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Anti-bacterial effect of Indian costus and sea-qust and their water extracts on some pathogenic bacteria of the human respiratory system

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The pathogenic bacteria of the human respiratory system are characterized by resistance to most antibiotics. *Staphylococcus aureus* and *Klebsiella pneumonia* are some of the pathogenic bacteria of the human respiratory system which often cause pneumonia and meningitis. Moreover, they are the most prominent strains of bacteria in most hospitals. Bacterial resistance to antibiotics occurs as a result of excessive usage of antibiotics in the treatment of diseases. For that reason, it is necessary to seek for medical alternatives that are safer for the treatment of these bacteria. Alternative medicine, especially, has revealed many plants and herbs that are used in the treatment for some diseases including respiratory diseases. The purpose of this study is to determine the effect of the Indian *Costus* and sea-Qust on the pathogenic bacteria; *Escherichia coli, Pseudomonas aeruginosa, S. aureus* and *K. pneumonia*. In addition, the effect of the water extracts of the Indian *costus* and sea-qust on *S. aureus* and *K. pneumonia* was also determined. The results showed antibacterial effect of two types of dried *Costus* roots on all tested bacteria, especially in high concentrations. Also, the cold or hot water extract of Indian *Costus* was highly effective against tested bacteria at 20 to 25% concentration, while the hot extract of sea-Qust was more effective against tested bacteria than its cold extract in all the concentrations used.

Key words: Medicinal plants, dried roots, bacterial resistance, lung diseases.

INTRODUCTION

Bacterial resistance to antibiotics is one of the most important problems that confront the world at the present time. The main reason for this problem is the over-use of drugs to remedy diseases (Shihabi, 1998) which infect human and animals. Over the past decade, the increase in antibiotic resistance has generated considerable medical troubles (Andersson, 2003). The large consumption of antibiotics in an intensive care to protect patients from inflammations of disease after surgery, has led to the emergence of bacterial resistance to important bacteria species such as *Pseudomonas aeruginosa*, *Staphylococcus aureus* and *Klebsiella pneumonia* on pneumonia patients in the use assistive devices for breathe in hospitals as well as, throat, sinus, bronchitis and bronchiolitis infections in infants and weakened the immune system (McKenna, 2003). Furthermore, antibiotic-resistant *Streptococcus pneumoniae*, *Haemophilus influenzae*, *S. aureus* and *K. pneumoniae* strains have been isolated from patients suffering from lower respiratory tract infections in recent years (Moore et al., 2002; Ferrara, 2005; Shaw, 2005).

Nicasio et al. (2008) reported that multidrug resistance among *P. aeruginosa* and *Acinetobacter sp*. has always been apparent across many hospitals in the United States and recent surveillance indicates increasing resistance to all currently available antibiotics. These strains

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have been associated with prolonged hospital stays, higher health care costs and increased mortality, particularly when initial antibiotic therapy does not provide coverage of the causative pathogen (Slama, 2008). The resistant strains of Gram-negative bacteria are common in the hospital, especially, *P. aeruginosa* and *E. coli*, as a result of incorrect use or underuse of antibiotics for too short a time, too low a dose, inadequate potency and poor adherence (UAB Insight, 2008; Craig, 2009). The *P. aeruginosa* is an opportunistic pathogen chronically infecting the lungs of patients with chronic obstructive pulmonary (pneumonia) disease (Bomberger et al., 2011). Consequently, it becomes necessary to use alternative natural resources like medicinal plants, which are safe for human health, and reduce the risk of treatment by antibiotics. There are expectations (Marr et al., 2006) of a new generation of antimicrobials with a broad range of topical and systemic applications against infections.

