, Hutchings A, Terblanche S, Jager A, Preliminary screening of some traditional zulu medicinal plants for, J Ethnopharmacol, 15(68), 1999, 267-274.

Madureira AR, Pereira CI, Truzkowska K, Gomes AM, Pintado ME, Malcata FX, Survival of probiotic bacteria in a whey cheese vector submitted to environmental conditions prevailing in the gastrointestinal tract, International Dairy Journal, 15, 2005, 921-927.

Mahboubi M, Haghi G, Antimicrobial activity and chemical composition of Mentha pulegium L, essential oil, J Ethnopharmacol, 119(2), 2008, 325-327.

Misaghi A, Basti AA, Effect of Zataria multiflora boiss, Essential oil and nisin on Bacillus cereus ATCC 11778, Food Control, 1(9), 2007, 1043-1049.

Mitscher L, Leu RP, Bathala M, Wu WN, Beal JL, Antimicrobial agents from higher plants I, Introduction, rationale and methodology, Lloydia, 35(2), 1972,157-166.

Moeini F, Mohammadi-Sichani M, shahanipour K, The antibacterial effect of methanol extract and blue fruit Vaccinium arctostaphylos on some species of *Salmonella in vitro*, Rafsanjan Uni Med Sci J, 14, 2015, 268-257.

Moghtader M, Salari H, Farahmand A, Antibacterial Effect of plant *Teucrium polium* on human pathogenic bacteria, Journal Iran Medical Microbiology, 7(2), 2013, 1-6.

Mosavai MH, Akhondzadeh-Basti A, Misaghi A, Jabari-Khameneh H, Karim G, zahraei-Salehi T, Evaluation effect of the Zataria multiflora Boiss oil effects on the growth of *Salmonella* typhimurium in commercial barley soup, Journal of Medicinal Plants, 34, 9(2), 2010, 109-116.

Nakhjavani FA, Emaneini M, Hosseini H, Iman-Eini H, Aligholi M, Jabalameli F, Haghi-Ashtiani MT, Taherikalani M, Mirsalehian A, Molecular analysis of typical and atypical enteropathogenic Escherichia coli (EPEC) isolated from children with diarrhoea, J Med Microbiol, 62(2), 2013, 191-195.

Nickavar B, Mojab F and Dolat-abadi R, Analysis of the essential oils of two Thymus species from Iran, *Food Chem*, 90, 2005, 609 – 611.

Nordmann P, Poirel L, Mak JK, White PA, McIver CJ, Taylor P, Multidrug-Resistant *Salmonella* Strains Expressing Emerging Antibiotic Resistance Determinants, Clin Infect Dis, 46(2), 2008, 324-325.

Ogunbanwo ST, Sanni AI, Onilude AA, Characterization of bacteriocin produced by Lactobacillus plantarum Fl and Lactobacillus brevis OGI, Afr J Biotechnol, 2(8), 2003, 219-227.

Oussalah M, Caillet S, Saucier L, Lacroix M, Inhibitory effects of selected plant essential oils on the growth of four pathogenic bacteria, E,coli O157,H7, *Salmonella* typhimurium, Staphylococcus aureus and Listeria monocytogenes, Food Control, 18, 2005, 414-420.

Pakzad I, Ghafourian S, Taherikalani M, Sadeghifard N, Abtahi H, Rahbar M, Mansory Jamshidi N, qnr Prevalence in Extended Spectrum Beta-lactamases (ESBLs) and None-ESBLs Producing Escherichia coli Isolated from Urinary Tract Infections in Central of Iran, Iran J Basic Med Sci, 14(5), 2011, 458-464.

Pervin M, Hasnat MA, Lim BO, Antibacterial and antioxidant activities of Vaccinium corymbosum L, leaf extract, Asian Pac J Trop Dis, 3(6), 2013, 444-453.

Pirnia M, Edalatian Dovom MR, Tabatabaee Yazdi F, Shahidi F, The Antibacterial Effects of the Aqueous and Ethanolic Extracts of Cordia myxa L, Fruit on Staphylococcus aureus, Bacillus cereus, Escherichia coli, and *Salmonella* typhi, Qom University of Medical Sciences Journal, 9(4), 2015, 39-48.

#### Journal of Chemical and Pharmaceutical Sciences

Puupponen-Pimiä R, Nohynek L, Hartmann- Schmidlin S, Kähkönen M, Heinonen M, Määttä- Riihinen K, Berry phenolics selectively inhibit the growth of intestinal pathogens, J Appl Microbiol, 98(4), 2005, 991-1000.

Puupponen-Pimiä R, Nohynek L, Meier C, Kähkönen M, Heinonen M, Hopia A, Antimicrobial properties of phenolic compounds from berries, J Appl Microbiol, 90(4), 2001, 494-507.

Roler S, The Quest for Natural Antimicrobials as Novel Means of Food Preservation, Status Reports on a European Research project, International Biodeterioration, 1995, 333 – 345.

Sacchetti G, Maietti S, Muzzoli M, Scaglianti M, Manfredini S, Radice M and Bruni R, Comparative evaluation of 11 essential oils of different origin as functional antioxidants, antiradicals and antimicrobials in foods, Food Chem, 91 (4), 2005, 621 - 632.

