Review Article

Medicinal Plants with Anti-\textit{Trichomonas vaginalis} Activity in Iran: A Systematic Review

Hajar ZIAEI HEZARJARIBI 1, Najmeh NADEALI 2, *Mahdi FAKHAR 1, Masoud SOOSARAEI 2

1. Toxoplasmosis Research Center, Department of Parasitology, School of Medicine, Mazandaran University of Medical Sciences, Sari, Iran
2. Student Research Committee, Department of Parasitology, School of Medicine, Mazandaran University of Medical Sciences, Sari, Iran

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\textbf{Abstract}

\textbf{Background:} Trichomoniasis, due to \textit{Trichomonas vaginalis}, is one of the most common sexually transmitted parasitic diseases in the world such as Iran. This systematic review aimed to explore the studies evaluating the medicinal herbs with anti- \textit{T. vaginalis} activity which used in Iran.

\textbf{Methods:} Articles published in 4 Persian and 4 English databases were obtained between 2000 and 2015 including Google Scholar, PubMed, Science Direct, Scopus, Magiran, Barakatkins (formerly IranMedex), Elm net, and SID (Scientific Information Database). Studies out of Iran, studies on animal models and articles on other parasite species than \textit{T. vaginalis} were excluded from this review.

\textbf{Results:} Twenty-one articles including in vitro experiments, met our eligibility criteria. Thoroughly, 26 types of plants were examined against \textit{T. vaginalis}. Medicinal herbs such as \textit{Artemisia}, \textit{Zataria multiflora}, and \textit{Lavandula angustifolia} are remarkably effective on \textit{T. vaginalis}. As such, use of other parts of these plants in different concentrations and timelines is recommended for future in vivo studies.

\textbf{Conclusion:} The present systematic review provides comprehensive and useful information about Iranian medicinal plants with anti-\textit{T. vaginalis} activity, which would be examined in the future experimental and clinical trials and herbal combination therapy.

\textbf{Keywords:} \textit{Trichomonas vaginalis}; Medicinal plants; Systematic review; Iran

\textbf{*Correspondence Email:} mahdifu53@yahoo.com
Introduction

Trichomonas vaginalis (T. vaginalis) is a flagellated protozoan parasite that attaches to vaginal epithelial cells leading to the occurrence of trichomoniasis. Trichomoniasis is one of the most common sexually transmitted parasitic diseases in the world such as Iran (1). The overall prevalence rate of trichomoniasis in Iran was estimated to be 8% (2). This infection is likely to remain asymptomatic in 10%-50% of the cases. In women, trichomoniasis may lead to different conditions, including vaginitis, dysuria, dyspareunia, premature delivery, premature rupture of membranes, low birth weight, spontaneous abortion, ectopic pregnancy, postpartum endometritis, salpingitis, cervical erosion, chronic cervicitis, cervical cancer, (3, 4) and infertility (5). Although trichomoniasis is associated with no significant clinical symptoms in men, it has been reported to cause urethritis (6).

The risk of T. vaginalis increases with the removal of the secretory procase of white blood cells, which protects the vaginal mucosa membrane cells against the human immunodeficiency virus (HIV). Furthermore, some researchers believe T. vaginalis to be a co-factor for the transmission of HIV and other sexually transmitted infections (7, 8). Metronidazole is considered the most useful medication in the treatment of trichomoniasis (9). Metronidazole has numerous side effects and in some cases, it has low efficacy in the treatment of infections caused by different bacterial strains. In other words, antibiotic resistance against this medication has increased. Among the main side effects of metronidazole are nausea and vomiting, bad taste in the mouth, gastrointestinal disorders, skin rashes, urticaria, angioedema, dizziness, peripheral neuropathy, and transient neutropenia. There is disagreement among medical specialists regarding the use of this antibiotic during pregnancy, while the use of metronidazole is forbidden during the first trimester of pregnancy (9). Moreover, carcinogenic and mutagenic effects of metronidazole have been reported in animal models (10-12).

