

TITLE: ANTIMICROBIAL AND ANTIBIOFILM ACTIVITY OF *Plantago major* EXTRACT AGAINST METHICILIN-RESISTANT *Staphylococcus aureus* (MRSA), *Pseudomonas aeruginosa* AND CARBAPENEMASE-PRODUCING *Klebsiella pneumoniae*

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ABSTRACT:

Microbial resistance to available drugs has become a serious public health problem and the development of new antimicrobials is necessary. In natural products, including medicinal plants, molecules that can be used for the development of this class of drugs have been sought. *Plantago major*, popularly known as plantain, is a plant used to treat diseases, cancer, diarrhea, as an anti-inflammatory, healing and antioxidant. Therefore, the objective of this study was to evaluate the activity of the methanol extract of *Plantago major* leaves against methicillin-resistant *Staphylococcus aureus* (MRSA), *Pseudomonas aeruginosa* and carbapenemase-producing *Klebsiella pneumoniae* strains. To determine the MIC, the resazurin microtiter assay (REMA) methodology was used. The options tested range from 1.25 mg/mL to 50 mg/mL. The contents of the wells were plated on brain-heart infusion agar plates for determination of CBM. The synergistic effect was analyzed by combining the extract and commonly used antibiotics, tetracycline, polymyxin B, cephalothin, oxacillin and imipenem. The results were read in a spectrophotometer at 600 nm. To determine the antibiofilm activity, the bacteria were inoculated in tryptic soy broth (TSB) with 1% glucose with different extract recommendations. The adhered biofilm was fixed with methanol and stained with crystal violet. The dye was solubilized with 33% acetic acid and the results were read in a spectrophotometer at 570 nm. The MIC for MRSA was 35 mg/mL for ATCC 33591, and 2.5 mg/mL for isolated. For *Pseudomonas aeruginosa* ATCC 27853 the MIC was 35 mg/mL and for isolated, 45 mg/mL. In the tested configurations, the extract did not present presentation against carbapenemase-producing *Klebsiella pneumoniae*. However, there was a synergistic bactericidal effect between the extract and imipenem. Biofilm reduction was up to 90% in MRSA ATCC and up to 54% in isolated MRSA. For *P. aeruginosa* ATCC, there was no reduction. However, for isolated *P. aeruginosa*, there was a reduction of 13.7%. For KPC, a reduction was up to 80%. The results show that the extract of *Plantago major* has action against MRSA, which is a Gram-positive bacteria, *Pseudomonas aeruginosa* and KPC, which are Gram-negative, and can be used to treat infections caused by these bacteria.

Keywords: Bacterial resistance, KPC, MRSA, *P. aeruginosa*

Development Agency: Fundação de Amparo à Pesquisa do Estado de São Paulo, processo N° 2020/04211-0