Thus, the purpose of this study was to determine the effect of the Indian *costus* or sea-qust and their water extracts on the above-mentioned bacteria that cause diseases in respiratory tract of humans. *Costus* has been mentioned in Prophet's medicine for treatment those diseases. Ibn Qayim (2008) mentioned that pleurisy or lung diseases are painful ailment which can be cured by using sea-qust or Indian *costus*, chiefly when it is ground to fine powder or blended with hot oil. The plants of *Costus* are species belonging to the family Zingiberaceae, which grow on the moist slopes of the Himalayas at altitudes of 8000 to 12000 feet in India. Also, the roots have a long history of medicinal and aesthetic use in Tibet, India and other mountain regions. Indian *Costus* has black roots and has a pungent taste, peculiar fragrance, tonic and antiseptic. However, sea-qust has white roots, less bitter than Indian *Costus* and the part used in a treatment is peel roots (Viel et al., 1999; Kala et al., 2006; Pandey et al., 2007). In addition the dried roots of *Saussurea lappa* called *Costus* roots are used in the traditional system of medicine for treatment of cancer because it has hexane extract of anti-cancer (Robinson et al., 2008). Also, the study of Magassouba et al. (2007), Pandey et al. (2007) and Mothana et al. (2009) reported that *Costus* species was one of the registered plants used in traditional medicine to treat infectious diseases in West Africa and Yemeni, because it had antibacterial activity against *Bacillus cereus*, *Mycobacterium fortuitum*, *S. aureus*, and *Candida albicans*. In addition, the *Costus arabicus* plant has also inhibited the growth of cancer cells.

MATERIALS AND METHODS

Roots powder of *costus* and sea-qust

The dried roots of Indian *costus* and sea-qust were collected from many herb stores at (Jeddah, Makkah, Saudi Arabia), washed with water, and left them to dry. Then, they were ground into fine powder experimental use (Ody, 1999).

Bacterial strains and media preparation

The pathogenic isolates of *E. coli, P. aeruginosa, S. aureus and K. pneumonia* were obtained from the King Faisal Specialist Hospital and Research Centre – Jeddah, Saudi Arabia. The blood agar media (Oxoid) was used for the cultivation of pathogenic bacteria isolates (Madigan and Martinko, 2005).

The cold water extracts of roots were prepared by weighed 50 g of Indian *Costus* or sea-qust, ground and added to a conical flask containing 100 ml of distilled water. This was left for 24 h and then percolated by paper filtration using bacterial filter for sterilization (Sheikh, 2006). On the other hand, the hot water extracts of roots were prepared by same approach but the boiling water temperature 100°C was a substitute for cold water (Sheikh, 2006). The bacteria growth by Inoculation was repeated on same concentrations of Indian *Costus* or sea-Qus. After 48 h of the bacteria incubation for first time, the apparent growth in a dish taken and re-inoculated by same concentration for the second time and also repeated for a third time. The dry weight of pathogenic bacteria was determined as milligram according to the method of Al-kattan (2006).

RESULTS AND DISCUSSION

The various concentrations (5, 10, 15 and 20%) of *Costus* species used showed high inhibitory rate on the growth of *E. coli, P. aeruginosa, S. aureus* and *K. pneumonia*, although 5 and 10% of Indian *Costus* were more effective on *S. aureus* than *P. aeruginosa* and *K. pneumonia*. The effect was increased at 10% of sea-qust on all the tested bacteria and the bacterial growth were totally inhibited when using 15 and 20% of *Costus* compared to control samples (Table 1; Figures 1 and 2). For the determination of the most effective concentration, two strains of bacteria were selected for the experiments. At 10, 15 and 20% of Indian *Costus* and sea-qust, the rate of inhibitions were 63.63, 90.10 and 100%, 45.46 and 100% for *K. pneumonia* and 90 and 100%, 70 and 100% for *S. aureus,* respectively. The effect continued after bacteria inoculation for 2 than 3 times, especially in the samples which are treated by 15 and 20% of the two types of the *Costus*.

The results in this experiment showed a high antimicrobial activity and percentage of inhibition for *K. pneumonia* and *S. aureus* at 10, 15 and 20% concentrations of the *Costus* used (Table 2) compared to control samples. The prior observed results revealed high percentages against tested bacteria for two types of the

Table 1. Effect of various concentrations of Indian *Costus* and sea-qust on some types of pathogenic bacteria for respiratory system in the human.

Treatment	Pathogenic bacteria	Control	Concentration (%)			
			5	10	15	20
Costus Indian	*E. coli*	+++	++	±	-	-
	K. pneumonia	+++	+++	+++	±	-
	P. aeruginosa	+++	+++	+++	±	-
	S. aureus	+++	±	±	-	-
sea-Qust	*E. coli*	+++	+++	++	-	-
	K. pneumonia	+++	+++	++	±	-
	P. aeruginosa	+++	+++	++	±	-
	S. aureus	+++	++	±	-	-

Table 2. Effect of various concentrations of Indian *Costus* and sea-qust on dry weight and percentage growth for *K. pneumonia* and *S. aureus* bacteria, and repeat of them by inoculation on the same concentrations of a *Costus* (mean of replicates ± SE).