WHO has recommended the use of medicinal herbs and natural food compounds for the treatment of various diseases in order to reduce the side effects of chemical drugs (13). Different studies have evaluated the efficacy of medicinal herbs in the treatment of trichomoniasis. In this systematic review, we explored the studies assessing the utilities of medicinal plants with anti-T. vaginalis activity in Iran. Evaluation of the studies on the effects of different medicinal herbs on trichomoniasis could provide an overview of the proper treatment of this infection in Iran. The results of this review help researchers find the proper compounds for trichomoniasis treatment with no and or fewer complications. This study aimed to investigate the effects of anti-T. vaginalis medicinal plants in Iran.

Methods

Searching plan

This systematic review was conducted through searching in 8 databases such as Google Scholar, PubMed, Science Direct, Scopus, Magiran, Barakatkins (formerly IranMedex), Elm net, and SID (Scientific Information Database) throughout 2000-2015 (Fig.1). We chose all the articles published in Persian and English languages evaluating anti-T. vaginalis medicinal plants using the following keywords: Trichomonas vaginalis, trichomoniasis, herb, medicinal plant, herbal medicine, anti-T. vaginalis and Iran both separately and combined.

Quality assessment and article selection

All the articles identified in the aforementioned databases were evaluated by two authors independently. After the review of the titles, abstracts, and full texts of the articles,
unrelated studies were excluded from the review. Remaining articles were investigated using quality assessment checklists.

Inclusion criteria of this study were the articles evaluating the in-vitro effects of medicinal herbs on *T. vaginalis* in Iran between 2000 and 2015.

Exclusion criteria were the studies conducted outside the determined deadline, articles on other parasite species than *T. vaginalis*, and in-vivo studies performed on animal models.

**Fig. 1:** Flowchart describing the study design process

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Data extraction

Essential data including the scientific name of plants, type of herbal extracts, used parts of the plants, extract concentrations, and killing or growth-inhibitory effects were obtained from the selected articles and recorded in prepared forms.

Results

Overall, 254 articles published from 2000 to 2015 (16 years) in Iran were identified in the literature search. Considering the inclusion and exclusion criteria of the study and after the review of the titles, abstracts, and full texts of these articles, 21 articles were selected for this systematic review. Overall, 26 types of plants had assessed among the selected articles (Table 1).

Myrtus communis and Zataria multiflora medicinal plants were reported to have the most anti-T. vaginalis activity. Among the studied medicinal herbs, Z. multiflora and Lavandula angustifolia were observed to apply the most significant inhibitory effects against T. vaginalis.

Only a limited number of medicinal plants, such as Stachys lavandulifolia and Eucalyptus camaldulensis, were found to have minimal inhibitory effects against T. vaginalis, and no significant difference was reported between the effects of these plants and control groups.

