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Research Article

Phytotherapy for *Escherichia coli*: Iranian Native Medicinal Plants with Anti-*Escherichia coli* Effect

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ABSTRACT
Escherichia coli bacteria as a gram-negative bacilli of Enterobacteriaceae family causes different diseases in human such as wound infection, pneumonia, urinary tract infections, meningitis, premature and weak children birth, peritonitis and cholecystitis. One of the major pathogens that has shown resistance to most antibiotics is *Escherichia coli*. Therefore, development of natural antibacterial agents such as medicinal plants for the treatment of infectious diseases is necessary. This study was aimed to present the phototherapy of Iranian native medicinal plants with anti-Escherichia coli effect. The required information was obtained by searching key words such as *Esherichia coli*, Native medicinal plant of Iran, medicinal plant extracts or essential oils of related published articles in authentic scientific databases. Results showed that different native medicinal plants were effective against *E. coli* in Iran, including *Cuminum cyminum, Mentha piperit, Myrtus communis, Mentha pulegium, Rosmarinus officinalis, Stachys inflate, Thymus caramanicus, Zataria multiflora,* Ziziphora clinopodioides, *Allium cepa, Ocium gratissimum , Olea europaea* and *Carum copticum*.

Keywords: Infectious diseases, *Escherichia coli*, Medicinal plants, Iran.

INTRODUCTION

Nowadays, *Esherichia coli* bacteria are major causes of infectious diseases in developing countries with high health costs and mortality. Current antibiotics are expensive and pathogenic strains resistance to them is one of the most important issues in clinical treatments[1]. *E. coli* bacteria as a gram-negative bacilli of Enterobacteriaceae family causes different diseases in human such as wound infection, pneumonia, urinary tract infections (UTI), meningitis, premature and weak children birth, peritonitis and cholecystitis[2,3]. *Escherichia coli* has been introduced as an indicator of foods fecal contamination in many international standards[4]. Recently, a number of antibiotics have lost their therapeutic effects due to development of strains resistant to antibiotics. In addition, antibiotics have various side effects such as allergic reactions, severe allergies and immunity suppression[5]. *E. coli* is one of the major pathogens that have shown resistance to most antibiotics[6] and uses various mechanisms for resistance to beta-lactams, which include changes in outer membrane proteins, over-production of chromosomal and plasmid cephalosporinase or production of a broad spectrum beta lactamase[7,8]. Therefore, development of natural antibacterial agents such as medicinal plants for the treatment of infectious diseases is necessary. Medicinal plants have wide range of health effects[8-12]. Furthermore, these plants other than treatment, are usful in prevention of a wide variety of diseases[20-23]. Medicinal plants have been used for a long time ove generations and it is believed that they are safer than synthetic drugs[24-26]. Many native medicinal plants in Iran have antimicrobial and antibiotic properties. So the aim of this study is reporting medicinal plants with anti *Esherichia coli* effect.

METHODS

The required information was obtained by searching key words such as *Esherichia coli*, native medicinal plant of Iran, medicinal plant extracts or essential oils of published articles in authentic scientific databases such as Sciencedirect, Blackwell Wiley, Springer, Google scholar and Scientific Information Database (SID) and Magiran. All related articles were selected.

RESULTS

According to literature reviews, results showed that different native medicinal plants in Iran were effective against *E. coli*, including *Cuminum cyminum, Mentha piperit, Myrtus communis, Mentha pulegium, Rosmarinus*

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Table 1: List of Iranian native medicinal plants effective against *E.coli.*

