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Research Article

Phytotherapy for *Streptococcus sanguis*

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ABSTRACT

Streptococcus mutans and *Streptococcus sanguis*are the most important bacterial agents of dental caries. Streptococcus *sanguis*is the most commonly isolated species of the dental plaque. Medicinal plants are rich sources of bioactive and antioxidant substances which treat various diseases with various mechanisms. Since *Streptococcussanguis*is one of the bacterial agents responsible for dental caries, the efforts in this article were on reporting the medicinal plants which have an effective effect on this bacteria. Searching for articles with words of *Streptococcussanguis*, phytotherapy, medicinal herbs, and tooth diseases was done in present reviewing study. Searching was done from databases such as Scopus, ISC, SID, Meiran, and some other databases.

Accordingly, 23 drugs which are effective on *Streptococcus sanguis*are used. It was determined based on the obtained results that *Cinnamomum cassia*, *Stachys byzanthina*, *Stachys lavandulifolia*, *Phlomis brugueur*, *Juglans regia*, *Lonicera japonica*, *Jasminum sambac*, *Eucommia ulmoides*, *Camellia sinensis*, *Gynostemma pentaphyllum*, *Cymbopogon citratus*, *Ilex paraguariensis*, *Rosmarinus officinalis*, *Kaempferia pandurata*, *Azardirachta indica*, *Acacia nilotica*, *Ocimum basilicum*, *Emblica officinalis*, *Terminalia bellirica*, *Syzygium cuminii*, *Syzygium aromaticum*, *Diclinanona calycina* and *Thyrsodium spruceanum* medicinal plants are the most important medicinal plants with anti-*Streptococcus sanguis* properties. Medicinal plants used in this study have anti-*Streptococcus sanguis* properties due to presents of bioactive substances, antioxidants, flavonoids, flavones, anthocyanins, and the like.

Keywords: Medicinal plants, *Streptococcussanguis*

INTRODUCTION

Streptococci are the most important gram-positive bacteria that can cause toxic septicemia and childhood infections. These bacteria are genetically diverse which contain important human pathogens (1).

Some bacteria are the main cause of dental caries (2,3). *Streptococcus mutans* and *Streptococcussanguis*are the most important bacterial agents of dental caries (4). Streptococcus sanguisis the most commonly isolated species of the dental plaque that it is the major causative factor of periodontitis (5).

This bacteria provides the energy necessary to grow the bacteria in the absence of carbohydrate fermentation via the mechanism of hydrolysis of arginine. Hence, bacteria can survive and function without the existence of carbohydrate fermentation (4).

The efforts have been on stopping the growth of bacteria causing dental decay by using plaque control methods such as toothbrushes and the use of antibacterial mouthwashes but if all of these arrangements do not work, the accumulation of these microorganisms will destroy the ivory and enamel and will eventually lead to loss of teeth (6, 7).

Medicinal plants have been used to treat dental diseases since ancient times (8-11). Medicinal plants are rich sources of bioactive and antioxidant substances (12-14) which will treat various diseases with various mechanisms (15-18).

Since *Streptococcussanguis*is one of the bacterial agents responsible for dental caries, the efforts in this study were on reporting medicinal plants that have an effective effect on this bacteria.

METHOD OF STUDY

Searching for articles with words of *Streptococcussanguis*, phytotherapy, medicinal herbs, and tooth diseases was done in present reviewing study. Searching was done from databases such as Scopus, ISC, SID, Magiran, and some other databases.

RESULTS

It was determined based on the obtained results that *Cinnamomum cassia*, *Stachys byzanthina*, *Stachys lavandulifolia*, *Phlomis brugueur*, *Juglans regia*, *Lonicera japonica*, *Jasminum sambac*, *Eucommia ulmoides*, *Camellia sinensis*, *Gynostemma pentaphyllum*, *Cymbopogon citratus*, *Ilex paraguariensis*, *Rosmarinus officinalis*, *Kaempferia pandurata*, *Azardirachta indica*, *Acacia nilotica*, *Ocimum basilicum*, *Emblica officinalis*, *Terminalia bellirica*, *Syzygium cuminii*, *Syzygium aromaticum*, *Diclinanona calycina* and *Thyrsodium spruceanum* medicinal plants are the most important medicinal plants with anti-*Streptococcussanguis* properties.

Further details in this regard are provided in Table 1.

