FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF POLYMER, TEXTILE AND INDUSTRIAL ENGINEERING

FINAL YEAR PROJECT

GREEN SYNTHESIS OF SILVER NANOPARTICLES USING CAMELLIA SINENSIS AQUEOUS LEAF EXTRACT FOR DYE WASTEWATER TREATMENT

BY

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A final year project submitted to the department of Polymer Textile and Industrial Engineering as a partial fulfillment of the requirement for the award of bachelor's degree in Polymer Textile and Industrial engineering of Busitema University.

ABSTRACT

Nanotechnology provides an environmentally friendly green technique for synthesizing silver nanoparticles using various parts of the plants. In this research, aqueous leaf extract of the *Camellia Sinensis* plant was used. The optimum concentration of silver nitrate solution used as a reducing agent was 1mM, the optimum reaction temperature used for the synthesis of silver nanoparticles was 100ºC and the optimum volume of leaf extract used was 5mls. Change of color was observed within 5 minutes of the reaction which was confirmation of presence of silver nanoparticles. Characterization of the silver nanoparticles was done using the UV-VIS spectrophotometer and FTIR. The synthesized silver nanoparticles gave a maximum peak wavelength ranging from 380-450nm which was a confirmation of their presence. 10mls of silver nanoparticles was used to decolorize 100mls of dye wastewater at a temperature of 30ºC for an incubation time of 30 minutes.

ACKNOWLEDGEMENT

We greatly thank the almighty God so much for having given us life, strength and determination for fully participate in the final year project proposal and successfully writing this project proposal report.

Secondly, we thank the Project supervisor DR. NIBIKORA IIDEPHONSE, MR. DAN TIGALANA and MR. TUMUSIIME GODIAS who dedicated their time to impart different research ideas and engineering skills to us and at the end of it all present this report. We also greatly appreciate DR. KIGOZI, DR. ANDIMA MOSES and MISS. MARY AMADO from Busitema university Nagongera campus for their efforts, knowledge and guidance during our research period.

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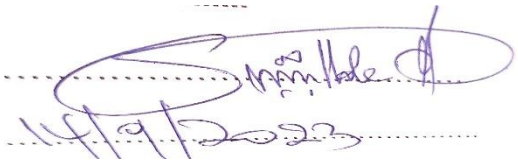
APPROVAL

The following supervisors haave confidently approved this report submitted to the department of Polymer Textile and Industrial Engineering.

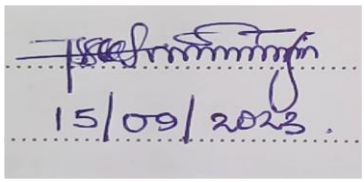
DR. IIDEPHOSE NIBIKORA

Signature

Date 

MR. DAN TIGALANA

Signature

Date 

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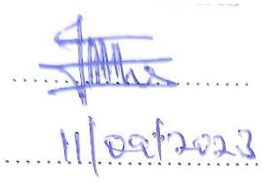
Date 

DECLARATION

We BAKUNDA FRANCIS AND AMATI ALLEN hereby declare that this final year project report was written by us and it has not been utilized for academic award by any individual in any learning institution

NAME: BAKUNDA FRANCIS

Signature: .....

Date..08/09/2023.....

NAME: AMATI ALLEN

Signature..

Date..13/09/2023.....

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DEDICATION

I BAKUNDA FRANCIS dedicate this report to My beloved Mother Mrs. Lydia Tusingwire, and my Beloved brother Mr. John Owoyesigyire who endlessly supported and motivated me towards my goal and throughout the project.

I AMATI ALLEN dedicate this report to my beloved mother Mrs. Alice Chandiru and my Beloved father Mr. Viyo Robert who endlessly supported and motivated me towards my goal and throughout the project.

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LISTS OF ACRONYMS

AgNPs……Silver Nanoparticles

NDP……National Development Plan

SDG……. Sustainable Development Goals

NTO……. Nanocrystalline Titanium di Oxide

JCPDS……...Joint Committee on Powder Diffraction Standard

CHAPTER ONE: INTRODUCTION

This chapter discusses the background of the study, the problem statement, the objectives of the project and the reasons why the project should be carried out.