No	Scientific name	Family name	Description
1	*Cuminum cyminum*	Apiaceae	Results of a study showed that essential oil of *Cuminum cyminum* had the highest antimicrobial effect on *E. coli* ATCC 25922 in 1, ½, ¼ and 1/8 dilutions and growth inhibition zone diameter of this essential oil was 13 mm[27]
2	*Mentha piperita*	Lamiaceae	Results of a study showed antimicrobial effects of *Mentha piperita* essential oil at 1 µg/gr concentration was 3+, for 2 µg/gr was 2+ and growth inhibition zone diameter of this essential oil was 31.33 mm. D-values for this essential oil was 2.14 [28]
3	*Myrtus communis*	Myrtaceae	Results of a study showed that antimicrobial effects of *Myrtus communis* essential oil at 1 µg/gr concentration was 3+, for 2 µg/gr was 2+ and growth inhibition zone diameter of this essential oil was 13 mm. D-values for this essential oil was 2.8 [28]
4	*Mentha pulegium*	Lamiaceae	Results of an experimental study showed that MIC and MBC of *Mentha pulegium* essential oil was 4 µg/gr[29]
5	*Rosmarinus officinalis*	Lamiaceae	Results of the antimicrobial activity of *Rosmarinus officinalis* essential oils in a showed growth inhibition zone diameter were 16, 12.5, 9, 8 and 7 mm in 1, 1/2, 1/4, 1/8 and 1/16 dilutions, respectively30
6	*Stachys inflata*	Labiatae	Results of an experimental study showed that MIC of *Stachys inflate* essential oil was 5 µg/gr[21]
7	*Thymus caramanicus*	Lamiaceae	Results of an experimental study showed that MIC of *Thymus caramanicus* essential oil of Vegetative stage, Floral budding, Flowering stage and seed set against *E.coli* was 0.9 µL[22]
8	*Zataria multiflora*	Lamiaceae	Results of an experimental study showed that minimum growth inhibition zone diameter of *Zataria multiflora* essential oil collected from Hajiabad, Farashabad, Yazd, Najafabad and poldokhtar area against *E.coli* were 4, 16, 8, 2 and 16 mm [33]
9	*Ziziphora clinopodioides*	Lamiaceae	Results of an experimental study showed that IZ index and MIC of *Ziziphora clinopodioides* essential oil against *E.coli* were 20±0.5 and 3.75±0.1, respectively. These indices for 1,8-Cineole were 20±0.1 and11.68±0.5, and for Pulegone were 12±0.4 and 7.2±0.3, respectively against *E. coli*[34]
10	*Allium cepa*	Liliaceae	Results of an experimental study based on disc diffusion method showed that growth inhibition zone diameter of 6.25, 12.5, 25 and 50 percent concentrations of yellow onion extract were 0.9 ± 0.3, 1.8 ± 0.2, 2.3 ±0.2 and 6.8 ± 0.5 mm, respectively and MIC and MBC of this extract were less than 50 % and 25 %, respectively[35]
11	*Allium spp.*	Liliaceae	Results of an experimental study based on disc diffusion method showed that growth inhibition zone diameter of 6.25, 12.5, 25 and 50 percent concentrations of Red onion extract were 0.8 ± 0.2, 2.1 ± 0.3, 3.5 ±0.3 and 8.1 ± 0.3 mm, respectively and MIC and MBC of this extract were less than 50 % and 25 %, respectively[36]
12	*Allium spp.*	Liliaceae	Results of an experimental study based on disc diffusion method showed that growth inhibition zone diameter of 6.25, 12.5, 25 and 50 percent concentrations of Red onion extract were 0.4 ± 0.2, 1.4 ± 0.2, 2.2 ±0.2 and 3 ± 0.2 mm, respectively and both MIC and MBC of this extract were less than 50 %, respectively[36]
13	*Ocimum gratissimum*	Lamiaceae	Results of a study showed that growth inhibition zone diameters of *Ocimum gratissimum* extract against *E. coli* were 5 mm and 9 mm in 100 mg/ml and 200 mg/ml concentrations, respectively[36]
14	*Olea europaea*	Oleaceae	Results of a study showed that growth inhibition rate of *Dezful* and *Yellow olive* varieties against *E. coli* were 93% and 94.9% in 20 mg/ml concentration, respectively[37]
15	*Carum copticum*	Asteraceae	Results of an experimental showed that growth inhibition zone diameter of *Carum copticum* extract against *E. coli* were 23 and

		28 mm[38]
16	*Scrophularia Striata*	Results of an in vitro study showed positive effect of Scrophularia Striata extract against E. coli[39]

officinalis, Stachys inflate, Thymus caramanicus, Zataria multiflora, Ziziphora clinopodioides, *Allium cepa, Ocium gratissimum, Olea europaea* and *Carum copticum* which are listed in Table 1.

DISCUSSION

Results showed that different native medicinal plants in Iran including *Cuminum cyminum, Mentha piperit, Myrtus communis, Mentha pulegium, Rosmarinus officinalis, Stachys inflate, Thymus caramanicus, Zataria multiflora,* Ziziphora clinopodioides, *Allium cepa, Ocium gratissimum, Olea europaea* and *Carum copticum* were effective against *E. coli*.

It is not clear that with what mechanisms these plants have anti *E. coli* activities. Medicinal plants have various compounds by which they may act against bacteria. Phenolic compounds are a group of compounds which are abundant in most of these and other medicinal plants[40-50] These plants mostly have shown to possess antibacterial effects[51-58.] Therefore, these compounds might be responsible for anti E. coli activity of these plants. More importantly these compounds in medicinal plants have antioxidant activities[58-67].

Infections are associated with increase in free radicals and oxidative stress which may exacerbate the condition. Hence, medicinal plants may also be beneficial in infected diseases by their antioxidant activities and reducing oxidative stress. Oxidative stress in involved in various diseases such as neurological disorders, inflammation, ischemia/reperfusion ischemia/reperfusion, diabetes, athrosclerosis, cardiovascular diseases and wound complication[68-78].

The oxidative stress involves many changes, including alterations in redox state. Antioxidants, particularly the herbal medicines with antioxidant activities are able to counteract these complications[79,80] Various studies have demonstrated promising results for counteracting these conditions by medicinal plant especially for life threatening diseases[81-84]. These agents are also effective in inhibition of toxic agents induced complications. Therefore, these plants other than infections may also be beneficial in other disease.

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