Antibacterial Effects of Oak Fruit, Jaft, and Jaftex Herbal Mouthwash: A Review

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Research article

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Abstract

Recently, natural products have been evaluated as a source of antimicrobial agent with efficacies against a variety of microorganisms. The antibacterial activities of the oak fruit,inner husk of oak fruit (Jaft), and Jaftex mouthwash have been studiedin several studies. Thisstudy aimedto review the studies ofthe effects of antibacterial properties of the oak fruit, oak fruit hull (Jaft), and Jaftex mouthwash. Materials and Methods In this review study, relevant articles related to the antimicrobial activity of the oak fruit, inner husk of oak fruit (Jaft), and 'Jaftex mouthwash' were searched from the current digital literature using electronic databases namely, SID, ScienceDirect, PubMed, Google Scholar, Magiran, Web of Science employing the same keywords from 1990 to 2019. Results Oakfruit, inner husk of oak fruit (Jaft), and Jaftex mouthwash have antimicrobial properties against many microorganisms. Discussion and Conclusion Antibacterial properties of oak fruit, inner husk ofoak fruit (Jaft) can be used to reverse the antibiotic sensitivity against pathogenic bacteria. Jaftex is recommended as an antibacterial and anti-plaque mouthwash.

Background

The twenty-first century is called “the century of back to nature and the use of medicinal plants”(1).In recent years, due to concerns about some the safety of synthetic compounds, there has been an increasing interest in the use of natural substances, encouraging more detailed studies on originated substances (2).Medicinal plants containing plant materials such as leaf,root, flower, and seed, are used in the form of extracts and chemical compounds to produce human drugs or veterinary medicines (3).Infectious diseases caused by different microorganisms are very common worldwide (4).Recently,antibiotic drug resistance by pathogenic microorganisms, which has been an increasing problem in the past few decades, has led to the continuous exploration of natural plant products for new antibiotic agents (5). Recently, natural products have been evaluated as a source of the antimicrobial agent with efficacies of a variety of microorganisms (6).The extracts and essential oils of many plants have exerted biological activity, justifying research on traditional medicine focused on the characterization of antimicrobial activity of these plants. Iran, India, Pakistan, and Turkey are examples of countries that have diverse flora and a rich tradition in the use of medicinal plants for antimicrobial applications (7-9).According to the World Health Organization (*WHO*), 80% of the world's population uses traditional herbal medicines for the initial treatment of their diseases (10).In the western regions of Iran, people use the extract of different plants such as the extract of the inner layer of oak (*Jaft* in Persian) and fruit of the oak tree for the treatment of microbial infections (11, 12).Iranian oak has covered central, southern and southeast regions in the *Zagros* Mountains (13).Iranian oak is a large tree of 20 meters inheight, with a large coral crown and belongs to the Fabaceaefamily. Itsleaves are usually monotonous and egg-shaped with a jagged margin. There are massive star-shaped downs on the leaves, and soft and yellow fur downs also coveritsback. Its fruit is pulled like an oval in velvet and cone-shaped white bowl (1).An oak tree fruit called Acron is located in a bowl named Gland. The fruits have different amounts of oily materials, different sugars, amidon, a small amount of quercetin, pentosan and tannin (14).Oak

fruithas external and internal layers and its internal layer is known as *Jaft* (15).The color of *Jaft* turns from yellow to brown after exposure to light due to oxidation (15,16). According to Iranian indigenous information, this plant is traditionally used for problems,such as gastropathy, (17) acute diarrhea inflammation, burns/cuts, (18) and cancers. Like the fruit, *Jaft*also has health benefits (19)The antibacterial activities of different parts of oak have been studied in several studies (20-22).Medicinal herbs are particularly valuable in providing community health in both disease treatment and prevention (23).The use of natural products in dentistry has been justified by their popular use, low cost and appropriate antimicrobial, and anti-inflammatory activities (24).The mouth is a perfect environment for colonization and growth of a wide range of microorganisms, especially bacteria (25). Dental plaque is a complex of microbial community found on the surface of teeth, embedded in a matrix of bacteria and salivary origin (26).The bacteria are responsible for 70–80 percent of the plaques (27).Mouthwashes are oral solutions or liquids used to rinse the mouth in order to remove bacteria (28).Chlorhexidine (*CHX*) is a golden chemical antiplaque, however, it may cause side effects due to the long usage (29).Herbal mouthwashes are more proper than *CHX* because they contain organic compounds, which aremore fitted with body physiology, and they have lower toxicity; therefore, they are recommended for people who cannot use chemical mouthwashes (27).*Jaftex* is a new herbal mouthwash that consistsof *Jaft* aquatic extract as a base, aquatic extract of *Zataria multiflora*(Thyme), and *Saturej bachtiarica*;this herbal mouthwashis prepared scientifically in the Pharmaceutical Plant Growth Center of Ahvaz Jundishapur University of Medical Sciences (30).The antibacterial effects of *Jaftex* mouthwash have been studied in the few studies (27, 28, 30, 31).