Table 1: Most medicinal plants with anti-T. vaginalis activity in Iran

| Scientific name of plant | Preparation | Plant part | Lethal or growth inhibitory | Reference |
|--------------------------|-------------|------------|-----------------------------|-----------|
| Artemisia aucheri         | Essential oils | Aerial parts | 100% lethal at 0.1, 0.01 and 0.001% concentrations at the beginning of culture. | (14) |
| Zataria multiflora       | Essential oils | Aerial parts | 100% lethal at 0.1, 0.01, 0.001 and 0.004% concentrations at the beginning of culture. | |
| Myrtus communis          | Methanolic | Aerial parts | 100% lethal at 0.1, 0.01, 0.001 and 0.004% concentrations at the beginning of culture. | |
| Artemisia aucheri         | Methanolic | Aerial parts | 100% lethal at 0.1 and 0.01 mg/mL concentrations respectively | |
| Zataria multiflora       | Methanolic | Aerial parts | 100% lethal at 0.1 and 0.01 mg/mL concentrations at the beginning of culture | |
| Myrtus communis          | Methanolic | Aerial parts | 100% lethal at 0.1 mg/mL concentration at the beginning of cultivation and 0.01 mg/mL | |
| Allium birtifolium       | Hydroalcoholic | Root | MIC for extract of hydro alcoholic and dichloromethanic was 10 and 5 µg/mL respectively | (16) |
| Myrtus communis          | Dichloromethanic | Root | IC50 = 0.034 µg/mL | |
| Zataria multiflora       | Dichloromethanic | Root | IC50= 0.012 µg/mL | |
| Dorstenia barteri        | Ethanol | Root | IC50 = 3.2 µg/mL | |
| Lavandula angustifolia   | Ethanol | Root | IC50= 0.0015 µg/mL | |
| Mentha piperita          | Ethanol | Root | IC50= 0.051 µg/mL | |
| Micana cordifolia        | Ethanol | Root | IC50= 12.5 µg/mL | |
| Myrtus communis          | Methanolic | Aerial parts | Methanolic extract at concentrations of 0.1 and 0.01 mg/mL and essential oil at concentrations of 0.1, 0.01, 0.001 mg/mL and 0.0004 mg/mL are effective at the beginning of inoculation and at concentrations of 0.0002 and 0.0001 mg/mL respectively | (19) |
| Artemisia absinthium     | Ethanolic | Leaves | The effects of concentrations of 6.25 to 800 mg/mL compared to the control group were significant | (20) |

IC50: Inhibitory concentration 50%
MIC: The minimum inhibitory concentration
NR: Not reported

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Discussion

Quite a lot of evidence based studies have supported the use of herbs in complementary and preventive medicine to facilitate treat of various sickness or disorders. Considering the adverse effects of chemical drugs, increasing antibiotic resistance, and lack of access to many of these medicines, use of medicinal plants could be beneficial in the treatment of infectious diseases.

Many synthetic drugs have a natural origin, such as emetine (34), quinine (anti-malarial drug), and Artemisinin (35), as such, parasites of the Plasmodium spp. have reported to have no resistance to these agents. In this systematic review, we systematically reviewed the effects of medicinal plants used against T. vaginalis in Iran.

Several studies have been conducted in different countries evaluating the potential effectiveness of various medicinal plants against T. vaginalis. Some of these herbs include Garcinia kola, Commpbora molmol, Persea americana, Nigella sativa, Eugenia uniflora, Polygala decumbens, Maytenus imbricata, Arbutus unedo, and Hypericum polyanthemum, most of which have beneficial effects against T. vaginalis (36-45).

Plants of the genus Artemisia exhibit antimicrobial activities in different laboratory animals, while the possible toxic effects of these plants should be evaluated in different cultured cells. In the absence of such toxic effects and efficacy of these medicinal plants in vivo, combinations of these herbs have been used as an appropriate alternative for anti-trichomonial therapy.

Various anti-parasitic and antifungal properties have been attributed to artemisinin, extracted from Artemisia annua plant as an important medicinal herb. In this regard, studies were performed to assess the effects of the essence and methanol extract of Artemisia aucheri (A. aucheri) on T. vaginalis. A. aucheri is one of the most important medicinal plants used against T. vaginalis, and the essence of this herb had more significant effects compared to the alcoholic extract (14, 15).

Based on the results of the aforementioned studies, the most effective dose of the herbal extract of A. aucheri was 0.1 mg/mL (14, 15).

Moreover, plant metabolites containing alkaloids, isoflavonoid glucosides, saponins and sesquiterpene lactones possess anti-T. vaginalis activities. (46).

In another study, the antifungal activity of the herbal extracts obtained from the aerial parts of different species of genus Artemisia against Candida albicans, Aspergillus flavus, A. niger, Trichophyton rubrum, and Epidermophyton floccosum were investigated, all of which could be pathogenic to human (47).

The in vitro anti-parasitic effects of Artemisinin on Neospora caninum were evaluated and it could inhibit the growth of N. caninum tachyzoites (48). In this regard, Shuhua et al. also investigated the protective and therapeutic effects of Artemether on animal models infected with Schistosoma mansoni. The parasitic infection did not spread in the laboratory animals treated with Artemether during the first month. In addition, the infection decreased by 72%-82% compared to the control group, while treatment replication reduced the infection by 97.2%-100% (49).

