IOP Conf. Series: Materials Science and Engineering **307** (2018) 012034 doi:10.1088/1757-899X/307/1/012034

Antimicrobial activity of jasmine oil against oral microorganisms

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Abstract. *Jasmine sambac* is a species of jasmine indigenous to the tropical and warm temperature regions in particular West and Southeast Asia. Essential oil extracted from the flowers of *J. sambac* has been shown to have anti-oxidant activity. However, very little information regarding antimicrobial activity especially oral microorganisms exists. Objective: To investigate antimicrobial effect of essential oil extracted from flowers of *J. sambac* against various oral microorganisms. Materials and Methods: Oral microbial strains used in the study were *Streptococcus mutans* KPSK2, *Staphylococcus aureus* ATCC 5638, *Lactobacillus casei* ATCC 6363, *Klebsiella pneumoniae* (clinical isolate), *Escherichia coli* ATCC 25922, *Candida albicans* ATCC 10231, *Candida krusei* ATCC 6258, *Candida parapsilosis* ATCC 22019, *Candida tropicalis* (clinical isolate), *Candida glabrata* ATCC 90030, *Candida pseudotropicalis* (clinical isolate) and *Candida stellatoidia* (clinical isolate). The potential of microbial growth inhibition of the oil was firstly screened by Kirby-Bauer disk diffusion method and then the minimum inhibitory concentration (MIC) was determined by agar dilution method. Results: Jasmine oil showed antimicrobial activities against *S. mutans, L. casei*, *E. coli* and all strains of Candida species with the zones of inhibition ranging from 9 to 26 mm and MIC values of 0.19-1.56 %v/v. Conclusion: Results from the present study are scientific evidence to demonstrate that jasmine oil could be employed as a natural antimicrobial agent against oral microorganisms.

1. Introduction

Several antimicrobial agents including fluoride, phenol, amoxicillin, erythromycin, tetracycline, vancomycin have been used to a great extent in dentistry. However, over use of these chemicals can result in disturbance of the oral and intestinal microflora and cause side effects such as microbial resistance, vomiting and diarrhea [1-2]. Therefore, the search for natural antimicrobial agents, which are safe for humans, is necessary.

Jasminum sambac L. (Oleaceae) is commonly known as Arabian jasmine or in Thai as Mali. It is a species of jasmine indigenous to regions in Bhutan, India, Nepal and Pakistan. It is grown in many places, especially over much of West and Southeast Asia. *J. sambac* is a small shrub or vine growing up to 1-3 m in height. It is extensively cultivated for its glamorous and gently perfumed flowers. *J. sambac* has been appraised a holy flower in Asian tradition, as it symbolizes purity, spirituality, elegant, clarity and honesty. It also presents the image of beauty of humility; a small and plain white flower that can give such sweet scent. Jasmine flowers are used for the production of perfumes, aromatizing agents, hair decorations and accessories, and ingredient in jasmine tea.

Essential oils from many plants have been used as therapeutic agents since ancient times. The essential oil from *J. sambac* or jasmine oil is used as perfume for skincare products, in anti- irritation and infection, moisturizer, anti-aging, anti-hyperpigmentation and as sun protection [3]. Previous studies have reported several phytochemicals ingredients in this plant including α-amyrin, α-terpineol, daucosterol, dotriacontanoic acid, dotriacontanol, jasminin, kaempferol, linalool, lupeol, oleanolic acid, quercitin, sambacin, sambacoside A, sambacolignoside and glucoside- sambacoside A-G as well as ursolic acid [4-5]. In the case of pharmacological activity, jasmine oil was demonstrated to have antimicrobial properties against many types of bacteria such as *Staphylococcus aureus, Staphylococcus epidermidis, Bacillus cereus, Bacillus subtilis, Enterobacter aerogenes, Escherichia coli, Salmonella typhi, Salmonella typhimurium, Shigella spp.*, and fungus such as *Candida albicans and Saccharomyces cerevisiae* [6], puerperal lactation inhibition [7], anti-oxidant [3], anti-diabetic [8], improve blood cholesterol [9], anti-viral [10], anti-acne [11], heart tonic [12], autonomic nervous system stimulant [13] and anti-tumor activities [14].

Even though ethanolic extract of *J. sambac* has been reported to have antimicrobial against many bacteria, very little information regarding activity on oral microorganisms exists. Therefore, the aim of the present study was to investigate antimicrobial effect of jasmine oil against various oral microorganisms.