1.1 BACKGROUND

1.1.1 Nanotechnology

The science and technology related to diverse nanostructures has expanded into a significant area of study for the advancement of human society, and the technology is rapidly developing to have significant commercial influence in the future. Taniguchi coined the phrase "nanotechnology" for the first time in 1974. He claims that the processes of material separation, consolidation, and deformation by a single atom or molecule comprise nanotechnology(Goutam et al., 2020). To put it another way, the study of nanoparticles that have exceptional qualities, functions, and phenomena because of their small size is another application of nanotechnology(Khan et al., 2017). The word “nano” comes from the Greek word Nanos which refers to small animals or plants. The one-nanometer scale is equal to 10−9 m. The aim of nanotechnology is to measure and manipulate the matters at nanoscale; the scale of its dimension lies in the range of 1–100 nm(Mansoori & Soelaiman, 2005). At nano-level, material shows unique chemical, physical, and biological properties due to higher surface to volume ratio where the surface area of the nanoparticle is inversely proportional to particle size, which probably occurs due to the increasing order of surface atoms with respect to the decreasing order of particle size(Goutam et al., 2020). Consequently, because to its extraordinarily high surface energy and enormous surface area, the nanoparticle exhibits unique optical, electrical, and magnetic capabilities(Goutam et al., 2020).

Nanoparticles were usually synthesized through the physical and chemical processes but these processes present many drawbacks such as being toxic to the environment, expensive and complicated procedures, which led to the development of new techniques of nanoparticle

REFERENCES

Abou El-Nour, K. M. M., Eftaiha, A., Al-Warthan, A., & Ammar, R. A. A. (2010). Synthesis and applications of silver nanoparticles. *Arabian Journal of Chemistry*, *3*(3), 135–140. https://doi.org/10.1016/j.arabjc.2010.04.008

Batool, M., Daoush, W. M., & Hussain, M. K. (2022). Dye Sequestration Using Biosynthesized Silver Nanoparticles Adsorbent in Aqueous Solutions. *Crystals*, *12*(5). https://doi.org/10.3390/cryst12050662

Carlsson, J., & Martin, P. M. (2010). Chemical Vapor Deposition. In *Handbook of Deposition Technologies for Films and Coatings* (Third Edit). Elsevier Ltd. https://doi.org/10.1016/B978-0-8155-2031-3.00007-7

Gautam, P. K., Singh, A., Misra, K., Sahoo, A. K., & Samanta, S. K. (2019). Synthesis and applications of biogenic nanomaterials in drinking and wastewater treatment. *Journal of Environmental Management*, *231*(June 2018), 734–748. https://doi.org/10.1016/j.jenvman.2018.10.104

Gour, A., & Jain, N. K. (2019). Advances in green synthesis of nanoparticles. *Artificial Cells, Nanomedicine and Biotechnology*, *47*(1), 844–851. https://doi.org/10.1080/21691401.2019.1577878

Goutam, S. P., Saxena, G., Roy, D., Yadav, A. K., & Bharagava, R. N. (2020). Green Synthesis of Nanoparticles and Their Applications in Water and Wastewater Treatment. In *Bioremediation of Industrial Waste for Environmental Safety* (Issue Dm). https://doi.org/10.1007/978-981-13-1891-7_16

Khan, I. U., Sajid, S., Javed, A., Sajid, S., Shah, S. U., Khan, S. N., & Ullah, K. (2017). *COMPARATIVE DIAGNOSIS OF TYPHOID FEVER BY POLYMERASE CHAIN REACTION Contents List available at RAZI Publishing*. *1*, 10–13.

Lade, B. D., & Shanware, A. S. (n.d.). *Phytonanofabrication : Methodology and Factors Affecting*

Biosynthesis of Nanoparticles. 1–17.

Loo, Y. Y., Chieng, B. W., Nishibuchi, M., & Radu, S. (2012). Synthesis of silver nanoparticles by using tea leaf extract from Camellia Sinensis. *International Journal of Nanomedicine*, *7*, 4263–4267. https://doi.org/10.2147/IJN.S33344

M. Awwad, A., & M. Salem, N. (2012). Green Synthesis of Silver Nanoparticles byMulberry LeavesExtract. *Nanoscience and Nanotechnology*, *2*(4), 125–128. https://doi.org/10.5923/j.nn.20120204.06

Mansoori, G. A., & Soelaiman, T. A. F. (2005). Nanotechnology - An introduction for the standards community. *Journal of ASTM International*, *2*(6), 17–38. https://doi.org/10.1520/JAI13110

Musial, C., Kuban-jankowska, A., & Gorska-ponikowska, M. (2020). *Beneficial Properties of Green Tea Catechins*.

Namita, P., Mukesh, R., & Vijay, K. J. (2012). Camellia sinensis (green tea): A review. *Global Journal of Pharmacology*, *6*(2), 52–59.

Patra, J. K., & Baek, K. (2014). *Green Nanobiotechnology : Factors Affecting Synthesis and Characterization Techniques*. *2014*.

Potential, T., Anticancer, E., Ratan, Z. A., Haidere, M. F., Shahriar, S., Ahammad, A. J. S., Shim, Y. Y., & Reaney, M. J. T. (2020). *Green Chemistry Synthesis of Silver Nanoparticles*. 1–26.