Treatment	Pathogenic bacteria	Replication of treatment	Control	Concentration (%)							
				5		10		15		20	
				A	B	A	B	A	B	A	B
Costus Indian	*K. pneumonia*	1	110 ± 17.32	90 ± 0.00	-18.18	40 ± 17.32*	-63.63	10 ± 17.32**	-90.10	0.00	-100
		2	100 ± 17.32	90 ± 0.00	-10.00	70 ± 17.32	-30.00	30 ± 0.00*	-70.00	0.00	-100
		3	120 ± 0.00	70 ± 17.32*	-41.67	40 ± 17.32*	-66.67	10 ± 17.32*	-91.67	0.00	-100
	S. aureus	1	100 ± 17.32	30 ± 0.00*	-70.00	10 ± 17.32*	-90.00	0.00	-100	0.00	-100
		2	100 ± 17.32	40 ± 17.32*	-60.00	10 ± 17.32**	-90.00	0.00	-100	0.00	-100
		3	110 ± 17.32	30 ± 0.00*	-75.00	0.00	-100	0.00	-100	0.00	-100
Sea-qust	*K. pneumonia*	1	110 ± 17.32	80 ± 17.32	-27.27	*60 ± 0.00	- 45.46	0.00	-100	0.00	-100
		2	100 ± 17.32	40 ± 17.32*	-60.00	*30 ± 0.00	-70.00	0.00	-100	0.00	-100
		3	120 ± 0.00	30 ± 0.00*	-75.00	10 ± 17.32*	-91.67	0.00	-100	0.00	-100
	S. aureus	1	100 ± 17.32	60 ± 0.00*	-40.00	30 ± 0.00*	-70.00	0.00	-100	0.00	-100
		2	100 ± 17.32	50 ± 34.64	-50.00	30 ± 0.00*	-70.00	0.00	-100	0.00	-100
		3	110 ± 17.32	30 ± 0.00*	-72.72	50 ± 34.64	-54.54	0.00	-100	0.00	-100

A, Dry weight; *significance at 5%; B, percentage growth; **significance at 1%.

Costus. However, they were fatal to bacterial growth when re-grown on same concentrations of Indian *Costus* or sea-Qust. The *Costus* spp. has many chemical and pharmacological compounds for example: sulfonic acid group, costunolide, dehydrocostus lactone and cynaropicrin, isolated from this plant. These compounds were also tested for antibacterial activity (Yin et al., 2005; Gutiérrez et al., 2008). In the study of Robinson et

Table 3. Effect of various concentrations of water extract hot or cold of Indian *Costus* and sea-qust on dry weight and percentage growth for *K. pneumonia* and *S. aureus* bacteria (mean of replicates ± SE).

Treatment	Pathogenic bacteria	Control	Concentration (%)							
			10		15		20		25	
			A	B	A	B	A	B	A	B
Cold water extract of *Costus* Indian	*K. pneumonia*	90 ± 34.64	75 ± 30.00	-16.67	37.5 ± 15.00*	-58.33	0.00	-100	0.00	-100
	S. aureus	82.5 ± 28.72	45 ± 17.32	-45.45	0.00	-100	0.00	-100	0.00	-100
Hot water extract of *Costus* Indian	*K. pneumonia*	90 ± 34.64	45 ± 17.32	-50.00	37.5 ± 15*	-58.33	0.00	-100	0.00	-100
	S. aureus	82.5 ± 28.72	0.00	-100	0.00	-100	0.00	-100	0.00	-100
Cold water extract of sea-Qust	*K. pneumonia*	90 ± 34.64	60 ± 0.00*	-33.33	67.5 ± 15*	-25.00	37.5 ± 15**	-58.33	0.00	-100
	S. aureus	82.5 ± 28.72	45 ± 17.32	-45.45	37.5 ± 15	-54.54	0.00	-100	0.00	-100
Hot water extract of sea-Qust	*K. pneumonia*	90 ± 34.64	37.5 ± 15.00*	-58.33	15 ± 17.32*	-83.33	0.00	-100	0.00	-100
	S. aureus	82.5 ± 28.72	0.00	-100	0.00	-100	0.00	-100	0.00	-100

A, Dry weight; *significance at 5%; B, percentage growth; **significance at 1%.

al. (2008), they isolated new compounds from the dried roots of costus such as sesquiterpene with the known compounds costunolide, β-cyclocostunolide, dihydro costunolide and dehydro costuslactone and, these compounds exhibited potent cytotoxic activity on cell cancer because the roots are used in the traditional system of medicine for the treatment cancer.

