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Antibacterial effects of *Alchornea cordifolia* (Schumach. and Thonn.) Müll. Arg extracts and compounds on gastrointestinal, skin, respiratory and urinary tract pathogens

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ABSTRACT

Ethnopharmacological relevance: The leaves, stems and roots of *Alchornea cordifolia* (Schumach. and Thonn.) Müll. Arg. are used as traditional medicine in many African countries for the management of gastrointestinal, respiratory and urinary tract infections as well as for the treatment of wounds.

Aim of the study: To determine the in vitro antibacterial activity of the crude extracts of leaves and stems of *A. cordifolia* on gastrointestinal, skin, respiratory and urinary tract pathogens and to identify the compounds in the extracts that may be responsible for this activity.

Materials and methods: The antibacterial activities of crude extracts [hexane, chloroform (CHCl₃), ethyl acetate (EtOAc), ethanol (EtOH), methanol (MeOH) and water (H₂O)] as well as pure compounds isolated from these extracts were evaluated by means of the micro-dilution assay against four Gram-positive bacteria, i.e. *Bacillus cereus* ATCC 11778, *Enterococcus faecalis* ATCC 29212, *Staphylococcus aureus* ATCC 25923 and *S. saprophyticus* ATCC 15305, as well as four Gram-negative bacterial strains, i.e. *Escherichia coli* ATCC 25922, *Klebsiella pneumoniae* ATCC 13883, *Moraxella catarrhalis* ATCC 23246 and *Proteus mirabilis* ATCC 43071. The isolation of the active constituents was undertaken by bio-autographic assays in conjunction with chromatographic techniques. The identification and characterisation of the isolated compounds were done using mass spectrometry (MS) and Fourier transformed infrared spectrometry (FTIR) as well as 1D- and 2D- nuclear magnetic resonance (NMR) analyses.

Results: The leaves and stems of *A. cordifolia* exhibited varied antibacterial activity against all eight pathogens. Most of the MIC values ranged between 63 and 2000 µg/ml. The highest activities for the crude extracts (63 µg/ml) were observed against *S. saprophyticus* [stem (EtOAc, CHCl₃ and hexane), leaves (MeOH, EtOH, EtOAc and CHCl₃)], *E. coli* [stem (MeOH and EtOH), leaves (MeOH, EtOH, EtOAc and CHCl₃)], *M. catarrhalis* [leaves (EtOAc and CHCl₃)], *K. pneumoniae* [stem (CHCl₃), leaves (CHCl₃)] and *S. aureus* [leaves (CHCl₃)]. Seven constituents [stigmasterol (1), stigmasta-4,22-dien-3-one (2), friedelin (3), friedelane-3-one-28-al (4), 3-O-acetyl-aleuritic acid (5), 3-O-acetyl-erythrodiol (6) and methyl-3,4,5-trihydroxybenzoate (methyl gallate) (7)] were isolated from the stem MeOH extract. All these compounds displayed some antibacterial activity against the eight pathogens with highest activity against *S. saprophyticus* (2 µg/ml). Furthermore, this is the first report of compounds 1, 2, 3, 4, 6 and 7 isolated from *A. cordifolia* and where a complete set of 2D-NMR data for friedelane-3-one-28-al (4) is presented.

Conclusion: The study demonstrated that the antibacterial activities of *A. cordifolia* extracts may be due to the presence of the seven isolated compounds, where compounds 3–6 showed the best activity. The observed activity against gastrointestinal, skin, respiratory and urinary tract pathogens supports the traditional use for the treatment of such ailments.

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Abbreviations: ATCC, American type culture collection; CC, column chromatography; CFU, colony forming units; CHCl₃, chloroform; COSY, correlation spectroscopy; DCM, dichloromethane; DEPT, distortionless enhancement by polarisation transfer; DMSO, dimethyl sulfoxide; EtOH, ethanol; EtOAc, ethyl acetate; FTIR, Fourier transform infrared spectroscopy; H₂O, water; HMBC, heteronuclear multiple bond correlation; HNC, Herbarium National du Cameroun (i.e. National Herbarium of Cameroon); HSQC, heteronuclear single quantum correlation; INT, iodinitrotetrazolium chloride; MeOH, methanol; MIC, minimum inhibitory concentration; MS, mass spectrometry; 1D- and 2D-NMR, one dimension and two dimensions nuclear magnetic resonance; PE, petroleum ether; TLC, thin layer chromatography; VCC, vacuum column chromatography; w/v, weight by volume

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