Previous studies have reported different antimicrobial and therapeutic properties for pot-herbs such as thyme, Z. multiflora and myrtle, M. communis. For instance, the anti- T. vaginalis properties of the oil and alcoholic extracts of different Artemisia spp. were examined, and the most effective inhibitory dose was determined at 0.1 mg/mL. As such, these extracts could be used as capable anti-T. vaginalis agents for in vivo studies in the future (14, 15).

In another in vitro study, inhibitory effects of thyme against Giardia cysts were assessed. Concentrations of 1:2, 1:4, 1:10, 1:50, and 1:100 of this herbal extract had significant inhibitory effects against Giardia spp. cysts at 30 and 60 min (50).

In this regard, the study was performed to investigate the anti- T. vaginalis activity of lavender, Lavandula angustifolia. The anti-parasitic effects of the concentrations of 0.1, 0.01, and
0.001 mg/mL of this plant were examined after 3, 4, 5, 6, 12, 24, 48, and 72 h. Concentration of 0.1 of the lavender extract killed all T. vaginalis trophozoites after 90 min (8). Lavender plant has been shown to have sedative and antimicrobial properties. The effects of lavender extract on bacteria such as Streptococcus pneumoniae, Streptococcus pyogenes, Staphylococcus aureus, and Pseudomonas aeruginosa were evaluated. Minimal inhibitory concentration for S. pneumoniae, S. pyogenes, S. aureus, and P. aeruginosa was 0.097, 0.097, 6.25, and 3.125 μg/mL, respectively (51).

In a study, the inhibitory effects of lavender against A. fumigatus were evaluated and this plant exerted protective effects against A. fumigatus and could be used as a natural antifungal agent (52).

The genus Allium spp. of the Liliaceae family has more than 600 species, the most important of which are nourishing plants such as garlic (A. sativum) and onion (A. cepa) (34). Several investigations have been performed on different properties of these species (35-56). A. sativum has been widely used as a therapeutic plant in the traditional and modern medicine due to its anti-microbial, anti-viral, anti-fungal, and anti-parasitic properties. Furthermore, the results proposed by Moazeni et al. were indicative of the presence of extraordinary anti-protoscoleces agents in garlic in vitro (57). The findings of Behnia et al. were indicative of the anti-parasitic effects of garlic against Entamoeba histolytica denoting no significant difference between the effects of garlic plant and metronidazole in this regard (58).

Two species of genus Allium, including A. sativum and A. hirtifolium, were reported to have adequate anti-T. vaginalis activity (16). With respect to the in vitro and in vivo effects of garlic extract on flagellated Giardia lamblia, this herbal extract had the most significant inhibitory effect against G. lamblia at the dose of 80 mg/mL, which resulted in the complete recovery of mice within three days (59).

In addition, the in vitro effects of the liquid extracts of three herbal species of the genus Allium (garlic, onion, and shallot) assessed against Giardia spp. cysts. Mean of the inhibitory dose of garlic was 107.5±34.1 mg/mL with the rate of 43.2%. In onion, mean of the inhibitory dose was 102.83±9.88 mg/mL with the rate of 40.8%, while these rates were determined at 84.66±4.80 mg/mL and 33.6% in shallot, respectively (60,61).

Eucalyptus, Echinophora platyloba, is a plant traditionally used in herbal medicine for various conditions. In this regard, Kazemian et al. (21) and Youse et al. (23) investigated the inhibitory effects of this plant against T. vaginalis. Methanolic and hydroalcoholic extracts of E. platyloba could kill 100% of T. vaginalis trophozoites.

According to the findings of the present review, Mentha longifolia is one of the most effective medicinal plants against T. vaginalis (31). Moreover, Eucalyptus camaldulensis, exhibit significant inhibitory effects against T. vaginalis and it could be used as safer and effective alternatives of chemical agents in the treatment of this infection in future (21,23,25,26).