2. Materials and method

2.1. *Preparation of essential oil*

Jasmine oil extracted from flowers of *J. sambac* was from Ananda Apothecary, Colorado, USA. The stock solution of the oil was prepared in 10% dimethyl sulfoxide (DMSO) and further diluted in distilled water to give the final concentration of 50% (v/v) for the use in the experiment.

2.2 *Microorganisms*

The oral microbial strains used in this study were *Streptococcus mutans* KPSK2, *Staphylococcus aureus* ATCC 5638, *Lactobacillus casei* ATCC 6363 , *Klebsiella pneumoniae* (clinical isolate), *Escherichia coli* ATCC 25922, *Candida albicans* ATCC 10231, *Candida krusei* ATCC 6258, *Candida parapsilosis* ATCC 22019, *Candida tropicalis* (clinical isolate), *Candida glabrata* ATCC 90030, *Candida pseudotropicalis* (clinical isolate) and *Candida stellatoidia* (clinical isolate). All of them strains from the culture collection of Oral Microbiology Department, Faculty of Dentistry, Mahidol University. Brain heart infusion broth supplemented with 1% yeast extract (Difco Laboratories, Detriot, MI) was used for growing all microbial strains. The suspensions of 10^8 cfu/mL of bacteria and 10^7 cfu/mL of fungi (equivalent to McFarland no. 0.5) were used for antimicrobial determination.

2.3 *Disk diffusion test*

The microbial growth inhibitory potential of the oil was determined using disk diffusion method described by Kirby-Bauer [15]. Freshly prepared microbial suspensions were spread on Mueller Hinton agar (Difco Laboratories, Detriot, MI). The 15 µL of oil (50% v/v) was dropped onto sterile paper disks (6 mm diameter). The same volume of 0.2% chlorhexidine gluconate solution served as positive control for *S. mutans, L. casei* and all strains of *Candida* spp., tetracycline for *S. aureus, K. pneumoniae* and *E. coli*. A 5% DMSO solution was used as negative control. The plates were incubated at 37 °C for 24-48 h. The zones of inhibition were measured after incubation.

2.4 *Minimum inhibitory concentration (MIC)*

The MICs of jasmine oil were determined with the agar dilution method. Mueller Hinton agar plates were prepared with serial two-fold dilutions of oil (ranging from 12.5 to 0.015 % v/v). The microbial suspensions were prepared by adjusting their density to 0.5 McFarland Standard. The 20 µL of suspension were dropped on each plate and incubated at 30 °C for 48 h.

All tests were performed in triplicate on three separate occasions

3. Results

By using disk diffusion method, jasmine oil showed antimicrobial activities against all strains of Candida species and some bacteria. The zones of inhibition ranged from 9 to 26 mm (Table 1). *S. aureus* and *K. pneumonia* exhibited resistant to the oil.

In the case of MICs, the values for all *Candida* spp. ranged from of 0.19-0.78 %v/v whereas those for susceptible bacteria were from 0.39-1.56 %v/v.

Table 1 Inhibitory effect of jasmine oil against various oral microorganisms

Microorganisms	Inhibition zone (mm)		
	oil	positive control [a]	negative [b] control
Streptococcus mutans KPSK2	23	24	-
Staphylococcus aureus ATCC 5638	-	35	-
Lactobacillus casei ATCC 6363	17	24	-
Klebsiella pneumoniae (clinical isolate)	-	23	-
Escherichia coli ATCC 25922	9	27	-
Candida albicans ATCC 10231	17	18	-
Candida krusei ATCC 6258	26	20	-
Candida parapsilosis ATCC 22019	17	17	-
Candida tropicalis (clinical isolate)	10	18	-
Candida glabrata ATCC 90030	19	20	-
Candida pseudotropicalis (clinical isolate)	13	19	-
Candida stellatoidia (clinical isolate)	20	18	-

[a] positive control for *S. mutans*, *L. casei* and all strains of *Candida* spp. was 0.2% chlorhexidine gluconate and for *S. aureus*, *K. pneumoniae* and *E. coli* was tetracycline
[b] negative control for all the test microorganisms was 5% DMSO

