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## In vitro antimycobacterial activity and toxicity of eight medicinal plants against pathogenic and nonpathogenic mycobacterial strains

Joseph M. Nguta<sup>a,b,\*</sup>, Regina Appiah-Opong<sup>a</sup>, Alexander K. Nyarko<sup>a</sup>,  
Dorothy Yeboah-Manu<sup>c</sup>, Phyllis G.A. Addo<sup>d</sup>, Isaac Darko Otchere<sup>c</sup>, Abena Kissi-Twum<sup>a</sup>

<sup>a</sup>Department of Clinical Pathology, Noguchi Memorial Institute for Medical Research, University of Ghana, Accra, Ghana

<sup>b</sup>Department of Public Health, Pharmacology and Toxicology, Faculty of Veterinary Medicine, University of Nairobi, Nairobi, Kenya

<sup>c</sup>Department of Bacteriology, Noguchi Memorial Institute for Medical Research, University of Ghana, Accra, Ghana

<sup>d</sup>Department of Animal Experimentation, Noguchi Memorial Institute for Medical Research, University of Ghana, Accra, Ghana

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### ABSTRACT

Tuberculosis (TB) caused by *Mycobacterium tuberculosis* remains a serious public health challenge towards which new hits are urgently needed. Medicinal plants remains a major source of new ligands against global infectious illnesses. In our laboratories, we are currently investigating locally used ethnobotanicals for novel compounds against zoonotic tuberculosis. The microplate alamar blue assay (MABA) was used to study the anti-TB activity while the CellTiter 96® AQueous Assay, which is composed of solutions of a novel tetrazolium compound [3-(4,5-dimethylthiazol-2-yl)-5-(3-carboxymethoxyphenyl)-2-(4-sulfophenyl)-2H-tetrazolium, inner salt; MTS] and an electron coupling reagent (phenazine methosulfate) PMS, was used for cytotoxic studies. Correlation coefficients ( $R^2$ ) were used to compare the relationship between antimycobacterial activity of the eight crude extracts against non-pathogenic strains and the pathogenic *Mycobacterium bovis*. Minimum inhibitory concentration (MICs) values indicated that all the eight tested medicinal plant species had activity against all the three tested mycobacterial strains. Minimum inhibitory concentration value as low as 19.5 µg/mL was observed against non-pathogenic strains *M. bovis*. Activity of the crude extracts against *M. aurum* was the best predictor of natural product activity against the pathogenic *Mycobacterium bovis* strain, with a correlation coefficient value ( $R^2$ ) of 0.1371. Results obtained from the current study validate, in part, the traditional utilization of the tested medicinal plants against tuberculosis. The unripe fruits from *Solanum torvum* are a potential source of safe and efficacious anti-TB crude drugs as well as a source for natural compounds that act as new anti-infection agents, and thus deserve further investigation towards development of a new class of molecules with activity against sensitive and drug resistant strains of *M. bovis*.

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\* Corresponding author at: Department of Clinical Pathology, Noguchi Memorial Institute for Medical Research, University of Ghana, Box 29053-00625, Nairobi, Kenya/LG 581 Legon, Accra, Ghana.

E-mail addresses: [joseph.nguta@uonbi.ac.ke](mailto:joseph.nguta@uonbi.ac.ke), [jmnguta@gmail.com](mailto:jmnguta@gmail.com) (J.M. Nguta).

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## Introduction

Tuberculosis (TB) caused by the *Mycobacterium tuberculosis* complex represents a never-ending challenge towards which drug discovery efforts are needed [1–3]. Several medicinal plants are used traditionally in Ghanaian ethnomedicine to treat TB [4]. In our ongoing research efforts aimed at drug discovery against TB, we designed the current study to evaluate the *in vitro* antimycobacterial activity and toxicity of eight medicinal plants against pathogenic and nonpathogenic mycobacterial strains. The study was further extended to investigate the nonpathogenic mycobacterial strain which best predicts natural product activity against the pathogenic *Mycobacterium bovis*.

## Material and methods

The microplate alamar blue assay was used to study the anti-TB activity while the CellTiter 96 AQueous Assay, which is composed of solutions of a novel tetrazolium compound (3-[4,5-dimethylthiazol-2-yl]-5-[3-carboxymethoxyphenyl]-2-[4-sulfophenyl]-2H-tetrazolium, inner salt; MTS) and an electron coupling reagent (phenazine methosulfate) (Promega Corporation, 2800 Woods Hollow Road Madison, WI 53711 USA) was used for cytotoxic studies. Correlation coefficients ( $R^2$ ) were used to compare the relationship between antimycobacterial activity of the eight crude extracts against nonpathogenic strains and the pathogenic *M. bovis*.

## Results

Minimum inhibitory concentration values indicated that all the eight tested medicinal plant species had activity against all the three tested mycobacterial strains. Minimum inhibitory concentration values of 19.5  $\mu\text{g/mL}$ , 156.3  $\mu\text{g/mL}$ , and 312.5  $\mu\text{g/mL}$  were observed against nonpathogenic strains *M. bovis* Bacillus Calmette–Guérin (American Type Culture Collection [ATCC] 3574) *Mycobacterium aurum* (ATCC 23366), and the pathogenic strain *M. bovis* (ATCC 35720), respectively, from the unripe fruits of *Solanum torvum* Sw. (Solanaceae).

Cytotoxicity of the crude extracts towards human fetal lung fibroblast cell lines (ATCC CCL-171) varied, and the unripe fruits from *S. torvum* exhibited the most promising selectivity index. Activity of the crude extracts against *M. aurum* was the best predictor of natural product activity against the pathogenic *M. bovis* strain, with a correlation coefficient value ( $R^2$ ) of 0.1371.

## Conclusion

The results obtained from the current study validates, in part, the traditional utilization of the tested medicinal plants against TB. *S. torvum* unripe fruits have selective efficacy against the studied mycobacteria, including *M. bovis*. The unripe fruits from *S. torvum* are a potential source of safe and efficacious anti-TB crude drugs as well as a source for natural compounds that act as new anti-infection agents, and thus deserve further investigation towards the development of a new class of molecules with activity against sensitive and drug-resistant strains of *M. bovis*.

## Conflicts of interest

The authors declare no conflict of interest.

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