Rai, M., Yadav, A., & Gade, A. (2009). Silver nanoparticles as a new generation of antimicrobials. *Biotechnology Advances*, *27*(1), 76–83. https://doi.org/10.1016/j.biotechadv.2008.09.002

Ramasamy, K. A. J. V. V. (2015). Characterization of silver nanoparticles by green synthesis method using Pedalium murex leaf extract and their antibacterial activity. *Applied Nanoscience*. https://doi.org/10.1007/s13204-015-0449-z

Ramasamy, K. A. J. V. V. (2016). Characterization of silver nanoparticles by green synthesis method using Pedalium murex leaf extract and their antibacterial activity. *Applied Nanoscience*, *6*(3), 399–408. https://doi.org/10.1007/s13204-015-0449-z

Saliby, I. J. El, Shon, H. K., Kandasamy, J., & Vigneswaran, S. (1999). *BRIEF SA NE M SC PL O E – C EO AP LS TE S PL O E –*.

Shafaghat, A., & Shafaghat, A. L. I. (2015). *Synthesis and Characterization of Silver Nanoparticles by Phytosynthesis Method and Their Biological Activity Synthesis and Characterization of Silver Nanoparticles by Phytosynthesis Method and Their Biological Activity*. *3174*. https://doi.org/10.1080/15533174.2013.819900

Spectrophotometers Operating Manual. (n.d.). *Data Processing*.

Tiwari, D., & Sen, P. (2015). *Application of Nanoparticles in Waste Water Treatment Application of Nanoparticles in Waste Water Treatment*. *January 2008*, 2006–2007.

Vijayaraghavan, K., & Ashokkumar, T. (2017). Plant-mediated biosynthesis of metallic nanoparticles : A review of literature , factors affecting synthesis , characterization techniques and. *Biochemical Pharmacology*. https://doi.org/10.1016/j.jece.2017.09.026

Yadav, N., Anand, D., Kola, K., & Naz, I. (2020). A review on advanced physico-chemical and biological textile dye wastewater treatment techniques. *Reviews in Environmental Science and Bio/Technology*, *19*(3), 543–560. https://doi.org/10.1007/s11157-020-09543-z

Yaseen, D. A., & Scholz, M. (2019). Textile dye wastewater characteristics and constituents of synthetic effluents: a critical review. In *International Journal of Environmental Science and Technology* (Vol. 16, Issue 2). Springer Berlin Heidelberg. https://doi.org/10.1007/s13762-018-2130-z

Yu, S. J., Yin, Y. G., & Liu, J. F. (2013). Silver nanoparticles in the environment. *Environmental Sciences: Processes and Impacts*, *15*(1), 78–92. https://doi.org/10.1039/c2em30595j

Abou El-Nour, K. M. M., Eftaiha, A., Al-Warthan, A., & Ammar, R. A. A. (2010). Synthesis and applications of silver nanoparticles. *Arabian Journal of Chemistry*, *3*(3), 135–140. https://doi.org/10.1016/j.arabjc.2010.04.008

Batool, M., Daoush, W. M., & Hussain, M. K. (2022). Dye Sequestration Using Biosynthesized Silver Nanoparticles Adsorbent in Aqueous Solutions. *Crystals*, *12*(5). https://doi.org/10.3390/cryst12050662

Carlsson, J., & Martin, P. M. (2010). Chemical Vapor Deposition. In *Handbook of Deposition Technologies for Films and Coatings* (Third Edit). Elsevier Ltd. https://doi.org/10.1016/B978-0-8155-2031-3.00007-7

Gautam, P. K., Singh, A., Misra, K., Sahoo, A. K., & Samanta, S. K. (2019). Synthesis and applications of biogenic nanomaterials in drinking and wastewater treatment. *Journal of Environmental Management*, *231*(June 2018), 734–748. https://doi.org/10.1016/j.jenvman.2018.10.104

Gour, A., & Jain, N. K. (2019). Advances in green synthesis of nanoparticles. *Artificial Cells, Nanomedicine and Biotechnology*, *47*(1), 844–851. https://doi.org/10.1080/21691401.2019.1577878

Goutam, S. P., Saxena, G., Roy, D., Yadav, A. K., & Bharagava, R. N. (2020). Green Synthesis of Nanoparticles and Their Applications in Water and Wastewater Treatment. In *Bioremediation of Industrial Waste for Environmental Safety* (Issue Dm). https://doi.org/10.1007/978-981-13-1891-7_16

Khan, I. U., Sajid, S., Javed, A., Sajid, S., Shah, S. U., Khan, S. N., & Ullah, K. (2017). *COMPARATIVE DIAGNOSIS OF TYPHOID FEVER BY POLYMERASE CHAIN REACTION Contents List available at RAZI Publishing*. *1*, 10–13.