Moreover, Costus *ssp*. are widely used in Indian medicine to treat various diseases and ailments such as respiratory disorders like bronchitis, asthma, inflammatory, ulcer and stomach problems, and different pharmacological experiments in a number of *in vitro* and *vivo* models have convincingly demonstrated the ability of Costus to exhibit anti-inflammatory, anti-ulcer, anticancer and hepatoprotective activities (Pandey et al., 2007; Eliza et al., 2009). On the Other hand, some of the studies reported that the water extracts of *Costus* species are used in treatment of many diseases such as pleurisy (pleura-pneumonia) and dry out the phlegm when they are taken as a drink. They also help in weak liver and stomach (Ibn Qayim, 2008).

In addition, the obtained results (Table 3; Figures 3 and 4) showed that processing extracts of *Costus* species by hot or cold water had effective impact on the bacteria tested at all concen-trations. The hot and cold water extracts of Indian *Costus* had the highest antimicrobial activity against *K. pneumonia* and *S. aureus* at 15, 20 and 25%, while the hot water extract of it was more effective on *S. aureus* for each concentrations used. In processing samples of sea-qust on hot or cold, results showed a high effectiveness on pathogenic bacteria at 15 and 20%. However, the growth for *S. aureus* was affected by all sea-qust concentrations used on hot water, with 100% percentage of inhibition compared by control samples. These results were supported by several studies which recommended the use of plant medicinal extracts for bacterial infections. Twenty-two plant extracts from 15 families in India exhibited activity against both Gram-positive and Gram-negative bacteria (Srinivasan et al., 2001). Ngemenya et al. (2006) also screened forty crude extracts of twenty Cameroonian medicinal plants and found bacteriostatic effect on Gram-negative pathogenic bacteria such as *E. coli, S. aureus* and *P. aeruginosa*.

The present research study was performed with the evaluation of sixty four methanolic and water extracts of thirty Yemeni plants used in traditional medicine for treatment of human cancer cells and also possessing antimicrobial activity against antibiotic susceptible three Gram-positive, three Gram-negative bacteria, one fungal strain and three multi-resistant *Staphylococcus* strains (Mothana et al., 2009). Furthermore, the study of AL-Kattan and AL-Sheikh (2011) confirmed the

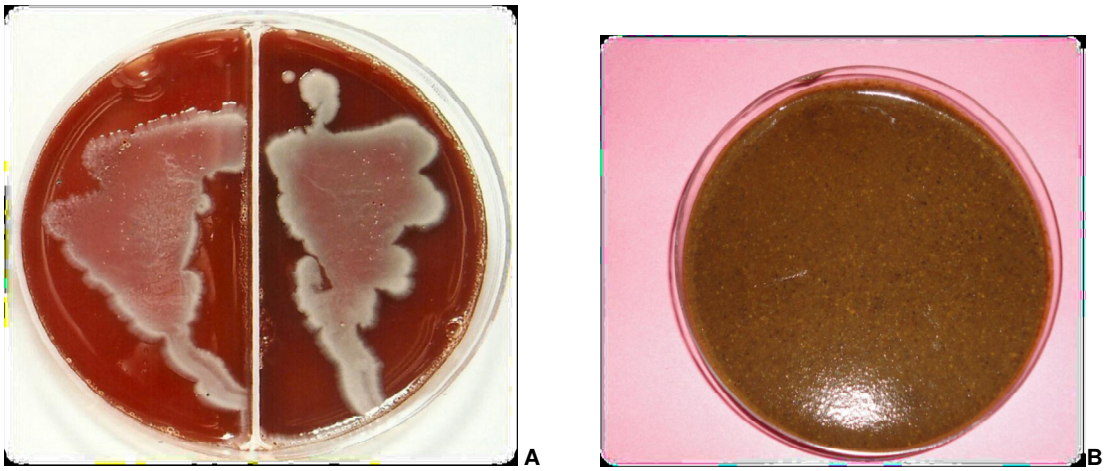

Figure 1. Effect of Indian *Costus* on the growth of *Kelbsilla pneumonia* bacteria. (A): Control culture; (B): *K. pneumonia* culture with 20% of Indian *Costus* powder.