**Conclusion**

Considering the adverse effects of many current chemical drugs, increasing drug resistance, and lack of access and high costs of the available drugs, it is recommended apply for natural sources and cost-effective medicines in the treatment of parasitic infections (62) such as T. vaginalis infection. To date, several natural compounds have been shown to be efffectual in the treatment of trichomoniasis. Unfortunately, limited research has been conducted as to investigate the exact effects of all these medicinal plants, and the use of natural anti-T. vaginalis agents are not approved by the Food and Drug Administration (FDA).

Various plants including Artemisia spp. members of the Allium family, potherbs (Z. multiflora, M. communis), and lavender could exert significant inhibitory effects against T. vaginalis and are considered relatively safer and
efficient alternatives for treatment of *T. vaginalis* infections rather than metronidazole. The present systematic review provides comprehensive and useful information about Iranian medicinal plants with anti-*T. vaginalis* activity, which would be examined in the future experimental and clinical trials and herbal combination therapy.

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**Conflict of interest**

The authors declare that there is no conflict of interests.

**References**

1. Patel SR, Wiese W, Patel SC, Ohl C, Byrd JC, Estrada CA. Systematic review of diagnostic tests for vaginal trichomoniasis. Infect Dis Obstet Gynecol. 2000; 8(5-6):248-57.

2. Hezarjaribi HZ, Fakhar M, Shokri A, Teshnizi SH, Sadough A, Taghavi M. *Trichomonas vaginalis* infection among Iranian general population of women: a systematic review and meta-analysis. Parasitol Res. 2015; 114(4):1291-300.

3. Wolner-Hanssen P, Krieger JN, Stevens CE at al. Clinical manifestations of vaginal trichomoniasis. JAMA. 1989; 261(4):571-6.

4. Johnston VJ, Mabey DC. Global epidemiology and control of *Trichomonas vaginalis*. Curr Opin Infect Dis. 2008; 21(1):56-64.

5. Shiadeh MN, Niyaty M, Fallahi S, Rostami A. Human parasitic protozoan infection to infertility: a systematic review. Parasitol Res. 2016; 115(2):469-77.

6. Sobel JD. Vaginitis. N Engl J Med. 1997; 337(26):1896-903.

7. Vermani K, Garg S. Herbal medicines for sexually transmitted diseases and AIDS. J Ethnopharmacol. 2002; 80(1):49-66.

8. Ezatpour B, Badparva F, Ahmadi S, Rashidipour M, Ziaei H. Investigation of anti-*trichomonas vaginalis* activity of *Lavandula angustifolia* essential oil in invitro. J Ilam Uni Med Sci. 2009; 16(4):31-37.

9. Lacy CF, Armstrong LL, Goldman MP, Lance LL. Drug information handbook with international trade names index: Lexi-Comp Inc, 2007.

10. Zarinifar N, Fani A, Didgar F, Khaki M, Karimi M. Effect of metronidazole on amount of blood’s lipids of hyperlipidemia people. Arak Med Uni J. 2008;11(3):63-9.

11. Falagas ME, Walker AM, Jick H et al. Late incidence of cancer after metronidazole use: a matched metronidazole user/nonuser study. Clin Infect Dis. 1998; 26(2):384-8.

12. Elmi T, Gholami Sh, Azadbakht M, Ziaei H. Effect of Chloroformic Extract of *Tanacetum parthenium* in the treatment of *Giardia lamblia* infection in Balb/c Mice. J Mazandaran Univ Med Sci. 2014;24(1):157-65.

13. De La Sante O. WHO/PAHO informal consultation on intestinal protozoal infections. World Health Organization, Geneva, Switzerland. 2004.

14. Azadbakht M, Ziaei H, Abdollahi F, Shabankhani B. Effect of essential oils of *Artemisia zataria* and *Myrtus* on *Trichomonas vaginalis*. J Med Plant. 2003;4(8):35-40.

