Antimicrobial Activities of Medicinal Plants Mostly used for Acute Pharyngitis Treatment

Metar Siriwattanasatorn BATM*,
Sumalee Panthong BSc**,***, Arunporn Itharat PhD**,***

** Student of Doctor of Philosophy (Applied Thai Traditional Medicine), Faculty of Medicine, Thammasat University, Pathumthani, Thailand*
*** Department of Applied Thai Traditional Medicine, Faculty of Medicine, Thammasat University, Pathumthani, Thailand*
**** Center of Excellence on Applied Thai Tradition Medicine Research (CEATMR), Faculty of Medicine, Thammasat University, Pathumthani, Thailand*

Background: *Many people suffer from acute pharyngitis which is caused by bacteria, especially Streptococcus pyogenes. Patients consume antibiotics even though antibiotic drugs have been causing adverse effects. Ten Thai medicinal plant species commonly used for treating acute pharyngitis may reduce the use of antibiotics.*
Objective: *To determine the antimicrobial activity of ten Thai medicinal plant species most commonly used for acute pharyngitis.*
Material and Method: *Plant materials were extracted with 95% ethanol or distilled water then concentrated and dried. Antimicrobial activity of ten Thai medicinal plant species were determined using two standard assays, broth dilution method for minimal inhibitory concentration value (MIC) and agar dilution method for minimal bactericidal concentration value (MBC), against microorganisms that cause acute pharyngitis.*
Results: *The ethanolic extract of Garcinia mangostana showed the strongest activity of both assays, MIC value in range of 0.6-9.8 μg/ml and MBC value in range of 1.2-625 μg/ml, which inhibited all the bacteria tested and particularly inhibited S. pyogenes ATCC 19615 as the most common cause of acute pharyngitis with the value of MIC and MBC at 0.6 and 1.2 μg/ml, respectively. The second highest antimicrobial activity was the ethanolic extract of Glycyrrhiza glabra with MIC value in range of 39-156 μg/ml and MBC value in range of 78-312 μg/ml and it showed strong activity against S. pyogenes ATCC 19615, S. pneumoniae ATCC 49619 and S. mutans ATCC 25175 with the value of MIC and MBC at 39 and 78 μg/ml, respectively.*
Conclusion: *The ethanolic extract of G. mangostana and G. glabra are the two best choice for acute pharyngitis treatment.*

Keywords: *Acute pharyngitis, Thai traditional medicine, Antimicrobial activity, Garcinia mangostana, Glycyrrhiza glabra*

J Med Assoc Thai 2016; 99 (Suppl. 4): S144-S152
Full text. e-Journal: *http://www.jmatonline.com*

Acute pharyngitis causes suffering in many people with classic symptoms of fever greater than 38°C, absence of cough, swelling of anterior cervical nodes, tonsillar swelling or exudates and particularly in young and teenage. Many bacteria cause acute pharyngitis especially group A beta-hemolytic streptococcus as *Streptococcus pyogenes*[1]. Patients suffering from acute pharyngitis have consumed antibiotic drugs to treat and prevent recurrent diseases even though antibiotic drugs have had adverse effects and allergic reactions[2]. Reducing antibiotic use is important in decreasing drug resistance[3], avoiding allergic reactions and lowering the cost of treatment. Thai folk medicines have been treating patients with various medicinal plants and the most commonly used to treat acute pharyngitis are listed in ancient scriptures and the National Essential Drugs Lists that associated with oral cavity diseases, particularly acute pharyngitis. Ten medicinal plants species are shown in Table 1, which have been using mostly and are the main component in each remedy for treating acute pharyngitis although the antimicrobial activities have studied only in some species of medicinal plants[4,5] or only against some microorganisms[6,7], but reports are limited especially on the minimal bactericidal concentration value (MBC) and relationship between the list of microorganisms and the most common bacteria and fungi causing acute pharyngitis. Thus,

Correspondence to:
Itharat A, Department of Applied Thai Traditional Medicine, Faculty of Medicine, Thammasat University, Rangsit, Klongluang, Pathumthani 12120, Thailand.
Phone & Fax: +66-2-9269749
E-mail: iarunporn@yahoo.com

Table 1. Thai medicinal plants and percentage of yield by maceration and decoction methods

Scientific name	Family name	Common name	Part of use	Biological activity	% yield	
					Maceration	Decoction
Garcinia mangostana Linn.	Clusiaceae	Mangosteen	Pericarp	Antibacterial[5,8], Antioxidant[9]	23.81	12.73
Glycyrrhiza glabra Linn.	Fabaceae	Licorice	Root	Antibacterial[7], Antitumor[10]	6.08	15.33
Syzygium aromaticum Linn.	Myrtaceae	Clove	Flower	Antibacterial[4]	18.79	13.15
Mimusops elengi Linn.	Sapotaceae	Bullet wood	Bark	Wound healing[16], Antiinflamation[15]	1.23	0.62
Nigella sativa Linn.	Ranunculaceae	Black cumin	Seed	Antibacterial[4], Antitumor[14]	22.07	13.31
Phyllanthus emblica Linn.	Euphorbiaceae	Indian gooseberry	Dry fruit	Antioxidant, Antitumor[13]	13.11	22.11
Solanum indicum Linn.	Solanaceae	Indian nightshade	Dry fruit	Antioxidant[12]	6.77	12.98
Solanum trilobatum Linn.	Solanaceae	Thai nightshade	Dry fruit	Antibacterial[6]	7.67	19.64
Camphor		Camphor	Crystal	Antibacterial[11]	-	-
Borneol		Borneol	Crystal	Antibacterial[11]	-	-

aims of this study were to determine the minimal inhibitory concentration (MIC) and minimal bactericidal concentration (MBC) value of the aqueous extracts and the ethanolic extracts of the most commonly used medicinal plants against microorganisms that are the common cause of acute pharyngitis.

Material and Method

Chemicals and reagents

Mueller-Hinton Agar (Difco, USA), Mueller-Hinton Broth (Difco, USA), Brain Heart Infusion Agar (Difco, USA), Brain Heart Infusion Broth (Difco, USA), Nutrient Agar (Difco, USA), Blood Agar (Difco, USA), Sabouraud Dextrose Agar (Difco, USA), Resazurin (Sigma, USA), 95% Ethanol (CMJ Anchor company, Thailand) and Dimethyl sulphoxide (RCI Labscan, Thailand).

Plant materials and preparation of crude extracts

Thai medicinal plants commonly used to treat acute pharyngitis as in Table 1 were collected from several parts of Thailand. The fresh plants were washed, sliced into small pieces and dried in hot air oven at 50°C for 24 hours, then powdered and macerated with 95% ethanol at room temperature for 3 days and filtered through Whatman No. 1 filter paper. The residues were macerated twice more times. Filtrates were collected and concentrated by rotary evaporator under reduced pressure then the 95% ethanol crude extracts were stored at -20°C until antimicrobial activity testing. Aqueous extracts were obtained from powdered plants which were decocted by boiling in distilled water for 15 mins then filtered through Whatman No. 1 filter paper. The residues were further decocted twice more times. Filtrates were combined and concentrated by freeze dryer and stored at -20°C.

Determination of antimicrobial activity

Microorganisms

Bacteria and fungi strains causing acute pharyngitis purchased from Department of Medicine Sciences, Ministry of Public Health, Thailand were *Staphylococcus aureus* ATCC 25923, Methicillin-resistant *Staphylococcus aureus* DMST 20651, *Streptococcus pyogenes* ATCC 19615, *Streptococcus pneumoniae* ATCC 49619, *Streptococcus mutans* ATCC 25175 and *Candida albicans* ATCC 90028.

Culture of microorganisms

S. aureus ATCC 25923 and Methicillin-resistant *S. aureus* DMST 20651 were cultured in

nutrient agar in ambient air at 37°C for 24 hours, while *S. pyogenes* ATCC 19615 and *S. pneumoniae* ATCC 49619 were cultured in blood agar in candle jar at 37°C for 24 hours. *S. mutans* ATCC 25175 was cultured in brain heart infusion agar in candle jar at 37°C for 24 hours and *C. albicans* ATCC 90028 was cultured in sabouraud dextrose agar in ambient air at 37°C for 48 hours.