Lade, B. D., & Shanware, A. S. (n.d.). *Phytonanofabrication : Methodology and Factors Affecting Biosynthesis of Nanoparticles*. 1–17.

Loo, Y. Y., Chieng, B. W., Nishibuchi, M., & Radu, S. (2012). Synthesis of silver nanoparticles by using tea leaf extract from Camellia Sinensis. *International Journal of Nanomedicine*, *7*, 4263–4267. https://doi.org/10.2147/IJN.S33344

M. Awwad, A., & M. Salem, N. (2012). Green Synthesis of Silver Nanoparticles byMulberry LeavesExtract. *Nanoscience and Nanotechnology*, *2*(4), 125–128. https://doi.org/10.5923/j.nn.20120204.06

Mansoori, G. A., & Soelaiman, T. A. F. (2005). Nanotechnology - An introduction for the standards community. *Journal of ASTM International*, *2*(6), 17–38. https://doi.org/10.1520/JAI13110

Musial, C., Kuban-jankowska, A., & Gorska-ponikowska, M. (2020). *Beneficial Properties of Green Tea Catechins*.

Namita, P., Mukesh, R., & Vijay, K. J. (2012). Camellia sinensis (green tea): A review. *Global Journal of Pharmacology*, *6*(2), 52–59.

Patra, J. K., & Baek, K. (2014). *Green Nanobiotechnology : Factors Affecting Synthesis and Characterization Techniques*. *2014*.

Potential, T., Anticancer, E., Ratan, Z. A., Haidere, M. F., Shahriar, S., Ahammad, A. J. S., Shim, Y. Y., & Reaney, M. J. T. (2020). *Green Chemistry Synthesis of Silver Nanoparticles*. 1–26.

Rai, M., Yadav, A., & Gade, A. (2009). Silver nanoparticles as a new generation of antimicrobials. *Biotechnology Advances*, *27*(1), 76–83. https://doi.org/10.1016/j.biotechadv.2008.09.002

Ramasamy, K. A. J. V. V. (2015). Characterization of silver nanoparticles by green synthesis method using Pedalium murex leaf extract and their antibacterial activity. *Applied Nanoscience*. https://doi.org/10.1007/s13204-015-0449-z

Ramasamy, K. A. J. V. V. (2016). Characterization of silver nanoparticles by green synthesis method using Pedalium murex leaf extract and their antibacterial activity. *Applied*

Nanoscience, *6*(3), 399–408. https://doi.org/10.1007/s13204-015-0449-z

Saliby, I. J. El, Shon, H. K., Kandasamy, J., & Vigneswaran, S. (1999). *BRIEF SA NE M SC PL O E – C EO AP LS TE S PL O E –*.

Shafaghat, A., & Shafaghat, A. L. I. (2015). *Synthesis and Characterization of Silver Nanoparticles by Phytosynthesis Method and Their Biological Activity Synthesis and Characterization of Silver Nanoparticles by Phytosynthesis Method and Their Biological Activity*. *3174*. https://doi.org/10.1080/15533174.2013.819900

Spectrophotometers Operating Manual. (n.d.). *Data Processing*.

Tiwari, D., & Sen, P. (2015). *Application of Nanoparticles in Waste Water Treatment Application of Nanoparticles in Waste Water Treatment*. *January 2008*, 2006–2007.

Vijayaraghavan, K., & Ashokkumar, T. (2017). Plant-mediated biosynthesis of metallic nanoparticles : A review of literature , factors affecting synthesis , characterization techniques and. *Biochemical Pharmacology*. https://doi.org/10.1016/j.jece.2017.09.026

Yadav, N., Anand, D., Kola, K., & Naz, I. (2020). A review on advanced physico-chemical and biological textile dye wastewater treatment techniques. *Reviews in Environmental Science and Bio/Technology*, *19*(3), 543–560. https://doi.org/10.1007/s11157-020-09543-z

Yaseen, D. A., & Scholz, M. (2019). Textile dye wastewater characteristics and constituents of synthetic effluents: a critical review. In *International Journal of Environmental Science and Technology* (Vol. 16, Issue 2). Springer Berlin Heidelberg. https://doi.org/10.1007/s13762-018-2130-z

Yu, S. J., Yin, Y. G., & Liu, J. F. (2013). Silver nanoparticles in the environment. *Environmental Sciences: Processes and Impacts*, *15*(1), 78–92. https://doi.org/10.1039/c2em30595j