15. Ziaei H, Azadbakht M, Abdollahi F, Shabankhani B. Effect of methanolic extracts of *Artemisia aucheri* Boiss, *Zataria multiflora* Boiss and *Myrtus communis* L. on *Trichomonas vaginalis* In Vitro. J Gorgan Univ Med Sci. 2006; 8(1):34-8.

16. Taran M, Rezaeian M, Izaddoost M. Invitro antitrichomonas activity of *Allium birtifolium* [Persian shallot] in comparison with metronidazole. Iran J Public Health. 2006;35(1):92-4.

17. Azadbakht M. Azadbakht M. Five prevalent antiprotrozoal herbal drugs. J Mazandaran Univ Med Sci. 2008;18(67):118-32.

18. Sarkari B, Tadayon H, Askarian S, Farnia E, Askarian M. In Vitro anti-*Trichomonas* activity of *Freula assafoetida* and garlic extracts. J Gorgan Uni Med Sci. 2009;11(3):13.

19. Abdollahy F, Ziaei H, Shabankhani B, Azadbakht M. Effect of essential oil and methanol extract of *Myrtus communis* on
Trichomonas vaginalis. Iran J Pharma Res. 2010;3(2):35.

20. Rafieian M, Hejazi SH, Yusefi HA, Yektaian N, Shirani-Bidabadi L. Effect of Achillea millefolium, Artemisia absinthium & Inula roja leaves extracts on Trichomonas vaginalis, in vitro. J Shahrekord Uni Med Sci. 2011;12(4):62-9.

21. Kazemian A, Yousofi Darani H, Zebardast N, Sereshti M, Banaian S, Banaian S. Effects of Eucalyptus camaldulensis extracts on Trichomonas vaginalis growth in vitro. J Med Plant. 2012;2(42):116-20.

22. Sioresht M, Yousoufi Darani H, Zebardast N, Rafian M, Manochehre among others. Effect of ethanolic and watery extract of aerial parts of Stachys lavandulifolia on Trichomonas vaginalis, in vitro. J Med Plant. 2012;1(41):159-65.

23. Youse HA, Kazemian A, Sereshti M et al. Effect of Echinophora platyloba, Stachys lavandulifolia, and Eucalyptus camaldulensis plants on Trichomonas vaginalis growth in vitro. Adv Biomed Res. 2012;1:79.

24. Arekhah N, Taghipur S, Yousufi M, Rafieian M, Daneshpur S, Yousefi H. In-Vitro Effect of Hydro-Alcoholic Extract of Tanacetum parthenium Extract on Trichomonas vaginalis. J Isfahan Med School. 2013;31:236.

25. Hassani S, Asgari G, Yousefi H et al. Effects of different extracts of Eucalyptus camaldulensis on Trichomonas vaginalis parasite in culture medium. Adv Biomed Res. 2013;2:47.

26. Sharafi SM, Yousefi M, Yousefi HA, Asghari G, Darani HY. In vitro effects of various plants extracts on the growth of Trichomonas vaginalis. Infect Disord Drug Targets. 2013;13(5):322-7.

27. Fakhri-Kashan Z, Arbabi M, Delavari M, Taghi-Zadeh M, Hooshyar H, Solaymani F. The effect of aqueous and alcoholic extracts of Pelargonium rnceum on the growth of Trichomonas vaginalis in vitro. Feyz J. 2014;18(4):369-75.

28. Khanmohammadi M, Gani S, Reyhani Rad S. Anti protozoan Effects of Methanol extracts of the Ferula spathanana the Trichomonas vaginalis Trophozoites in vitro. IJWHRS. 2014; 2(5): 301- 306.

29. Zarea A, Asghari G, Ghanadian M, Yousefi H, Yousofi Darani H. Effect of Tanacetum leaves fractions on Trichomonas vaginalis growth in culture medium. Armaghane Danesh. 2014;18(11):888-99.