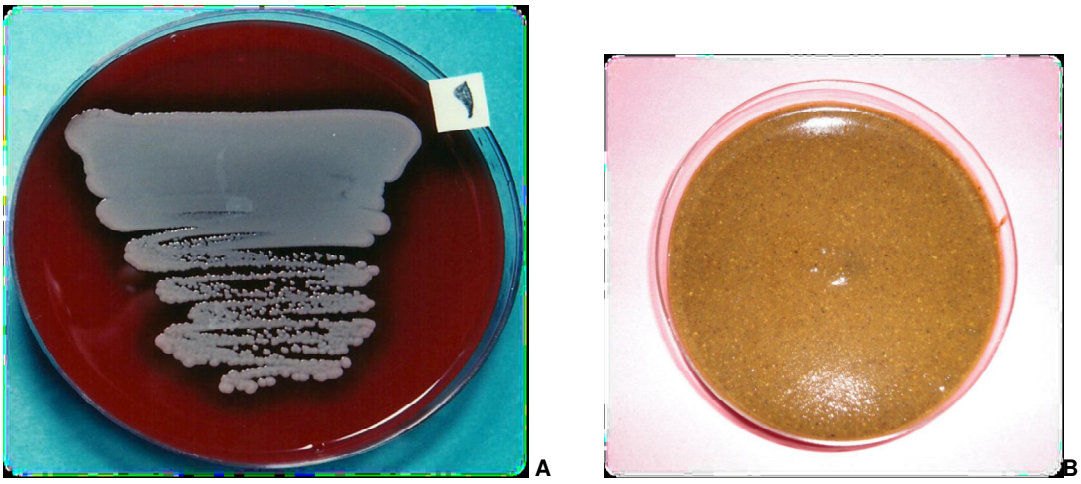

Figure 2. Effect of Sea-Qust on the growth of *Staphylococcus aureus bacteria*. (A): Control culture. (B): *S. aureus* culture with 15% Sea-Qust powder.

Figure 3. Effect (20%) of cold water extract of Indian *Costus* on the growth of *Kelbsilla pneumonia* bacteria.

Figure 4. Effect (15%) of hot water extract of Sea-Qust on the growth of *Staphylococcus aureus* bacteria.

same effectiveness for water extracts of Indian Costus or sea-qust, where their cold or hot extracts exhibited high effectiveness against *Aspergillus niger*, *Aspergillus flavus* and *Candida albicans* tested, especially at concentrations.

The results obtained herein therefore provide evidence as to the importance of using the different types of *Costus* in the treatment for bacterial diseases affecting the respiratory tract in human, whether dried or water extract. The *Costus* is one of the medicinal plants that have been used since ancient times in many different countries for treatment of several diseases that infect human. Particularly, the prophetic medicine has recommended the use of *Costus species* in the treatment of these diseases for thousands of years. At present, it is one of the medical alternatives to reduce the risk for antibiotic resistance.

REFERENCES

Al-Kattan MO (2006). Effect A-wazarin2 preparation from camel's urine on some pathogenic Bactria for digestive system. PhD Thesis pp. 60-68

AL-Kattan MO, AL-Sheikh HM (2011). Effect of water extract of Indian *Costus* or sea-Qust on pathogenic fungi for the respiratory system in human to exhibit the miracle scientific in the Sunah. Ass. Univ. Bull. Environ. Res. 14(1):1-14.

Andersson D (2003). Persistence of antibiotic resistant bacteria. Cur. Opin. Microbiol. 6(5):452-456.

Bomberger JM, Maceachran DP, Koeppen K, Barnaby RL, O'Toole GA, Stanton BA (2011). A *Pseudomonas aeruginosa* toxin that hijacks the host ubiquitin proteolytic system. PLoS, Pathog. 7(3):e1001325.

Craig A (2009). Neutrophil Recruitment to the Lungs during Bacterial Pneumonia. Am. Soc. Microbiol. pp. 10.1128.

Eliza J, Daisy P, Ignacimuthu S, Duraipandiyan V (2009). Antidiabetic and Antilipidemic effect of Eremanthin from Costus speciosus (Koen.)Sm., in STZ Induced diabetic rats. Chem. Biol. Inter. 10(1):67-72.

Ferrara AM (2005). New fluoroquinolones in lower respiratory tract infections and emerging patterns of pneumococcal resistance. Infection 33:106-114.

Gutiérrez RM, Mitchell S, Solis RV (2008). Psidium guajava: a review of its traditional uses, phytochemistry and pharmacology. J. Ethnopharmacol. 117(1):1-27.