Various studies have been done on the antibacterial properties of oak fruit and *Jaft*. The importance of this article is that it has reviewed previous studies in order to summarize and compare the findings, and to pose the possibility of creating an organized and comprehensive view of the research carried out in this area in a summarized form; as a result, it provides a new platform for the synthesis of new herbal products, including antibiotics and herbal mouthwashes.

Materials And Methods

In this review study, relevant articles related to the antimicrobial activity of the oak fruit, *Jaft*, and 'Jaftex mouthwash' were searched from the current digital literature using electronic databases, namely, *SID*, *ScienceDirect*, *PubMed*, *Google Scholar*, *Magiran*, *Web of Science*, employing the same keywords from 1990 to 2019.This literature was searched using keywords such as antimicrobial, oak fruit, *Jaft*, *Jaftex*, mouthwash, microorganism, antibiotic sensitivity in the last 29 years, particularly the recent 10 years.sixteen in-vitro study, and two clinical trials were selected and evaluated.Moreover, the contentsand topics of the antibacterial properties of the *Jaft*essenceand extract, and *Jaftex* mouthwash have been selected and collected.

Findings

In an experimental study conducted byEbrahimi *et al.,* antimicrobial activity of methanolic extract of Iranian oak components against Escherichia coli(E. coli) was investigated.Theyreported that Iranian oak has antibacterial properties, the effect of the extracts on the bacteria is concentration-dependent and the antibacterial effects of different parts of the oak are the same and in most cases, less than antibiotics. They concluded that this antibacterial activity was due to the presence of tannins in the extract (32). Ghaderi *et al.,* also reported that oak tree fruit has antimicrobial properties, and in comparison with gentamicin, kanamycin and tobramycinantibiotics, this plant has a good effect on *Staphylococcus aureus* (*S. aureus*), E. coli and *Staphylococcus epidermidis* (*S. epidermidis*) bacteria. They concluded that the antimicrobial effects of the oak tree fruit are due to the presence of phenolic compounds (33).

Chahardooli *et al.,* reported that oak extract also has a bactericidal property on *micrococcusluteus*, *Yersinia enterocolitica*, Shigella Dysenteriae, Salmonella *typhi,* and Citrobacterfreundiii (34). Ebrahimi *et al.,* studied antibacterial effects of the oak fruit extract on *S. aureus*, *S. epidermidis*and *E. coli* bacteria. After observing the antibacterial effects of the extract on bacteria, this property was attributed to phenolic compounds, especially tannins existing in these plants (35).In an experimental study, the antibacterial effects of the oak tree fruits (*Quercus persica*), collected in different parts of the Zagros Mountains in eastern Iran, against *S. aureus*, *Bacillus Sutilis*, *Klebsiella Pneumoria,* and *E. coli*were studied by the disc diffusion method. According to the results of this study, *Ghilane Gharb* extract was the most inhibition zone against S*. aureus* among the extracts of plants. They concluded that the extract of oak is effective for control of bacteria strains,especially *S. aureus,* and so it could be used as a natural antimicrobial agent (36).In an experimental study, Ebrahimi*et al.,* studied antibacterial andwound-healing effects of methanolic extract of *Quercus persica*fruits.The extract effect in three concentrations (25, 50, 75 mg/ml)on *S. aureus*, *S. epidermidis,* and *E. coli*was tested using the agar diffusion method and results showed that all of the concentrations were effective in inhibition of bacteria. Also, the extract effect was similar to,or higher than,the tested antibiotics (37). These results suggest that *Quercus persica* possesses antibacterial compounds.In a study to investigate the biosynthesis of silver nanoparticles using the extract of the oak tree fruit and investigating their antimicrobial activities against agents of nosocomialinfection, Chahardooli *et al.,* reported that the extract of the oak tree fruit has antimicrobial activity against *E. coli*, *S. aureus*, *pseudomonas aeruginosa*,and bacillus subtilis (38). In a laboratory study, Panahi *et al.,* investigated the inhibitory effect of the alcoholic extract of the *Jaft* on *Candida albicans*. According to them, the highest inhibitory area was seen in 80 gr/disk and 80 mg/ml using the disc diffusion method and agar well diffusion, respectively. They concluded that the alcoholic extract of the *Jaft* contains metabolites with an inhibitory effect on *Candida albicans*. The antibacterial effect of hydroalcoholic extract of this fruit was due to *lavanoidas* (11). Karimi Poor fard*et al.,*carried out a research about antibacterial activities of *thymus denaensis*, *Jaft,* and hydroalcoholic extract of green hull *pistacia atlantica* on listeria monocytogenes. Their study indicates that a hydroalcoholic extract of *Jaft* has the most antibacterial effect compared with other extracts (39). Roozegar *et al.,* reported that the alcoholic extract of *Jaft* has an inhibitory effect on anacinetobacter. The highest inhibitory effect of *Jaft* was in 80 mg/ml concentration (40) .Comparison of the results of the above study shows that most of the research in this field was In-vitro experimental study. The disk-diffusion agar method was used to