Preparation of inoculum

Three to five isolated colonies of each microorganism were cultured in Mueller-Hinton broth at 37°C for 2 hours while *S. pyogenes* ATCC 19615 and *S. pneumoniae* ATCC 49619 were cultured in brain heart infusion broth at 37°C for 2 hours, then turbidity adjusted to 0.5 McFarland standard.

Preparation of resazurin solution

Resazurin sodium salt was prepared with sterile water at 1 mg/ml and filtered through 0.22 μm filter. The resazurin solution was kept at 4°C, before use.

Preparation of samples

The 95% ethanol extracts of each plant were dissolved in dimethyl sulfoxide (DMSO) to give concentration of 500 mg/ml while the water extracts were dissolved in sterile water to give concentration of 100 mg/ml and filtered through 0.22 μm filter. Both ethanolic extracts and aqueous extracts were stored at -20°C, before use.

Minimal inhibitory concentration (MIC) and minimal bactericidal concentration (MBC)

Minimal inhibitory concentration was determined using a broth dilution method[17]. The sample solution of extracts were prepared using sterile dimethyl sulfoxide (DMSO) for the ethanolic extract while using sterile water for the aqueous extract and filtered with 0.22 μm filter. The concentration of sample solutions was adjusted to give a final concentration of 10 mg/ml. The extracts were serially diluted (two-fold) by Mueller-Hinton broth in 96 well plates, each sample in triplicate. The microorganisms were incubated for 18-24 hours while *C. albicans* ATCC 90028 was incubated for 48 hours. Three to five isolated colonies of each microorganism were cultured in the medium for 2 hours and turbidity adjusted to 0.5 McFarland standard then diluted down 200 fold and added to 96 well plates. The plate was wrapped with plastic and incubated in shaker incubator at 60 rpm, 37°C for 24 hours *C. albicans* ATCC 90028 was incubated at 37°C for 48 hours while *S. pyogenes* ATCC 19615 and *S. pneumoniae* ATCC 49619 were incubated at 37°C for 24 hours without shaking. The MIC assay was modified using resazurin as an indicator of viable microorganisms. Resazurin was added to the 96 well plates and incubated at 37°C for 2 hours to determine minimal inhibitory concentration value which is the lowest concentration of the extract, that can inhibit the microorganism showed the blue color of resazurin. The concentration of extract which cannot inhibit microorganism results in the resazurin changed to pink color.

Minimal bactericidal concentration was determined using agar dilution method[18]. The sample, from MIC value as well as higher concentration from MIC method, were subcultured into the fresh agar and incubated according to the specification of each microorganism. The minimal bactericidal concentration was the lowest concentration that showed no isolated colony on the surface of the solid medium.

Results

The percentage yield of medicinal plant extracts of both methods, maceration and decoction, are shown in Table 1. The ethanolic and the aqueous extracts ranged in percentage yields from 1.23-23.81% and 0.62-22.11%, respectively.

The MIC values of ethanolic extracts shown in Table 2 ranged from 0.0006-10 mg/ml. The ethanolic extract of *G. mangostana* showed the best activity in both assays, MIC value in range of 0.6-9.8 μg/ml and MBC values in range of 1.2-625 μg/ml, which inhibited all of the bacteria and particularly inhibited *S. pyogenes* ATCC 19615 which is the most common cause of acute pharyngitis with the value of MIC and MBC at 0.6 and 1.2 μg/ml but did not inhibit the fungus, *C. albicans* ATCC 90028. The second best antimicrobial activity was the ethanolic extract of *G. glabra* with MIC value in range of 39-156 μg/ml and MBC values in range of 78-312 μg/ml which showed high activity against *S. pyogenes* ATCC 19615, *S. pneumoniae* ATCC 49619 and *S. mutans* ATCC 25175 with the MIC and MBC value of 39 and 78 μg/ml, respectively. In addition, the ethanolic extract of *G. glabra* also showed moderate antifungal activity against *C. albicans* ATCC 90028 with the MIC and MBC values of 0.625 and 1.25 mg/ml, respectively. The *Nigella sativa* seed extract also showed antibacterial against *S. pyogenes* ATCC 19615, *S. pneumoniae* ATCC 49619 and *S. mutans* ATCC 25175 with the MIC and MBC value in the range of 156-312

