THE DYEING POTENTIAL OF URTICA MOSSAICA PLANT DYES ON SILK AND COTTON FABRICS

KATUMBA Abel

BU/UG/2009/186

katumbabel@gmail.com

SUPERVISORS

1. Mr. LOUM JANANI

2. Mr. WANDERA GOERGE

A DISSERTATION SUBMITTED TO THE DEPARTMENT OF TEXTILE AND GINNING ENGINEERING FOR THE AWARD OF BACHELORS DEGREE OF SCIENCE IN TEXTILE ENGINEEERING OF BUSITEMA UNIVERSITY.

May 2013

DECLARATION

I **Katumba Abel** declare to the best of my knowledge that this final year research project is a result of my sole personal efforts; it has never been presented or submitted to any institution of higher learning or university for the award of **Bachelor of science in Textile Engineering.** Any other use falls under the limitation of copyright, especially with regard to the obligation of mentioning the source explicitly on quoting the results of this research project.

Signature……Date…28/05/2013……

This research project report has been submitted for examination with approval from the following supervisors.

1. **Mr. Loum Janani**

Signature……Date……

2. **Mr. Wandera Goerge**

Signature……Date……

DEDICATION

This final year project report is dedicated to my beloved parents, Mr. and Mrs. Mukwaya James without them life would have been meaningless. They denied themselves most of what they deserved to ensure that i succeed. Thanks so much for the support towards my general life and academic success.

I dedicate this research work to my brothers and sisters for the love, advice and material support extended towards my education period and all throughout the period of my project's execution, thanks so much for that support dears.

I also warmly dedicate this report to my friend, Nayiga Joan Sanyu for the generous support extended towards my education in terms of spiritual advice, academic and moral upbringing as well as her unfailing love and care she has showed me since joined University. God bless you dear.

ACKNOWLEDGEMENTS

Immense thanks to the almighty God for granting me a gift of life such that i execute my final year project work successfully.

Many thanks to my dear mum and dad for great efforts they put in to fund my project research, may the almighty God reward you abundantly.

I would like to extend my sincere appreciation to the management of Busitema University, Faculty of Engineering and Department of Textile and Ginning Engineering for the facilitation and support that has culminated into the accomplishment of my research project.

Thanks to my supervisors Mr. Loum Janani and Mr. Wandera Goerge for the tremendous work of guidance and continued encouragement extended to me throughout the period of my project's execution. I also extend my gratitude of appreciation to my friends for the supportive work rendered to me during the research period.

Thanks a lot, May the almighty God bless you.

LIST OF ACRONYMS AND ABREVIATION

CFNL- Cotton, ferrous sulphate and nettle leaves

SFNL- Silk, ferrous sulphate and nettle leaves

CFNR - Cotton, ferrous sulphate and nettle roots

SFNR- Silk, ferrous sulphate and nettle roots

CANL- Cotton, alum and nettle leaves

SANL- Silk, alum and nettle leaves

CANR- Cotton, alum and nettle roots

SANR- Silk, alum and nettle roots

SNL- Silk and nettle leaves

CNL- Cotton and nettle leaves

SNR- Silk and nettle roots

CNR- Cotton and nettle roots

LIST OF FIGURES AND TABLES

ABSTRACT

The Use of natural dyes has increased several folds in the past few years due to the eco-friendl approach of the people. This research project therefore reports the potential use of dyes fron Urtica mossaica (stinging nettle plant), roots, stems and leaves on 100% silk and cotton fabric using Alum and Ferrous sulphate, the environmentally safe mordants. This analysis wa performed to identify the possible performance of color compounds of stinging nettle leaves stems and roots responsible for dyeing the above mentioned fabrics in the presence of Alum Ferrous sulphate and without using mordants (control experiment). Ferrous sulphate and Alum are the safest of the metal salt mordants, because it takes one ounce to kill an adult who swallows them, instead of just a few grams. (All About Hand Dyeing Q&A, January 03, 2010).

Stinging nettle is one of the richest sources of chlorophyll in the vegetable kingdom. The leaves of the plant were boiled in distilled water to produce a green dye decoction for which it was used to dye cotton and silk fabrics. A light yellow dye was extracted from the roots and also used to colour the mentioned fabrics above. During dyeing process, pre-mordanting of materials was done using the two mordants, alum and ferrous sulphate respectively.

Study about fastness tests of dyed clothes was undertaken. Large range of shades was obtained for using different mordants and without using mordants (control experiment). On fastness rating, dyes extracted from stinging nettle roots and leaves showed best results with Alum followed by ferrous sulphate and least with a control experiment. It should be noted that, the presence of alum and ferrous sulphate mordants did improve the fastness properties of dyes from roots and leaves of stinging nettle on both cotton and silk fabrics making them more stable under the influence of ultra violet light radiation. Washing developed the true fastness properties of the natural dyes in this study. Grey scale (ISO 105-A03: 1993, BS EN 20105-A03:1995, BS 1006-A03:1990, SDC Standard methods 5th Edition A03) was used in assessing colour change.

Depending on the results obtained from **table 10 and 11** of this study, dyes obtained from this selected plant in Uganda can be a fair source of natural dyes for natural fibres selected in the textile industry.

Table of Contents

CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND

In the recent textile applications, the use of natural dyes on natural fibers is seen to be at a rising demand for ecologically safer textiles and the increasing interest in dyeing with natural dyes(Raisamen et al; 2001, Anna and Christian, 2003). Natural dyes are reported to be biodegradable, less toxic to human health and cause no inflammation of the skin and allergy as compared to synthetic dyes (Ola et al., 2008). Over the last few years synthetic dyes have been losing good reputation because of the risk of toxicity, negative influence on the environment and high allergic potential (Papita and Siddhartha, 2008). