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FILE: ▪Sexual Transmitted Disease
▪Antimicrobial Activity
▪African Plants

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RE: Antimicrobial Activity and Toxicity of South African Plant Compounds in Sexually Transmitted Diseases

Tshikalange TE, Meyer JJM, Hussein AA. Antimicrobial activity, toxicity and the isolation of a bioactive compound from plants used to treat sexually transmitted diseases. *J Ethnopharmcol.* 2005;96:515–519.

In developed countries, sexually transmitted diseases (STDs) are generally treated with antibiotics; however, due to the rise of resistant strains of bacteria, especially in hospital-acquired infections, the search for novel antimicrobial agents continues. In societies where traditional medicine predominates, STDs are treated with herbal medicine. In this study, researchers analyzed the antimicrobial activity and toxicity of six South African plants used traditionally to treat STDs.

Roots and pods of the following plants were studied: Madeira vine (*Anredera cordifolia*), *Elaeodendron transvaalense*, *Elephantorrhiza burkei*, *Rauvolfia caffra, Senna petersiana*, and assegai wood (*Terminalia sericea*). Chloroform and aqueous extracts were prepared from all plants except *S. petersiana*, then tested in vitro against four gram positive bacteria (*Bacillus cereus*, *Bacillus pumilus*, *Bacillus subtilis,* and *Staphylococcus aureus*) and six gram negative bacteria (*Enterobacter cloacae, Escherichia coli, Klebsiella pneumoniae, Pseudomonas aeruginosa, Serratia marcescens,* and *Enterobacter aerogenes*). An ethanol extract of *S. petersiana* seed pod was made and tested against these same bacteria.

Most of the bacteria tested cause gastrointestinal (GI) illnesses. Those that primarily infect the GI tract are *B. cereus*, *B. pumilus*, *B subtilis, E. cloaca,* and *E. coli*. *S. aureus* is a common cause of in-hospital infections, called nosocomial infections. *S. aureus* infects the GI tract; the skin, causing folliculitis and boils; and wounds. *S. aureus* is the cause of toxic shock syndrome, and also infects the lungs (pneumonia), heart (endocarditis), bone (osteomyelitis), and joints (septic arthritis). *S. marcescens* also causes nocosomial infections. It infects the urinary and respiratory tract, the heart, bones, wounds, eyes, and central nervous system causing meningitis. *E. aerogenes* causes nosocomial infections, most frequently of

the urinary tract. *K. pneumoniae*, as the name implies, causes pneumonia, but can also infect the urinary tract, wounds, the blood, the GI tract, and the central nervous system, causing meningitis. *P. aeruginosa* accounts for 10% of in-hospital infections; "is the fourth most common cause of bacterial infections of the blood"[1]; and also infects bone, joints, the central nervous system, eye and ear ("swimmer's ear"), urinary tract, lungs (pneumonia), skin, and soft tissue.

A subset of the plants was also tested for toxicity and antiviral activity. Toxicity was determined for Madeira vine, *S. pertersiana,* and assegai wood using experimental vervet monkey kidney (VK) cells ex vivo. By exposing the cells to the extracts, incubating them for 7 days at 30 ^{o}C, then analyzing the cells microscopically, the "dose that inhibits 50% of cell growth after the incubating period (LD_{50})" was determined. An ethanol seed extract of *S. petersiana* was analyzed for its antiviral activity and compared to luteolin, a flavonoid with anti-inflammatory activity. Luteolin is found in many plants, including horsetail (*Equisetum avense*) and rosemary (*Rosmarinus officinalis*), and was isolated for this experiment from the seeds of *S. petersiana*.

Luteolin and the water extract of assegai wood showed the strongest antibacterial activity against gram positive bacteria. MIC of *B. pumilus* was achieved at 1.0 mg/ml of assegai wood water extract and luteolin. At 1.0 mg/ml, luteolin also inhibited *Bacillus cereus* and *Staphylococcus aureus*. An ethanol extract of *S. petersiana* inhibited all gram positive bacteria at a concentration of 20.0 mg/ml. Also at 20 mg/ml, water extracts of assegai wood inhibited both *S. aureus, B. subtilis* and *B. cereus*, while the *E. transvaalense* extract only inhibited *S. aureus* and *B. subtilis*. At 50 mg/ml, Madeira vine water extract inhibited *B. pumilus*, and the water extract of *E. transvaalense* inhibited *B. pumilus* and *B. cereus*. Madeira vine (water and chloroform extracts) exhibits MIC against *B. subtilis* and *S. aureus* at 60 mg/ml. At 60 mg/ml, the water extract of *E. burkei* inhibited *B. pumilus, B. subtilis,* and *S. aureus*. Water and chloroform extracts of *R. caffra* did not exhibit MIC against any gram positive bacteria at any concentration.

S. persiana (20 mg/ml) demonstrated MIC against the gram negative bacteria *E. cloacae* and *S. marcescens*. Water and chloroform extract of *R. caffra* achieved MIC against *E. cloacae* at 50 mg/ml. At 60 mg/ml, water and chloroform extracts of Madeira vine achieved MIC against all gram negative bacteria. None of the concentrations of luteolin tested exhibited MIC against the gram negative bacteria. MIC of gram positive and negative bacteria was not reached at any concentration for ethanol extracts of assegai wood, *E. transvaalense*, and *E. burkei.*

At 24 mcg/ml, *S. petersiana* and assegai wood extracts demonstrated "significant toxicity" against VK cells. Luteolin did not show any toxicity at concentrations ≤ 250 mcg/ml, while Madeira vine did not reach ID_{50} until 1560 mcg/ml. At 250 mcg/ml, luteolin reduced viral infection by 50%, and by 30% at 125 mcg/ml. *S. petersiana* reduced viral infection of the experimental cells by 30% at 31 mcg/ml and 65% at 125 mcg/ml.

As is the case with pharmacological antibiotic therapy, gram positive bacteria appeared easier to inhibit than gram negative bacteria. Ethanol extract of *S. persiana* was the most

effective plant against gram positive bacteria; however, the MIC of 20 mg/ml was greater than the LD_{50} dose of 24 mcg/ml. Its use as an extract may therefore be too toxic. In many traditional medicinal systems, single herbs are often not commonly prescribed. Rather, combinations of whole herbs or extracts are used to "balance" the formula and deliver therapeutic actions through different mechanisms. It's possible that the antimicrobial potential of these plants could be delivered with greater efficacy and safety if combined in smaller doses with other herbs. This requires additional research, but observing the combinations of herbs used by traditional healers and then studying those herbs would be a good starting point.

—John Neustadt, ND

References

[1]*Pseudomonas infections. Dr. Joseph F. Smith Medical Library [internet]. Available at: http://www.chclibrary.org/micromed/00062430.html. Accessed February 2, 2005.*

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