µg/ml. This plants were often used to enhance the activity of the remedy and it was also used in combination with the other plants in Thai traditional medicine principle. *Solanum indicum* fruits which are commonly used in Thai traditional medicine and used as ingredients in sore throat preparation showed the highest antifungal activity (MIC/MBC = 312/312 µg/ml). Interestingly, this result is the first report for *S. indicum* to have inhibitory effect on *C. albicans*. The ethanolic extracts of all other plants exhibited moderate to low activity against bacteria and fungi causing acute pharyngitis.

All of the aqueous extracts from medicinal plants are shown in Table 3. They exhibited moderate to weak antibacterial activity, with MIC and MBC values in the range of 0.312-10 mg/ml. However, the aqueous extract of *Syzygium aromaticum* was the most effective, with MIC and MBC values in the range of 0.312-5 mg/ml. It inhibited *S. aureus* MRSA DMST 20651 with MIC and MBC values of 0.312 mg/ml while the aqueous extract of *G. mangostana* inhibited *S. pyogenes* ATCC 19615 better, having MIC and MBC values of 0.625-1.25 mg/ml, which is lower than that of the aqueous extract of *S. aromaticum*. Nonetheless, none of the aqueous extracts inhibited *C. albican* ATCC 90028, which is the cause of oral candidiasis.

Discussion

The present study is on the use of different solvent systems and methods to extract medicinal plant such as distilled water and 95% ethanol and the extracts were studied for antimicrobial activity using broth dilution method to determine minimal inhibitory concentration value (MIC) and agar dilution method to determine minimal bactericidal concentration value (MBC), against microorganisms which is the cause of pharyngitis particularly group A beta-hemolytic streptococcus. Most common medicinal plants used for acute pharyngitis treatment of Thai traditional medicine were studied.

Streptococcus group (*S. pyogenes* ATCC 19615, *S. pneumoniae* ATCC 49619 and *S. mutans* ATCC 25175) causes several diseases especially group A beta-hemolytic streptococcus as *S. pyogenes* which is not only a common cause of acute pharyngitis but also associated with scarlet fever, rheumatic fever and glomerulonephritis[1,2]. This studies showed that the ethanolic extract of *G. mangostana* has the best antibacterial activity while the ethanolic extract of *G. glabra* was the next best to inhibit *Streptococcus* group with values of MIC and MBC less than 100 µg/ml while the other extracts and all of the aqueous extracts showed only moderate to low activity. One previous study has similar results, while camphor and borneol displayed no inhibitory activity on *S. pyogenes*[11], and another report related to this study, *S. pyogenes* and *S. mutans* were inhibited by the methanolic extract of *G. mangostana* with the value of MIC at 10 µg/ml for both strains[8], but this present study shows higher activity over 16 and 4 fold respectively. Thus, the ethanoic extract of *G. mangostana* showed better antibacterial activity than them ethanolic extract.

