

FIELD OF STUDY

Chemical Engineering

DISSERTATION TOPIC

Comestible Herbs in Wound Management: Effects of *Allium sativum*, *Asparagus officinalis*, and *Pinus strobus* Extracts on *Staphylococcus epidermidis*

EXAMINING COMMITTEE

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ABSTRACT

Effective wound management is one of the key ways to minimize complications and infections in wounds. Generally, repairing any damaged tissue involves a series of complex, imbricating physiological processes that can be disrupted by many local and systemic factors, such as infection. The rise in antimicrobial resistance, in addition to recent reports of nosocomial infections and the impacts of synthetic antibiotics on aquatic environments, present additional challenges to wound management. In this study, crude aqueous and ethanolic extracts from garlic (*Allium sativum*) cloves, garden asparagus (*Asparagus officinalis*) stems, and white pine (*Pinus strobus*) needles were prepared and evaluated for potential antibacterial properties against *Staphylococcus epidermidis*. Additionally, freeze-distilled samples of garlic solution prepared by freeze-distillation of ethanolic garlic extract were tested. Preliminary results from disk diffusion tests showed no evidence of *S. epidermidis* inhibition by either aqueous extract or ethanolic extract from *A. officinalis* and *P. strobus*. However, aqueous garlic extract, ethanolic garlic extract, and freeze-distilled garlic extract showed significant inhibition of *S. epidermidis* growth. Additional experiments were completed for aqueous garlic extract and freeze-distilled garlic extract to determine their minimum inhibitory concentrations (MIC) using the macro-broth dilution method. Results showed that aqueous garlic extract and freeze-distilled garlic extract have MIC values of 8 mg/ml and 16 mg/ml, respectively. Data obtained from tests to determine the extent of inhibition were statistically analyzed and compared to control (vancomycin) at 1xMIC and 4xMIC using the non-parametric Kruskal-Wallis test ($p < 0.05$). Results showed no statistically significant difference between vancomycin and aqueous garlic extract at both 1xMIC and 4xMIC. Results also showed no statistically significant difference in inhibition between freeze-distilled garlic extract at 4xMIC and vancomycin; however, a statistically significant difference was found at 1xMIC, with vancomycin having a better inhibitory effect than freeze-distilled garlic extract. Despite these high MIC values, results from this study present a potential opportunity to explore garlic extract for antiseptic applications to help address the burden of antibiotic resistance and the rising cost of wound management.

BIOGRAPHICAL SKETCH

Chima Chukwuemeka was born in Imo, Nigeria. He received his Bachelor of Science degree in Food Science and Technology from Imo State University, Nigeria in 2008 and his Master of Science in Chemical Engineering from Tennessee Technological University, Cookeville in 2014. In his graduate level research, he studied the role of fibrinolysis in preventing wound healing abnormalities. In August 2014, he continued in the Chemical Engineering graduate program for his Doctor of Philosophy degree where he studied comestible herbs for antimicrobial applications in wound management. Chukwuemeka has received numerous scholarships and awards, including Graduate Assistantships from Tennessee Technological University and the National Society of Black Engineers (NSBE) Golden Torch Awards Graduate Student of the Year 2017/2018.

EDUCATION

Ph.D., Engineering
Tennessee Technological University, Cookeville. 2014-2018

M.S., Chemical Engineering
Tennessee Technological University, Cookeville. 2012-2014

B.S., Food Science and Technology
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College of Engineering

TENNESSEE TECH

The Department of
Chemical Engineering
Announces the Dissertation Defense

of

Chima P. Chukwuemeka

In Partial Fulfillment of the Requirements

For the degree of

Doctor of Philosophy

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1020 Stadium Drive, Cookeville, TN 38505