GREEN SYNTHESIS OF SILVER NANOPARTICLES USING *Nymphaea nouchali* (Burm.) LEAF EXTRACT: ANTIMICROBIAL AND ANTIDIABETIC EVALUATION

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AUGUST, 2024

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A DISSERTATION SUBMITTED TO THE SCHOOL OF POSTGRADUATE STUDIES IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTERS OF SCIENCE (M.Sc) DEGREE IN INDUSTRIAL CHEMISTRY IN THE DEPARTMENT OF CHEMISTRY, COLLEGE OF SCIENCE AND TECHNOLOGY, COVENANT UNIVERSITY, OTA OGUN STATE, NIGERIA

AUGUST 2024

DECLARATION

I, AKOMOLAFE, OLUWATOBI AYOBAMI declare that this M.Sc. dissertation is based on my study in the Department of Chemistry, College of Science and Technology Covenant University, Ota, Ogun State. This project has not been submitted elsewhere for the award of a degree. All ideas and views expressed are products of personal research, and all sources of data and scholarly information used in this dissertation are duly acknowledged.

AKOMOLAFE, OLUWATOBI AYOBAMI

Signature and Date

ACCEPTANCE

This is to attest that this dissertation is accepted in partial fulfilment of the requirements for the award of the degree of Master of Science (M.Sc.) in Industrial Chemistry in the Department of Chemistry, College of Science and Technology Covenant University, Ota, Ogun State, Nigeria.

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CERTIFICATION

We certify that the Dissertation titled **"GREEN SYNTHESIS OF SILVER NANOPARTICLES USING *Nymphaea nouchali* (Burm) LEAF EXTRACT: ANTIMICROBIAL AND ANTIDIABETIC EVALUATION"** is original research carried out by **AKOMOLAFE, OLUWATOBI AYOBAMI (22PCC02439),** in the Department of Chemistry, College of Science and Technology, Covenant University, Ota, Ogun State, Nigeria, under the supervision of Dr. Akinsiku A. A. We have examined and found the work acceptable as part of the requirements for the award of Masters of Science (M.Sc) in Industrial Chemistry.

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DEDICATION

This work is dedicated to the pursuit of knowledge and the advancement of science, with the hope that it contributes to our understanding and brings positive change to the field.

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ABBREVIATION

AgNPs	Silver Nanoparticles
NLE	*Nymphaea nouchali* leaves in Ethylacetate
NLM	*Nymphaea nouchali* leaves in Methanol
NLH	*Nymphaea nouchali* leaves in Hexane
T2DM S	Type 2 Diabetes Mellitus
ROS	Reactive Oxygen Species
FTIR	Fourier Transform Infrared Spectroscopy
DLS	Dynamic Light Scattering
XPS	X-ray Photoelectron Spectroscopy
XRD	X-ray Diffraction Spectroscopy
SEM	Scanning Electron Microscopy
EDX	X-ray Spectroscopy
T1DM	Type 1 Diabetes Mellitus
GC-MS	Gas Chromatography-Mass Spectroscopy
DYg	Daylight Green
UVb	Ultra-violet Blue
UVo	Ultra-violet orange
UVr	Ultra-violet red
DYy	Daylight Yellow

ABSTRACT

The field of nanotechnology is gaining interest in science today; hence, there is a need to take this advantage in combating drug resistance by disease-causing microorganisms and finding alternative routes for antidiabetic treatment in humans. Moreover, the safety of the environment and humans has been an issue of concern as the method of producing nanoparticles poses a toxicity challenge. Thus, the green synthesis that engages sustainable biodiversity is considered a substitute, as the method produces less toxic nanoparticles especially for biomedical applications compared with the orthodox syntheses. This study evaluated the antimicrobial and antidiabetic potential of *Nymphaea nouchali* extract and its corresponding silver nanoparticles (AgNPs). Successive extraction was carried out on the plant via cold extraction method on a polarity scale using n-hexane, followed by ethyl acetate, and methanol yielding NLH, NLE, and NLM, respectively. Qualitative analysis was conducted to detect secondary metabolites in the leaf extract. In green chemistry, a hot maceration method was employed to prepare an aqueous extract of Nymphaea nouchali leaf, which was then used as a reducing agent in the synthesis of AgNPs. The UV-visible double spectrophotometer was used to monitor the reaction. FTIR, SEM-EDAX, XRD, XRF, and GC-MS techniques were used to analyze the nanoparticles that were prepared. Furthermore, the following test microorganisms were used for the antimicrobial assay: gram-negative bacteria- *Escherichia coli, Pseudomonas aeruginosa, Salmonella sp.*; gram-positive bacterium *Staphlococcus aureus;* Fungi-*Candida albicans,* and *Aspergillus niger*. An *in-vitro* assay targeting α-amylase activity was used for the antidiabetic evaluation. Noticeable colour change informed the nanoparticle formation, which was preliminarily confirmed with an appearance of surface plasmon resonance (SPR) around 450 nm using UV-visible spectrophotometer. The following peaks and functional groups were identified with FTIR, 3398 cm^{-1} (O-H), 2925 cm^{-1} and 2855 (C-H), 1703 cm^{-1} (C=O), and 1043 cm^{-1} (C-O). From the sensitivity testing, *Nymphaea nouchali* displayed the highest inhibition, even more than the control, against all the test organisms except *Candida albicans*. AgNPs inhibited the growth of *E. coli*, *Salmonella sp*., *S. aureus,* and *A. niger*. In the antidiabetic assay, *N. nouchali* and AgNPs inhibited α-amylase at IC_{50} value 204.48 mg/mL and 408.67 mg/mL, respectively. Hence, from this study, both *N. nouchali* extract and AgNPs are potential antibacterial, antifungal, and antidiabetic drug candidates.

Keywords: Silver nanoparticles, N. nouchali, green chemistry, antimicrobial, antidiabetic, α-amylase