Sahebekhtiari N, Nochi Z, Eslampour MA, Dabiri H, Bolfion M, Taherikalani M, Khoramian B, Zali MR, Emaneini M, Characterization of Staphylococcus aureus strains isolated from raw milk of bovine subclinical mastitis in Tehran and Mashhad, Acta Microbiol Immunol Hung, 58(2), 2011, 113-121.

Sajadi SE, Ghasemi Dehkordi N, Baloochi M, Volatile Constituents of *Ziziphora clinopodioides* Lam, Journal of Pajoohesh va Sazandeghi, , 8, 2003, 1-9.

Saki K, Bahmani M, Rafieian-Kopaei M, Hassanzadazar H, Dehghan K, Bahmani F, Asadzadeh J, The most common native medicinal plants used for psychiatric and neurological disorders in Urmia city, northwest of Iran, Asian Pac J Trop Dis, 4(2), 2014, 895-901.

Saki K, Bahmani M, Rafieian-Kopaei M, The effect of most important medicinal plants on two important psychiatric disorders (anxiety and depression)-a review, Asian Pac J Trop Med, 7(1), 2014, 34-42.

Sefidkon F, Jamzad Z, Barazandeh M, Essential oil of Satureja bachtiarica Bunge, A potential source of carvacrol, Iran J Med Aromat Plant, 20(4), 2005, 425-439.

Sewell RDE, Rafieian-Kopaei M, The history and ups and downs of herbal medicine usage, J HerbMed Pharmacol, 3(1), 2014, 1-3.

Shahsavan S, Emaneini M, Noorazar Khoshgnab B, Khoramian B, Asadollahi P, Aligholi M, Jabalameli F, Eslampour MA, Taherikalani M, A high prevalence of mupirocin and macrolide resistance determinant among Staphylococcus aureus strains isolated from burnt patients, Burns, 38(3), 2012, 378-382.

Singh G, Maurya S, Catalan C, Chemical constituent's antimicrobial investigations and antioxidant potentials of Anethum graveolens essential oil and acetone extract, J Food Sci, 70(4), 2005, 208-215.

Smith–Palmer A, Stewart J and Fyfe L, The potential application of plant essential oils as natural food preservatives in soft cheese, *Food Microbiol*, 18 (4), 2001, 463 – 470.

Smith-Palmer, A, J, Stewart, & L, Fyfe, Antimicrobial properties of plant essential oils and essences against five important food-borne pathogens, Letters in Food Microbiology, 26, 1998, 118–122.

Soroush S, Haghi-Ashtiani MT, Taheri-Kalani M, Emaneini M, Aligholi M, Sadeghifard N, Pakzad I, Abedini M, Yasemi M, Paiman H, Antimicrobial resistance of nosocomial strain of Acinetobacter baumannii in Children's Medical Center of Tehran, a 6-year prospective study, Acta Med Iran, 48(3), 2010, 178-184.

Tabatabaei-Yazdi F, heydari-Soreshjani m, Alizadeh-Behbahani B, The antimicrobial effect of aqueous extracts and ethanol of Ferulago angulate plant on Staphylococcus aureus, Bacillus cereus and *Salmonella* typhi *in vitro*, Journal of Infectious Diseases and Tropical Medicine, 19, 65, 2014, 25-31.

Tabatabaei-Yazdi F, Mortazavi SA, Alizadeh-Behbahani B, Vasiei AR, Moradi S, Tabatabaei-Yazdi F, Jafarian S, Compare the effect of extracts Hibiscus sabdariffa and choice of antibiotics based on clinical and standard strains in *in vitro* infection, Journal of Infectious Diseases and Tropical Medicine, 20, 69, 2015, 31-40.

Taherikalani M, Etemadi G, Geliani KN, Fatollahzadeh B, Soroush S, Feizabadi MM, Emergence of multi and pandrug resistance Acinetobacter baumannii carrying blaOXA-type -carbapenemase genes among burn patients in Tehran, Iran<u></u>, Saudi Med J, 29(4), 2008, 623-624.

Taherikalani M, Maleki A, Sadeghifard N, Mohammadzadeh D, Soroush S, Asadollahi P, Asadollahi K, Emaneini M, Dissemination of class 1, 2 and 3 integrons among different multidrug resistant isolates of Acinetobacter baumannii in Tehran hospitals, Iran, Pol J Microbiol, 60(2), 2011, 169-174.

#### Journal of Chemical and Pharmaceutical Sciences

Yang S, Yu R and Chou C, Influence of holding temperature on the growth and survival of *Salmonella spp*, and *staphylococcus aureus* and the production of staphylococcal enterotoxin in egg products, *International J, Food Microbiol*, 63, 2001, 99 - 107.

Zabetian-Hosseini F, Mortazavi SA, fazli-Bazaz BS, Kouchaki A, Bolourian SH, Antimicrobial effect of Thymus vulgaris on *Salmonella enteritidise* PT4 In the mayonnaise, Iranian Food Science and Technology Research Journal, 6(2), 2010, 84-90.