No	Scientific Name	Part of plant	Family Name	Common Name	Origin of plant	Country Of study	year	Bacteria	Result	ref
1	CINNAMOMUM CASSIA	Bark	Lauraceae	Chinese cinnamon	Pakistan	Pakistan	In vitro 2006	human isolates of *Streptococcus sanguis*	The diameter of inhibition zone of oil of this plant for bacteria was reported to be 27 mm	(19)
2	Stachys byzanthina		Lamiaceae	lamb's-ear	iran	iran	In vitro 1386	*Streptococcus sanguis*	Antibacterial properties of methanolic extract of this plant was proven with a concentration of 1000 µg / ml through the diameter of the inhibition zone of 15 mm. However, the diameter of inhibition zone for gentamicin and amikacin halo wasrespectively 24 mm and 19 mm	(20)
3	Stachys lavandulifolia		Lamiaceae		iran	iran	In vitro 1386	*Streptococcus sanguis*	Antibacterial properties of methanolic extract of this plant was proven with a concentration of 1000 µg / ml through the diameter of the inhibition zone of 15 mm. However, the diameter of inhibition zone for gentamicin and amikacin halo wasrespectively 24 mm and 19 mm	(20)
4	Phlomis bruguieri		Lamiaceae		iran	iran	In vitro 1386	*Streptococcus sanguis*	Antibacterial properties of methanolic extract of this plant was proven with a concentration of 1000 µg / ml through the diameter of the inhibition zone of 18 mm. However, the diameter of inhibition zone for gentamicin and amikacin halo wasrespectively 24 mm and 19 mm	(20)
5	Juglans regia	Leaf	Juglandaceae	English walnut	iran	iran	In vitro 1389	*Streptococcus sanguis* (PTCC:1449)	Antibacterial properties of methanolic extract of walnut leaves was proven with MIC = 15.6µg / ml and MBC = 31.25µg / ml. while, chlorhexidine as an antibiotic control had MIC = 15.6 and MBC = 31.25.	(21)
6	Lonicera japonica	Flowers	Caprifoliaceae	Honeysuckle	Taiwan	Taiwan	In vitro 2008	*Streptococcus sanguinis* (BCRC15273)	The methanolic extract of this plant with MIC = 4 mg / ml inhibited the growth of this bacteria	(22)
7	Jasminum sambac	Flowers	Oleaceae	Jasmine	Taiwan	Taiwan	In vitro 2008	*Streptococcus sanguinis* (BCRC15273)	The methanolic extract of this plant with MIC = 1 mg / ml inhibited the growth of this bacteria	(22
8	Eucommia ulmoides	Leaves	Eucommiaceae	Duzhong	Taiwan	Taiwan	In vitro 2008	*Streptococcus sanguinis* (BCRC15273)	The methanolic extract of this plant with MIC = 4 mg / ml inhibited the growth of this bacteria	(22)
9	Camellia sinensis	Leaves	Theaceae	Green tea	Taiwan	Taiwan	In vitro 2008	*Streptococcus sanguinis* (BCRC15273)	The methanolic extract of this plant with MIC = 4 mg / ml inhibited the growth of this bacteria	(22)
10	Gynostemma pentaphyllum	Leaves	Cucurbitaceae	Jiaogulan	Taiwan	Taiwan	In vitro 2008	*Streptococcus sanguinis* (BCRC15273)	The methanolic extract of this plant with MIC = 1 mg / ml inhibited the growth of this bacteria	(22)
11	Cymbopogon citratus	Leaves	Poaceae	Lemon grass	Taiwan	Taiwan	In vitro 2008	*Streptococcus sanguinis* (BCRC15273)	The methanolic extract of this plant with MIC = 1 mg / ml inhibited the growth of this bacteria	(22)
12	Ilex paraguariensis	Leaves	Aquifoliaceae	Yerba mate	Taiwan	Taiwan	In vitro 2008	*Streptococcus sanguinis* (BCRC15273)	The methanolic extract of this plant with MIC = 4 mg / ml inhibited the growth of this bacteria	(22)
13	Rosmarinus officinalis	Leaves	Lamiaceae	rosemary	Taiwan	Taiwan	In vitro 2008	*Streptococcus sanguinis* (BCRC15273)	The methanolic extract of this plant with MIC = 2 mg / ml inhibited the growth of this bacteria	(22)
14	Kaempferia pandurata	Rhizome	Zingiberaceae		Indonesia	South Korea	In vitro 2004	*Streptococcus sanguis* ATCC 35105	The antibacterial properties of isopanduratin A composition existing in this plant was proven with MIC = 4 mg / ml and MBC = 8 mg / ml.	(23)
15	Azardirachta indica	Foliage	Meliaceae	Neem	India	India	In vitro 2012	Clinical isolates of *Streptococcus*	Antibacterial properties of the aqueous extract of this plant was proven by having a diameter of 10.6 mm inhibition zone. However, the	(24)