30. Naemi F, Asghari G, Yousofi H, Yousefi HA. Chemical composition of essential oil and anti Trichomonas activity of leaf, stem, and flower of Rheum rubea L. extracts. Avicenna J Phytomed. 2014; 4(3):191-9.

31. Niyayati M, Joneidi Z, Kamalinejad M, Haghighi A, Abadi A, Arab-Mazar Z. In Vitro Activity of Mentha longifolia Leaves and Pimpinella anisum Seeds Against a Clinical Strain of Trichomonas vaginalis. Int J Molec Clinical Microb. 2015;5(1):503-9.

32. Jabari M, Asghari G, Ghanadian M, Jafari A, Yousefi H, Jafari R. Effect of Chaenomelium macropodum extracts on Trichomonas vaginalis in vitro. J Herb Med Pharmacol. 2015;4:61-4.

33. Kashan ZF, Arbabi M, Delavari M et al. Effect of Verbascum thapsus Ethanol Extract on Induction of Apoptosis in Trichomonas vaginalis in vitro. Infect Disord Drug Targets. 2015;15(2):125-30.

34. Sharma VD, Sethi MS, Kumar A, Ratrotra JR. Antibacterial property of Allium sativum Linn.: in vivo & in vitro studies. Indian J Exp Biol. 1977; 15(6):466-8.

35. Eidi A, Eidi M, Esmaeili E. Antidiabetic effect of garlic (Allium sativum L) in normal and streptozotocin-induced diabetic rats. Phytomedicine. 2006; 13(9-10):624-9.

36. Gabriel F, Emmanuel O. Pharmacological evaluation of Garinia kola nut for antitrichomonal activity. Int J Pharma Bio Sci. 2011;2(2):263-4.

37. El-Sherbiny GM, El Sherbiny ET. The Effect of Commiphora molmol [Myrrh] in Treatment of Trichomoniasis vaginalis infection. Iran Red Crescent Med J. 2011; 13(7):480-6.

38. Jiménez-Arellanes A, Luna-Herrera J, Ruiz-Nicolás R et al. Antiprototazoal and antimycobacterial activities of Persia americana seeds. BMC Complement Altern Med. 2013;13:109.

39. Tonkal A. In vitro antitrichomonal effect of Nigella sativa aqueous extract and wheat germ agglutinin. Med Sci. 2009;16(2).

40. Ibikunle GF, Adebajo AC, Famuyiwa FG et al. In-vitro evaluation of anti-trichomonal activities of Eugenia uniflora leaf. Afr J Tradit Complement Altern Med. 2011;8(2):170-6.
41. Frasson AP, dos Santos O, Duarte M et al. First report of anti-Trichomonas vaginalis activity of the medicinal plant *Pohgala decumbens* from the Brazilian semi-arid region, Caatinga. Parasitol Res. 2012; 110(6):2581-7.

42. Alvares Batista CR, Fonseca TH, Rodrigues VG, de Sousa GF, Chacon MO, Vieira Filho SA. Trichomonicidal activity of *Meytenus imbricata* (Celastraceae). Afr J Pharm Pharmacol. 2014;8(19):502-6.

43. Al-Heali FM, Rahemo Z. The combined effect of two aqueous extracts on the growth of *Trichomonas vaginalis*, in vitro. Turkiye Parazitol Derg. 2006; 30(4):272-4.

44. Ertabaklar H, Kiyveck B, Mert T, Ozensoy Töz S. In vitro activity of *Arbutus unedo* leaf extracts against *Trichomonas vaginalis* trophozoites. Turkiye Parazitol Derg. 2009; 33(4):263-5.

45. Cargnin ST, Vieira Pde B, Cibulski S et al. *Hypericum polyanthemum* extract obtained by supercritical fluid extraction and isolated compounds. Parasitol Int. 2013; 62(2):112-7.

46. Mehrjariestani M, Alihamadi A, Toliat T, Rahimi R. Medicinal plants and their isolated compounds showing anti-*Trichomonas vaginalis* activity. Biomed Pharmacother. 2017; 88:885-893.