Ibn Qayim A (2008). The prophetic medicine. Translation: Khalil, M. Pub. Dar Al-Manarah. Egypt pp. 91-102.

Kala CP, Dhyani PP, Sajwan B (2006). Developing the medicinal plants sector in northern India: challenges and opportunities. J. Ethnobiol. Ethnomed. India 2:32

Madigan M, Martinko J (2005). Brock biology of microorganisms, 11th ed. Prentice Hall. ISBN, 0131443291.

Magassouba FB, Diallo A, Kouyaté M, Mara F, Mara O, Bangoura O, Camara A, Traoré S, Diallo AK, Zaoro M, Lamah K, Diallo S, Camara G, Traoré S, Kéita A, Camara MK, Barry R, Kéita S, Oularé K, Barry MS, Donzo M, Camara K, Toté K, Berghe DV, Totté J, Pieters L, Vlietinck AJ, Baldé AM (2007). Ethnobotanical survey and antibacterial activity of some plants used in Guinean traditional medicine. J. Ethnopharmacol. 114(1):44-53.

Marr AK, Gooderham WJ, Hancock RE (2006). Antibacterial peptides for therapeutic use: obstacles and realistic outlook. Anti-infectives/New Technologies Cur. Opin. Pharmacol. 6(5):468-472.

Mckenna J (2003). Alternatives to antibiotics. Gill and Macmiillan, Dublin. p 97.

Moore T, Perry ML, Getsoian AG, Newstead MW, Standiford TJ (2002). Divergent Role of Gamma Interferon in a Murine Model of Pulmonary versus Systemic *Klebsiella pneumoniae* Infection. Infect Immu. 70(11):6310-6318.

Mothana RA, Gruenert R, Bednarski PJ, Lindequist U (2009). Evaluation of the *in vitro* anticancer, antimicrobial and antioxidant activities of some Yemeni plants used in folk medicine. Pharm. 64(4):260-268.

Ngemenya MN, Mbah JA, Tane P, Titanji PK (2006). Antibacterial effects of some Cameroonian pathogenic bacteria. Complementary Altern. Med. Afr. J. 3(2):84-93.

Nicasio AM, Kuti JL, Nicolau DP (2008). The Current State of Multidrug-Resistant Gram-Negative Bacilli in North America: Insights from the Society of Infectious Diseases Pharmacists. Pharm. 28:235-249

Ody P (1999). The herb society's complete medicinal herbal. Translation. Elvira Academic International. pp. 118- 120.

Pandey MM, Rastogi S, Rawat AK (2007). *Saussurea costus*: Botanical, chemical and pharmacological review of an ayurvedic medicinal plant. Rana Pratap Marg. Lucknow J. Ethnopharmacol. 110:379-390.

Robinson A, Kumar TV, Sreedhar E, Naidu VG, Krishna SR, Babu KS, Srinivas PV, Rao JM (2008). A new sesquiterpene lactone from the roots of *Saussurea lappa*: structure-anticancer activity study. Bioorg. Med. Chem. Lett. (14):4015-4017.

Shaw MJ (2005). Ventilator-associated pneumonia. Curr. Opin. Pulm. Med. 11:236-241.

Sheikh HM (2006). Evaluation of different methods to control fusarium root-rot in Cucumber (*Cucumis sativus L.*). PhD Thesis pp. 66-67.

Shihabi A (1998). Human pathogenic microorganisms. Jordan Book Centre pp. 55-59.

Slama TG (2008). Gram-negative antibiotic resistance: there is a price to pay. Indiana Univ. Sch. Med. 12(4):S4.

Srinivasan D, Nathan S, Suresh T, Lakshmana PP (2001). Antimicrobial activity of certain Indian medicinal plants used in folkloric medicine. J. Ethnopharmacol. 74(3):217-220.

UAB Insight (2008). Antibiotic Resistance: Emerging Problem, Corrective Approaches.

Viel AT, Domingos DC, Monteiro AP, Lima-Landman RM, Lapa AJ (1999). Evaluation of the antiurolithiatic activity of the extract of *Costus spiralis* Roscoe in rats. J. Ethnopharmacol. 66(2):193-198.

Yin HQ, Fu HW, Hua HM, Qi XL, Li W, Sha Y, Pei YH (2005). Two new sesquiterpene lactones with the sulfonic acid group from *Saussurea lappa*. Chem. Pharm. Bull. 53(7):841-842.