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Antimicrobial activity of clove oil against microbes isolated from water

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We studied the antimicrobial activity of clove oil against drug-resistant bacteria in water collected from nearby regions. The bacteria were identified and assessed of antimicrobial resistance by using BD Pheonix 100 automated microbiology system. *Klebsiella pneumoniae, Enterobacter cloacae, Klebsiella oxytoca, Acinetobacter lwoffii/haemolyticus, Escherichia coli, Arcanobacterium haemolyticum, Bacillus cereus, Pediococcus pentosaceus, Gardnerella vaginalis, Macrococcus caseolyticus, Dermacoccus nishinomiyaensis, Staphylococcus cohnii, Staphylococcus gallinarum, Bacillus megaterium, Streptococcus anginosus* and *Streptococcus porcinus* were isolated. Almost all the Gram-negative isolates were resistant to cefazolin, cephalexin, cefoxitin, cefotaxime, ampicillin, amoxicillin-clavulanate, trimethoprim-sulfamethoxazole, nalidixic acid and tetracyclin and nitrofurantoin. On the other hand, the Gram-positive isolates showed tolerance to cefoxitin, ampicillin, penicillin G, oxacillin, amoxicillin-clavulanate, teicoplanin, quinupristin-dalfopristin, vancomycin, clindamycin, erythromycin, ciprofloxacin, rifampin and tetracyclin. The Gram-negative bacteria showed highest resistant to ampicillin (76%), cefazolin (64%), cephalexin (52%) and nalidixic acid (40%), respectively. Similarly, up to 80% Gram-positive isolates were resistant to clindamycin and 60% to cefoxitin, ampicillin, penicillin G and erythromycin. The antibacterial activity of clove oil was tested in 5% aqueous DMSO and worked well in the order 1:1>1:5>1:10>1:20. The multiple drug-resistant *Enterobacter* cloacae isolate was relatively more sensitive (inhibition zone diameter (IZD): 19 mm) to clove oil than *Escherichia coli* (IZD 18 mm). For *Staphylococcus sciuri, Klebsiella pneumonia* and *Staphylococcus gallinarum* the IZDs were 14.5 mm, 13.5 mm and 11 mm, respectively. Clove oil appeared to have some significant antimicrobial activity which can be used for therapeutic purposes.

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Important challenges in water quality and the need for new approaches

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Water constitutes the most abundant compound on the surface of our planet, but only 1% of this resource is available as freshwater and is recognized as a scare resource in many parts of the world. Also, protection of this important resource has become a major global challenge especially amongst developing countries including South Africa. Challenges in this regards include for example, emerging and re-emerging microbial and chemical pollutants in water; their survival strategies in conventional treatment processes; evidences suggesting increasing incidences of resistance to regular disinfection regimes; hazardous chemicals used in water treatment and need for eco-friendly alternatives and the need for review of existing water quality guidelines to capture emerging trends such as waste water effluents as reservoirs of antibiotic resistance determinants becomes imperative and will be discussed in this paper.

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