measure the inhibition zone on the tested extract of oak fruit on microorganisms. The tube dilution method was used for determining the minimum inhibitory concentration (*MIC*) and minimum bacterial concentrations (*MBC*).In these papers, hydroalcoholic, methanolic and essential oil extracts have been used more than other extracts.The antibacterial effect of oak components has been investigated more against S. aureus, S. mutans, S. epidermidis, S. salivarius bacteriaand E. coli Ebrahimi et al., have conducted the most research on the antibacterial properties of oak. Comparison of the results of their studies shows that oak fruit has the most antimicrobial effect (32). The concentration of 75 mg/mc of methanolic extract of this fruit has an antibacterial effect more than antibiotics of gentamicin, Tobramycin and Kanamycin (32). One of the findings in their studies, compared with antibiotics the effect of the 75 mg/mc concentration of hydroalcoholic extract of oak fruit on S. aureus, was similar to gentamicin, lower than that of kanamycin and more than that of tobramycin. Also, the concentration of extract has the same effect as Kanamycin, more than gentamicin and lower than tobramycin on S.epidermis. This effect on E. coli was lower than gentamicin and Kanamycinbut more than tobramycin (35). Paying attention to the above-mentioned can provide new developments in the manufacture of herbal antibiotics made from oak fruit in the future.In a study, Alipur *et al.,* prepared and evaluatedan herbal mouthwash containing oak husk of *Quercus brantii* and Zataria multiflora. antimicrobial activity of formulation. The results showed that the best formulation with adequate stability was the formulations of the mouthwash containing 0.2% and 0.5% tannins. The results also showed antimicrobial activity in formulationsof both types of mouthwash(18). Babadi *et al.,* compared the antibacterial effects of *Jaftex* with chlorlexidine (CHX) mouthwash on some common oral icroorganisms. They concluded that *Jaftex* has antibacterial effects on*S. mutans*,*S. sanguinis* and *S. salivaris*, but it is less effective for oral bacteria growth inhibition compared to CHX (31). It is recommended to be used for plaque inhibition (31).In a study, Babad *et al.,* compared the antibacterial effects of *Jaftex* herbal mouthwash with *Matrica* and *Persica* on *S. mutans*, *S. sanguinis*, *S. salivaris,* and *Lactobacillus casei*. They reported that *Jaftex* has a greater inhibitory effect on bacterial growth than *Matrica* and *Persica* (27) The results of measuring the effect of MIC and MBC for Jaftex, Matrica and Persica on Streptococcus mutans, Streptococcus sanguinis, Streptococcus salivaris and Lactobacillus casei are reported in Table 1. In an in vivo study, Babadi*et al.,* compared the effect of *Jaftex,* and chlorhexidine mouthwash onthe oral microorganism.The results of this study showed that the *Jaftex*mouthwash significantly reduced the number of microorganisms in the mouth, but it had a less antimicrobial effect compared to CHX (30) (Table). In a study, Jahangirnejad *et al.,* investigated the effect of the *Jaftex* mouthwash on periodontal index compared with chlorhexidine.They noted that *Jaftex* reduces the amount of plaque and gingival index (41). For the new mouthwash of the Jaftex, two laboratory articles and two clinical trials are available.The comparison of the above studies shows that Jaftex antibacterial effect on oral microorganisms is lower than that of CHX, but is higher than Persica and Matrica herbal mouthwashes (27).The results of clinical trial studies also show that Jaftex reduces the number of salivary microorganisms (30).Jaftex reduced the amount of plaque index and gingival index. Furthermore, Jaftex increased the staining and the intensity of stained area indicators yet the amount and intensity of the staining in the use of CHXmouthwash were more, and the difference was not statistically significant (41).