47. Tan RX, Lu H, Wolfender JL et al. Mono- and sesquiterpenes and antifungal constituents from *Artemisia species*. Planta Med. 1999; 65(1):64-7.

48. Kim JT, Park JY, Seo HS, Oh HG et al. In vitro antiprotozoal effects of artesiminin on *Neospora caninum*. Vet Parasitol. 2002; 103(1-2):53-63.

49. Shuhua X, Chollet J, Weiss NA, Bergquist RN, Tanner M. Preventive effect of artemetherZ in experimental animals infected with *Schistosoma mansoni*. Parasitol Int. 2000; 49(1):19-24.

50. Farsangi M. Killing effect of *Zataria multiflora* on cysts of *Giardia lamblia* in vitro. J Clin Microbiol. 2001;4(1):88-95.

51. Darabad SG, Mohsenifar A, Yazdanparast SA, Bayar M. Antimicrobial Effects of *Lavandula angustifolia* Mill, *Artemisia sieveri* Besser, *Cinnamomum verum* J. Presl and *Myrtus communis* L. Encapsulated Essential Oils Against Prevalent Microorganisms Causing Sinusitis. Thrita. 2015;4(2): e24773.

52. Inouye S, Tsuruoka T, Watanabe M, Takeo K, Akao M, Nishiyama Y, Yamaguchi H. Inhibitory eVect of essential oils on apical growth of *Aspergillus fumigatus* by vapour contact Hemmung des apikalen Wachstums von *Aspergillus fumigatus* durch Dämpfe ätherischer Ole. Mycoses. 2000; 43(1-2):17-23.

53. Augusti KT. Therapeutic values of onion (*Allium cepa* L.) and garlic (*Allium sativum* L.). Indian J Exp Biol. 1996; 34(7):634-40.

54. Elkayam A, Mirelman D, Peleg E et al. The effects of allicin on weight in fructose-induced hyperinsulinemic, hyperlipidemic, hypertensive rats. Am J Hypertens. 2003; 16(12):1053-6.

55. Mathew PT, Augusti KT. Studies on the effect of allicin (diallyl disulphide-oxide) on alloxan diabetes. I. Hypoglycaemic action and enhancement of serum insulin effect and glycogen synthesis. Indian J Biochem Biophys. 1973; 10(3):209-12.

56. Chehregani A, Azimishad F, Alizade HH. Study on antibacterial effect of some *Allium* species from Hamedan-Iran. Int J Agricul Biol. 2007; 9(6):873-6.

57. Moazeni M, Nazer A. In vitro effectiveness of garlic (*Allium sativum*) extract on scolices of *hydatid cyst*. World J Surg. 2010; 34(11):2677-81.

58. Behnia M, Haghighi A, Komeilizadeh H, Tabaei SS, Abadi A. In vitro antiamebic activity of Iranian *Allium sativum* in comparison with metronidazole against *Entamoeba histolytica*. Iranian J Parasitol. 2008;3(4):32-8.

59. Safar Harandi MM, Dalimi Asl A, Ghaffarifar F. In vitro effects of garlic(*Allium sativum*) extract on *Giardia lamblia* and *Giardia muris*. Hakim Res J. 2006;9(31): (3):58-64.

60. Azadbakht M. The effects of three *Allium* spp extracts on the cyst of *Giardia lamblia*. J Basic Sci Iran. 2003;6(3):184-189.

61. Hezarjaribi HZ, Elmi T, Dayer MS, Gholami S, Fakhar M, Akbariqomi M, Ghaffarifar F. A systematic review of the effects of Iranian pharmaceutical plant extracts on *Giardia lamblia*. Asian Pacific J Trop Dis. 2015;5(12):925-9.

62. Soosaraei M, Fakhar M, Hosseini Teshnizi S, Ziaei Hezarjaribi H, Banimostafavi ES. Medicinal plants with promising antileishmanial activity in Iran: a systematic review and meta-analysis. Ann Med Surg (Lond). 2017; 21:63-80.