								sanguis	diameter of the inhibition zone for antibiotic controllers of ampicillin was 10.6 mm and it was 0 mm for nitrofurantoin	
16	Acacia nilotica	Foliage	Fabaceae	gum arabic tree	India	India	In vitro 2012	Clinical isolates of *Streptococcus sanguis*	Antibacterial properties of the aqueous extract of this plant was proven by having a diameter of 11.3 mm inhibition zone. However, the diameter of the inhibition zone for antibiotic controllers of ampicillin was 10.6 mm and it was 11.3 mm for carbenicillin, 0 mm for nitrofurantoin and 11.3 mm for tetracycline	(24)
17	Ocimum basilicum	Foliage	Lamiaceae	Basil	India	India	In vitro 2012	Clinical isolates of *Streptococcus sanguis*	Antibacterial properties of the aqueous extract of this plant was proven by having a diameter of 10.6 mm inhibition zone. However, the diameter of the inhibition zone for antibiotic controllers of ampicillin was 10.6 mm and it was 0 mm for nitrofurantoin	(24)
18	Emblica officinalis	Foliage	Euphorbiaceae		India	India	In vitro 2012	Clinical isolates of *Streptococcus sanguis*	Antibacterial properties of the aqueous extract of this plant was proven by having a diameter of 29.6 mm inhibition zone. However, the diameter of the inhibition zone for antibiotic controllers of ampicillin was 10.6 mm and it was 12 mm for gentamicin , 11.3 mm for carbenicillin, 0 mm for nitrofurantoin and 11.3 mm for tetracycline	(24)
19	Terminalia bellirica	Foliage	Combretaceae	Beleric	India	India	In vitro 2012	Clinical isolates of *Streptococcus sanguis*	Antibacterial properties of the aqueous extract of this plant was proven by having a diameter of 28.6 mm inhibition zone. However, the diameter of the inhibition zone for antibiotic controllers of ampicillin was 10.6 mm and it was 12 mm for gentamicin , 11.3 mm for carbenicillin, 12.6 mm for nalidixic acid, 0 mm for nitrofurantoin and 11.3 mm for tetracycline	(24)
20	Syzygium cuminii	Foliage	Myrtaceae	jambul	India	India	In vitro 2012	Clinical isolates of *Streptococcus sanguis*	Antibacterial properties of the aqueous extract of this plant was proven by having a diameter of 25 mm inhibition zone. However, the diameter of the inhibition zone for antibiotic controllers of ampicillin was 10.6 mm and it was 12 mm for gentamicin , 11.3 mm for carbenicillin, 12.6 mm for nalidixic acid, 0 mm for nitrofurantoin and 11.3 mm for tetracycline	(24)
21	Syzygium aromaticum	Floral parts	Myrtaceae	Cloves	India	India	In vitro 2012	Clinical isolates of *Streptococcus sanguis*	Antibacterial properties of the aqueous extract of this plant was proven by having a diameter of 23.6 mm inhibition zone. However, the diameter of the inhibition zone for antibiotic controllers of ampicillin was 10.6 mm and it was 12 mm for gentamicin , 11.3 mm for carbenicillin, 12.6 mm for nalidixic acid, 0 mm for nitrofurantoin and 11.3 mm for tetracycline	(24)
22	Diclinanona calycina	Leaf	Annonaceae		Brazil	Brazil	In vitro 2008	*Streptococcus sanguis* (ATCC 15300)	Antibacterial property of the chloropharmaceutical extract of this plant was with having a diameter of 22 mm for inhibition zone. MIC of this plant was also 48.8 µg / ml. while the diameter of the inhibition zone of rifampin as control was 20 mm	(25)
23	Thyrsodium spruceanum	Branch	Anacardiaceae		Brazil	Brazil	In vitro 2008	*Streptococcus sanguis* (ATCC 15300)	Antibacterial property of the methanolic extract of this plant was with having a diameter of 20 mm for inhibition zone. MIC of this plant was also 48.8 µg / ml. while the diameter of the inhibition zone of rifampin as control was 20 mm	(25)

Table 1. Medicinal plants affecting *Streptococcus sanguis*

DISCUSSION

Medicinal plants used in this study have anti-*Streptococcus sanguis* properties due to presents of bioactive substances, antioxidants, flavonoids, flavones, anthocyanins, and the like. Although the mechanism actions of these plants are not clear, but with no debt, these by-products are responsible for their actions. From these, phenolic components of these plants in various investigations have been shown to possess antimicrobial activity, other than having other benefits (26-35). The plants presented in this review and a lot of other plants have phenolic compounds (37-40). These plants, therefore, which possess phenolic compounds, might also be effective against pathogenic microorganism.

The resistance of microbial infections to anti-biotic agents has been increasing in the recent years Multi-drug resistance has huge challenges and infections due to multi-resistant bacteria especially in the intensive care units imposemore serious problems.Medicinal plants also have been shown to be effective on resistant bacteria. More importantly, the microorganism mechanism actions and resistance are different (41-52). Medicinal plants have various active compounds which each one may have its own effect. Therefore, they may act by various mechanisms to overcome on microorganisms or other diseases (53-61). In other words, consumption of medicinal plants to treat or prevent human diseases has certain advantages. They are mostly effective in multiple diseases (62-74). They also are mostly cheap, readily available as well as being less toxic environmental hazards and biodegradable. Effective plant extracts are able to combat human pathogenic microorganisms other than treating other complications which might be associated with infection (75-84). There is therefore, renewed interest for medicinal plants to search for plants with anti-microbial activities, especially the plants which have the potential to treat other diseases (85-92).This has led to discovery of plants with low side effects and high efficacy.

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