Discussion

The profession of dentistry has a lot of charm. However, this profession in the clinical setting also presents risks to dentists and patients (42-48). A review of past studies has shown that oak tree fruit, *Jaft*, and *Jaftex* mouthwash have antibacterial properties.Some of the properties ofthe plant extracts leading to antibacterial properties are: 1) The hydrophobic property that cause the extract to penetrate into the bacterial cell membrane lipid and ultimately the death of the bacterium; 2(phenolic materials in this extract containing carvacrol, eugenol and thymol, which interfere with the proton and electrical current of the cell and coagulate the contents of the cell by damaging the cytoplasmic membrane of the bacterial cell:more phenolic substances, more antibacterial effect; 3)binding the carbonic acid group of the extracts to the cellular proteins and preventing the role of amino acid and decarboxylase, which is more due to the presence of *cinnamaldehyde* in the extracts (4).Previous studies have shown that increasing the concentration of plant extracts increases their antibacterial effect, which can be attributed to the amount of active ingredient in the extracts, which is higher in fruits than in other parts (32). At high concentrations, the antibacterial effect of the extract was similar with, or even better than, some antibiotics. It is noteworthy that selecting the appropriate method and solvent for extraction is important for obtaining parts with high antibacterial activity and significantly affects the extract's product and its biological activity (32).At high concentrations, the antibacterial effect of the extract was similar with, or even better than, some antibiotics. It is noteworthy that selecting the appropriate method and solvent for extraction is important for obtaining parts with high antibacterial activity and significantly affects the extract's product and its biological activity (32).There are many reports on the antibacterial effect of oak fruit and *Jaft* due to the presence of phenols, tannins, and proteins in this plant (49-53). Oak is one of the richest fruits in terms of tannin content (54).Polyphenols and tannins are the main substances in the oak tree and are abundant in all parts of *Quercus biantii* (28).Tannin is one of the most important components of oak trees (14). Plants containing tannins are called astringent (55).Lelerc argued that tannin should be considered one of the most prominent substances in the world of plants (14).Scalbert examinedthe antimicrobial properties of tannins. According to these studies, tannins can be toxic to bacteria, fungi and even viruses (56).According to Lelerc,tannin should be considered as one of the most prominent substances in the world of herbs (14). Scalbert examined the antimicrobial properties of tannins. According to these studies, tannins can be toxic for bacteria, fungi and even viruses (56).The difference in the antimicrobial property of different parts of the plant is due to the presence of the different amounts of tannins in them.Tannin is a common name for a group of molecular polymeric materials with high molecular weight, which is one of the important classes of secondary metabolites in plants (57-58).Antimicrobial activity of tannins is carriedout with different mechanisms, with deposition, microbial proteinsinhibit their growth, as a result, food proteins are not available to them, or play a role through the mechanism of trapping iron, hydrogen bonding, and specific dispersions with vital proteins like enzymes (55-59).Jaftex mouthwash is a hybrid herbal solution of the *Jaft* as the base of *Bakhtiari* savory and *thyme*.Because of the minimum side effects of herbal mouthwash, theycan be recommended for long-term use. On the other hand, the presence of ethanol in commercial mouthwash seems to be problematic due to different reported side effects (28). A review of studies has shown that *Jaftex* has

shown antibacterial activity against common oral microorganisms and periodontal indexes in vitro and in vivo conditions (27-41).The antibacterial property of this mouthwash is largely attributed to the extract of *Jaft* (30).According to a review of the past studies, thyme and Saturej bachtiarica have some antibacterial effects. The antibacterial effects of these two products are attributed to the compounds of their elements. *Thymol* and *carvacrol* have been reported to be one of the most important compounds in *thyme* and *Saturej bachtiarica* (60-67).A remarkable point about the effect of herbal extracts on bacteria is that the antibacterial properties of herbal extracts against gram-positive bacteria are more than gram-negativebacteria. Perhaps the limitation of penetration of the extract into the layer is due to the presence of polysaccharide membranes of gram-negative bacteria (65).

Conclusion

The oak tree fruit, *Jaft*, and also *Jaftex* mouthwash have antibacterial properties and are effective against a range of oral bacteria. The use of *Jaftex* is recommended as an anti-bacterial and anti-plaque mouthwash.

Declaration

Abbreviation

Not applicable in this section

· **Ethics approval and consent participate:** Not applicable

· **Consent for publication:** Not applicable

· **Availability of data and material**: Not applicable

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Tables

		Bacteria			
Mouthwash	Concentration	Lactobacillus casei	Streptococcus Salivaris	Streptococcus Mutans	Streptococcus Sanguinis
Jaftex	MIC	0.0625	0.125	0.5	0.125
	MBC	0.25	0.125	0.5	0.25
Matrica	MIC	1	0.5	0.5	1
	MBC	1	0.5	0.5	1
Persica	MIC	1	1	1	1
	MBC	0	0	0	0

Table 1: Results of MIC and MBC measurements for Jaftex, Matrica and Persica mouthwashes (g/ml)

Group	Before Mouthwash use		After Mouthwash use		P-value
	Mean	SD	Mean	SD	
Jaftex	164545.45	77112.61	113636.36	3489.18	0.005
Chlorhexidine	180681.82	79091,50	108500	39858.98	<0.001

Table2: Distribution of the Means and Standard deviation for Jaftex and Chlorhexidine mouthwashes on oralmicroorganisms