Staphylococcus group (*S. aureus* ATCC 25923 and *S. aureus* MRSA DMST 20651) are known as the common human pathogen infecting damaged tissues such as skin or mucosal membrane[19]. The present studies showed that the ethanolic extract of *G. mangostana* possesses the highest activity against *Staphylococcus* group while the ethanolic extract of *G. glabra* also exhibited high inhibitory activity. Ethanolic extract of *G. mangostana* showed MIC and MBC values lower than 100 µg/ml while ethanolic extract of *G. glabra* showed MIC and MBC values of greater than 100 µg/ml to against *S. aureus*. Thus, the ethanolic extract of *G. mangostana* showed better inhibitory activity than ethanolic extract of *G. glabra*. On the other hand, it is beneficial that the effect of ethanolic extract of *G. glabra* has covered in range of *S. aureus* MRSA, where ethanolic extract of *G. mangostana* showed only moderate activity against *S. aureus* MRSA related with the ethanolic extracts of other plants and all the aqueous extracts which exhibited only moderate to low antibacterial activity. Previous studies on ethanolic extract of *G. mangostana* agree with the present study[8] and also, some showed efficacy of ethanolic extract of *G. mangostana*[5] and ethanolic extract of *G. glabra*[7] although the values of MIC were different. The different method of extract and time of maceration may have influence on the results.

C. albicans (*C. albicans* ATCC 90028) causes oral candidiasis which affects many people[20]. In the present study, the ethanolic extract of *S. indicum* exhibited the highest activity against *C. albicans* although it is in the range of moderate activity, having the MIC and MBC value of 0.312 mg/ml. This is the first report of *S. indicum* against *C. albicans*. The ethanolic extract of *G. glabra* was the second best to inhibit *C. albicans*, having MIC value of 0.625 mg/ml and MBC value at 1.25 mg/ml which being greater than 1 mg/ml thus showed only low activity. Therefore, the ethanolic extract of *S. indicum* is of greater potential than the ethanolic extract of *G. glabra* for inhibiting *C. albicans*;

Table 2. Minimal inhibitory concentration (MIC) and minimal bactericidal concentration (MBC) of ethanolic extracts against 7 microorganisms causing pharyngitis (n = 3)

Extracts or reference drugs*	Minimal inhibitory concentration/minimal bactericidal concentration (mg/ml)					
	S. aureus ATCC 25923	*S. aureus* MRSA DMST 20651	*S. pyogenes* ATCC 19615	*S.pneumoniae* ATCC 49619	*S. mutans* ATCC 25175	*C. albicans* ATCC 90028
Garcinia mangostana	0.0098/0.039	0.0049/0.625	0.0006/0.0012	0.0012/0.0024	0.0024/0.156	NA/-
Glycyrrhiza glabra	0.156/0.312	0.078/0.312	0.039/0.078	0.039/0.078	0.039/0.078	0.625/1.25
Syzygium aromaticum	2.5/5	1.25/2.5	1.25/2.5	0.625/1.25	1.25/1.25	1.25/1.25
Mimusops elengi	2.5/2.5	1.25/2.5	0.625/1.25	0.625/2.5	2.5/2.5	NA/-
Nigella sativa	NA/-	NA/-	0.312/0.312	0.156/0.312	0.156/0.156	NA/-
Phyllanthus emblica	NA/-	NA/-	1.25/1.25	NA/-	2.5/5	2.5/2.5
Solanum indicum	NA	NA	NA/-	NA/-	NA/-	0.312/0.312
Solanum trilobatum	5/10	5/5	5/5	2.5/5	NA/-	NA/-
Camphor	NA/-	NA/-	NA/-	10	NA/-	NA/-
Borneol	NA/-	NA/-	NA/-	10	NA/-	NA/-
Ampicillin*	0.0241	100	0.0241	0.048	0.0012	-
Vancomycin*	0.3906	0.3906	0.0241	0.024	0.39	-
Amphotericin B*	-	-	-	-	-	1

NA = no activity in the range of study (antibacterial activity in the range more than 10 mg/ml)
* Reference drugs are represented with MIC value (µg/ml)

Table 3. Minimal inhibitory concentration (MIC) and minimal bactericidal concentration (MBC) of aqueous extracts against 7 microorganisms causing pharyngitis (n = 3)