Table 2 Minimum inhibitory concentration (MIC) values of jasmine oil

Microorganisms	MIC (%v/v)
Streptococcus mutans KPSK2	0.39
Staphylococcus aureus ATCC 5638	>12.5
Lactobacillus casei ATCC 6363	0.39
Klebsiella pneumoniae (clinical isolate)	>12.5
Escherichia coli ATCC 25922	1.56
Candida albicans ATCC 10231	0.39
Candida krusei ATCC 6258	0.19
Candida parapsilosis ATCC 22019	0.39
Candida tropicalis (clinical isolate)	0.78
Candida glabrata ATCC 90030	0.19
Candida pseudotropicalis (clinical isolate)	0.39
Candida stellatoidia (clinical isolate)	0.19

4. Discussion

Jasmine sambac is a plant indigenous to tropical and warm temperature regions particularly West and Southeast Asia. Its flowers are strongly scented. Jasmine essential oil is extracted from flowers by solvent extraction followed by steam distillation. The main constituents found in jasmine oil are benzyl acetate, linalool, phytol, farnesol, benzyl alcohol land cresol.

Our results from screening by using disk diffusion technique revealed that *Candida spp*. had a degree of susceptibility to the oil with maximum activity on *C. krusei* (inhibition zone was 26 mm). For the bacteria, *S. mutans*, *L. casei* and *E. coli* were the three strains of test bacteria that showed susceptibility. When considering the minimum inhibitory concentration of jasmine oil against the test microorganisms, oral yeast seems to be more susceptible than oral bacteria (Table 2). The mechanism of antimicrobial action of jasmine oil is possibly due to the interruption of cell membrane synthesis, specifically membrane proteins interfering [16-17]. The hydrophobic characteristic of the oil enables it to make detachment in the membrane, providing permeability, causing leakage of cell contents and finally resulting in microbial cells death [18].

In conclusion, results from the present study are scientific evidence to demonstrate that jasmine oil could be applied as a natural antimicrobial agent for the prevention or treatment of oral microbial infection.

5. References

[1] Bidault P, Chandad F and Grenier D 2007 *J. Can. Dent. Assoc.***73** 721
[2] Maliz M, Jardim JJ and Alves LS 2010 *Braz. Oral. Res*.**1** 18
[3] Abdoul-Latif F, Edou P, Eba F, Mohamed N, Ali A, Djama S, *et al* 2010 *Afr. J. Plant. Sci.* **4** 38
[4] Alrashdi AS, Salama SM, Alkiyumi SS, Abdulla MA, Hadi AH, Abdelwahab ST, *et al* 2012 *Evid. Based. Complement. Alternat. Med.* **5** 786426.
[5] Sabharwal S, Vats M, Sardana S, and Aggarwal S 2011 *I.J.P.P.S.* **1** 237
[6] Chansukh KK 2016 *MFUIC & KTCM.* **2** 38
[7] Shrivastav P, George K, Balasubramaniam N, Jasper MP, Thomas M and Kanagasabhapathy AS 1988 Aust. N. Z. J. Obstet. Gynaecol. **28** 68

[8] Upaganlawar A, Bhagat A, Tenpe CR and Yeole PG 2009 *Pharmacol.* **1** 1
[9] Kalaiselvi M and Kalaivani K 2011 *Pharmacol.* **1** 38
[10] Chiang LC, Cheng HY, Liu MC, Chiang W and Lin CC 2003 *Biol. Pharm. Bull.* **26** 1600
[11] Tsai T, Wu W, Jonathon TT and Tsai P 2010 *Food. Chem.* **119** 964
[12] Somanadhan B, Varughese G, Palpu P, Sreedharan R, Gudiksen L, Smitt UM, *et al* 1999 *J. Ethnopharmacol.* **65** 103
[13] I Naohiko, Kyoko K, Akiko S, Tagami K and Tohru F 2003 *Biosci. Biotechnol. Biochem.* **67** 1206
[14] Rahman MA, Hasan M, Hossain SMA and, Biswas NN 2011 *Pharmacol.* **1** 124
[15] Bauer AW, Kirby WM and Sherris JC 1966 *Am. J. Clin. Pathol.* **36** 493
[16] Brul B and Coot P 1999 *Int. J. Food. Microbiol.* **50** 1
[17] Sikkema J, de Bont J and Poolman B 1995 *Microbiol. Rev.* **59** 201
[18] Rath CC, Devi S, Dash SK and Mishra RK 2008 *Indian. J. Pharm. Sci.* **70** 238