IULTCS Young Leather Scientist Grant

Identification: YLSG_ 2022 _Louret Atsenga Andalo

COMPLETE APPLICATION FORM (click application area)

☐ Basic Research ☐ Environmental/Sustainability

Application Area: **Environmental/ Sustainability**

1) Applicant Information

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If employed, starting date	

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By submitting this application, I commit to develop the project as outlined in the attached Research Project Plan and to complete a written report by February 28, one year after payment with the following items:
Introduction
Materials and Methods
Results and Discussion
Conclusion
Suggestion for Future Work
References

2) Research Plan

Title: Extraction of natural dye (*batalain*) from beetroot peels (*Beta Vulgaris*) and application in Leather dyeing using bio-mordant

Introduction

Natural dyes are natural colorants extracted from vegetable or animal (insects) kingdom with no or very little chemical processing. They can be derived from different parts of plants such as roots, leaves, woods and even flowers(Saxena & Raja, 2014). Natural dyes have become a crucial alternative to synthetic dyes which are mostly complex molecular structures making them non-biodegradable when discharged to the environment. Moreover, synthetic dyes are carcinogenic, mutagenic and also toxic to the environment and human(Ali, 2010). They also release large amount of waste and unfixed color(Rathe et al., 2016). There has been increased awareness of the use natural materials hence the use of natural extracts in processing gaining much popularity.

However research has extensively increased on red beet (beetroot) due to the presence of the brightly colored water- soluble pigment known as *betalain(Lee, Wettasinghe, Bolling, Ji, & Parkin, 2009).* This pigment is complemented by its antioxidant potential, its high total phenolic content of around 50-60 µmol/g dry matter, neuro-stimulators and anticancer effect. The pigment is applied in food and pharmaceutical products; it is also used in dyeing leather, textile and paper.

Beetroot is cultivated worldwide and mostly used due to its medicinal value. However the peels which are regarded as wastes are always disposed to the environment leading to environmental pollution. These peels can be utilized in leather industries by extracting the dye and using it in leather dyeing to replace synthetic dyes.

Furthermore, there is great need to develop an efficient and economical method of natural dye extraction with zero or less toxicity to the environment. Also, during dyeing it is necessary to use mordant since natural dyes fade with time and on exposure to different environments. Metal mordant forms a coordinate bond with the functional groups of the dye molecule and the substrate on the other side hence enhance the color; increase the fixation of the dye onto the leather. Metal mordant such as alum, iron (ii) sulphate, copper (ii) sulphate and potassium dichromate have been widely used in leather dyeing with natural dyes. However, only a small amount of these metal salts are fixed onto the leather and the rest is discharged as effluent which leads to environmental pollution(Pinheiro, Kohan, Duarte, Garavello, & Baruque-Ramos, 2019). Continuous accumulation of these metal salts to the land may affect the growth of plants and also affect aquatic animals when discharged into water sources. Studies on the use of bio-mordant in leather dyeing with natural dyes

have been widely used in textile dyeing to minimize the toxicity of metal mordant. This is also a sustainable and economical method of leather manufacture since it uses agricultural wastes and natural products.

Objectives

Main objective

- To extract natural dye from beetroot peels (*Beta Vulgaris*) and use it in dyeing leather using bio-mordant.

Specific Objectives

- To extract natural dye from beetroot peels (*Beta Vulgaris*) and determine its chemical properties
- To extract and determine the chemical properties of bio- mordant from Musa Sp. (*Banana Pseudo Stem* Sap) and *Acacia nilotica* leaves
- To use the extracted natural dye in dyeing goat wet blue with the help of bio-mordant and metal mordant without any mordant and one piece dyed with synthetic dye.
- To determine and compare the physico-chemical properties of the dyed leather and synthetic dyed leather.

Methods

Collected beetroot, banana and acacia leaves samples will be washed thoroughly with water to remove any impurities. The samples will then be sliced into small pieces and extraction accomplished using liquid extraction with distilled water; the samples will be soaked in water solution for 24 hours, heated at 75º C for 45 minutes, the filtered solution in a beaker will be concentrated at 75 ºC in an oven. The dry matter will be regulated at 20 %. The same will be done for the mordant. Goat wet blue will be divided into four pieces and dyed using the dye with bio-mordant, metal mordant in a pre-mordanting technique, without any mordant at pH 3 for 90 minutes at 50 ºC and another piece dyed with synthetic dyes separately. The chemical properties of the extract will be analyzed using UV-VIS spectrophotometry and gravimetric analysis. The physico-chemical properties of the dyed leather such as wet and dry rub fastness, perspiration and light fastness properties will be analyzed. Dye bath exhaustion will also be analyzed using spectrophotometric technique.

The results will be compared to leather dyed with synthetic dye to determine effectiveness.

Hypothesis/ Expected results

It is expected that the dye extracted using distilled water will produce a good yield and the leather produced by using different bio-mordant will exhibit different shades ranging from soft to light colors and moderately to

excellent color fastness properties. Dye exhaustion is also expected to be good since the bio-mordant (tannin extracts) will react with the dye and the leather therefore enhance fixation of the natural dye onto the leather.

Research benefit to the local/global leather industry

This study has various advantages since it utilizes agricultural waste for sustainable and economical leather manufacture with zero discharge of toxic chemicals from dyeing operation.

Literature

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Pinheiro, L., Kohan, L., Duarte, L. O., Garavello, M. E. d. P. E., & Baruque-Ramos, J. (2019). Biomordants and new alternatives to the sustainable natural fber dyeings. *SN Applied Sciences*. doi:10.1007/s42452-019-1384-5

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Saxena, S., & Raja, A. S. M. (2014). Natural Dyes: Sources, Chemistry, Application and Sustainability Issues. In *Roadmap to Sustainable Textiles and Clothing* (pp. 37-80)