Extracts or reference drugs*	Minimal inhibitory concentration/minimal bactericidal concentration (mg/ml)					
	S. aureus ATCC 25923	*S. aureus* MRSA DMST 20651	*S. pyogenes* ATCC 19615	*S. pneumoniae* ATCC 49619	*S. mutans* ATCC 25175	*C. albicans* ATCC 90028
Garcinia mangostana	0.625/0.625	0.625/2.5	0.625/1.25	0.625/2.5	1.25/2.5	NA/-
Glycyrrhiza glabra	10/10	5/5	2.5/2.5	2.5/5	5/5	NA/-
Syzygium aromaticum	0.625/0.625	0.312/0.312	2.5/5	5/5	2.5/2.5	NA/-
Mimusops elengi	2.5/5	2.5/2.5	NA/-	NA/-	NA/-	NA/-
Nigella sativa	5/5	5/10	5/10	2.5/2.5	NA/-	NA/-
Phyllanthus emblica	5/10	1.25/1.25	NA	10/10	NA/-	NA/-
Solanum indicum	NA	NA	NA/-	NA/-	NA/-	NA/-
Solanum trilobatum	10/10	5/5	NA/-	NA/-	NA/-	NA/-
Ampicillin*	0.0241	100	0.0241	0.048	0.0012	-
Vancomycin*	0.3906	0.3906	0.0241	0.024	0.39	-
Amphotericin B*	-	-	-	-	-	1

NA = no activity in the range of study (antibacterial activity in the range more than 10 mg/ml)
* Reference drugs are represented with MIC value (µg/ml)

while the other extracts exhibited only weak antifungal activity and none of aqueous extract showed activity. A previous study has reported the efficacy of ethanolic extract of *G. glabra*[7] against *C. albicans* but the value of MIC is different which may be due to the different method of extraction. The present study used ampicillin, vancomycin and amphotericin B as reference drugs as the standard control in the assay and represent as MIC values. For all the strains had MIC value in the normal range[21] except that for *S. aureus* MRSA which exhibited resistant to ampicillin which is destroyed by beta-lactamase it produces. Thus, vancomycin is used as control drug for *S. aureus* MRSA.

Conclusion

The present study shows that the ethanolic extract of *G. mangostana* pericarps is the first choice and the ethanolic extract of *G. glabra* roots is the second choice for controlling acute pharyngitis. All bacteria that cause acute pharyngitis particularly *S. pyogenes* were inhibited by both extracts which showed the best antibacterial activity. On the other hand, both extract showed poor antifungal activity against *C. albicans*. *S. indicum* is the first choice as antifungal, although its antifungal activity showed only MIC of 0.312 mg/ml. It also popularly used in Thai traditional remedy for sore throat, so it should be selected to prepare a drug for pharyngitis treatment or sore throat. Moreover, three extracts should be used to treat acute pharyngitis from microbial infection. Thus, the ethanolic extracts of these three plants should be further developed as drug for pharyngitis treatment.

What is already known on this topic?

Some species of medicinal plants or microorganisms had been studied the susceptibility tests such as agar and broth dilution methods but are limited especially the minimal bactericidal concentration value (MBC) and the relationship between the microorganisms as the most common cause of acute pharyngitis from bacteria and fungi. Some previous study showed medicinal plants with inhibitory activity against *S. aureus* while only few of previous studies were against *S. pyogenes* thus the aim of these studies was to determined the antimicrobial activity of medicinal plants extracts against microorganisms which are the most common cause of acute pharyngitis.

What this study adds?

The present study not only determined the minimal inhibitory concentration (MIC) but also showed minimal bactericidal concentration (MBC) value of aqueous extracts and ethanolic extracts of most commonly used of medicinal plants, with up to ten plants, against microorganisms, particularly *S. pyogenes* as common cause of acute pharyngitis. In addition, activity against the other microorganisms such as *S. aureus, S. aureus* MRSA, *S. pneumoniae*, *S. mutans* and *C. albicans* were also studied. Interestingly, this study is the first report of *S. indicum* to exhibit good inhibitory effect on *C. albicans*.

Acknowledgements

Thanks are extended to the National Research University Project of Thailand Office of Higher Education Commission and Center of Excellence on Applied Thai Traditional Medicine Research (CEATMR), Faculty of Medicine, Thammasat University for financial support.

Potential conflicts of interest

None.

References

1. Wessels MR. Clinical practice. Streptococcal pharyngitis. N Engl J Med 2011; 364: 648-55.
2. Anjos LM, Marcondes MB, Lima MF, Mondelli AL, Okoshi MP. Streptococcal acute pharyngitis. Rev Soc Bras Med Trop 2014; 47: 409-13.
3. Passali D, Lauriello M, Passali GC, Passali FM, Bellussi L. Group A streptococcus and its antibiotic resistance. ActaOtorhinolaryngol Ital 2007; 27: 27-32.
4. Lairungruang K, Itharat A, Panthong S. Antimicrobial activity of extracts from a Thai traditional remedy called Kabpi for oral and throat infection and its plant components. J Med Assoc Thai 2014; 97 Suppl 8: S108-S115.
5. Temrangsee P, Kondo S, Itharat A. Antibacterial activity of extracts from five medicinal plants and their formula against bacteria that cause chronic wound infection. J Med Assoc Thai 2011; 94 (Suppl 7): S166-71.
6. Nagarajan SM, Kandasamy S, Chinnappa R. Comparative antimicrobial activity of callus and natural plant extracts of *Solanum trilobatum* L. AncSci Life 2009; 28: 3-5.
7. Irani M, Sarmadi M, Bernard F, Ebrahimi Pour GH, Shaker BH. Leaves Antimicrobial Activity of *Glycyrrhiza glabra* L. Iran J Pharm Res 2010; 9: 425-8.
8. Tadtong S, Viriyaroj A, Vorarat S, Nimkulrat S,

SuksamrarnS. Antityrosinase and antibacterial activities of mangosteen pericarp extract. J Health Res 2009; 23: 99-102.
9. Tjahjani S, Widowati W, Khiong K, Suhendra A, Tjokropranoto R. Antioxidant properties of *Garcinia mangostana* L (Mangosteen) Rind. Procedia Chem 2014; 13: 198-203.
10. Nagaraj SRM, Lingaraj SM, Balaraju Y, Kumar A, Salimath BP. MTA1 induced angiogenesis, migration and tumor growth isinhibited by *Glycyrrhiza glabra*. IOSR J Pharm 2012; 2: 34-43.
11. Kotan R, Kordali S, Cakir A. Screening of antibacterial activities of twenty-one oxygenated monoterpenes. Z Naturforsch C 2007; 62: 507-13.
12. Deb PK, Das N, Ghosh R, Bhakta T. Evaluation of in-vitro antioxidant and anthelmintic activity of *Solanum indicum* Linn. berries. Indo Am J Pharm Res 2013; 3: 4123-30.
13. Sumalatha D. Antioxidant and antitumor activity of phyllanthusemblicain colon cancer cell lines. Int J CurrMicrobiol App Sci 2013; 2: 189-95.
14. Peng L, Liu A, Shen Y, Xu HZ, Yang SZ, Ying XZ, et al. Antitumor and anti-angiogenesis effects of thymoquinone on osteosarcoma through the NF-kappaB pathway. Oncol Rep 2013; 29: 571-8.
15. Khatri DK, Manjulakonka, Juvekar AR. Evaluation of anti-inflammatory activity of *Mimusops elengi* extracts in-vitro and in-vivo models. Int J Pharm Bio Sci 2014; 5: 259-68.
16. Gupta N, Jain UK. Investigation of wound healing activity of methanolic extract of stem bark of *Mimusops elengi* Linn. Afr J Tradit Complement Altern Med 2011; 8: 98-103.
17. Sarker SD, Nahar L, Kumarasamy Y. Microtitre plate-based antibacterial assay incorporating resazurin as an indicator of cell growth, and its application in the in vitro antibacterial screening of phytochemicals. Methods 2007; 42: 321-4.
18. Yilmaz M T. Minimum inhibitory and minimum bactericidal concentrations of boron compounds against several bacterial strains. Turk J Med Sci 2012; 42(Suppl 2): 1423-9.
19. Bueris V, Pimenta FC, Ito IY, Marin JM. Oral incidence of *Staphylococcus aureus* and antimicrobials agents resistance. Braz J Oral Sci 2005; 4: 676-9.
20. Akpan A, Morgan R. Oral candidiasis. Postgrad Med J 2002; 78: 455-9.
21. Clinical and Laboratory Standards Institute (CLSI). Performance standards for antimicrobial susceptibility testing; Seventeenth Informational Supplement. CLSI document M100-S17. Pennsylvania: CLSI; 2007.

ฤทธิ์ต้านจุลชีพของสมุนไพรที่นิยมใช้เพื่อรักษาอาการคออักเสบเฉียบพลัน

เมธาร์ ศิริวัฒนสาธร, สุมาลี ปานทอง, อรุณพร อิฐรัตน์

ภูมิหลัง: *ผู้ป่วยที่มีอาการคออักเสบเฉียบพลันมักมีสาเหตุมาจากการติดเชื้อแบคทีเรียโดยเฉพาะอย่างยิ่งเชื้อแบคทีเรีย Streptococcus pyogenes ผู้ป่วยมักใช้ยาปฏิชีวนะแม้ว่ายาเหล่านั้นจะมีฤทธิ์ที่ไม่พึงประสงค์ก็ตาม ด้วยเหตุนี้สมุนไพรไทย 10 ชนิด ที่นิยมใช้รักษาอาการคออักเสบเฉียบพลัน จึงถูกรวมรวมมาเพื่อศึกษาฤทธิ์ต้านเชื้อจุลชีพ*

วัตถุประสงค์: *เพื่อศึกษาฤทธิ์ต้านเชื้อจุลชีพของสมุนไพร 10 ชนิดที่นิยมใช้ในการรักษาอาการคออักเสบเฉียบพลัน*

วัสดุและวิธีการ: *สารสกัดชั้น 95% เอทานอลและสารสกัดชั้นน้ำซึ่งสกัดจากสมุนไพรได้นำไปศึกษาด้วยวิธีมาตรฐานสองวิธีได้แก่ การหาค่าที่น้อยที่สุดที่สามารถยับยั้งการเจริญของเชื้อ (MIC) และการหาค่าความเข้มข้นต่ำสุดที่สามารถฆ่าเชื้อได้ (MBC) เพื่อให้ทราบค่าที่สามารถต้านเชื้อจุลชีพที่เป็นสาเหตุของอาการคออักเสบเฉียบพลัน*

ผลการศึกษา: *สารสกัดชั้นเอทานอลของเปลือกมังคุดสามารถยับยั้งการเจริญของเชื้อได้ดีที่สุด (MIC = 0.6-9.8 ไมโครกรัม/มิลลิลิตร) และมีค่าที่สามารถฆ่าเชื้อได้ดีที่สุด (MBC) = 1.2-625 ไมโครกรัม/มิลลิลิตร) โดยเฉพาะกับ S. pyogenes ATCC 19615 (MIC และ MBC มีค่า 0.6 และ 1.2 ไมโครกรัม/มิลลิลิตรตามลำดับ) รองลงมาคือสารสกัดชั้นเอทานอลของรากชะเอมเทศ ซึ่งสามารถยับยั้งการเจริญของเชื้อได้ดี (MIC = 39-156 ไมโครกรัม/มิลลิลิตร) และมีฤทธิ์ฆ่าเชื้อ (MBC = 78-312 ไมโครกรัม/มิลลิลิตร) และยังสามารถต้าน S. pyogenes ATCC 19615, S. pneumoniae ATCC 49619 และ S. mutans ATCC 25175 (MIC และ MBC มีค่า 39 และ 78 ไมโครกรัม/มิลลิลิตร) ตามลำดับ ได้ดีอีกด้วย*

สรุป: *การศึกษาสรุปว่าสารสกัดชั้นเอทานอลของเปลือกมังคุดและสารสกัดชั้นเอทานอลของรากชะเอมเทศเป็นตัวเลือกที่ดีมาก ในการใช้เพื่อรักษาอาการคออักเสบเฉียบพลัน*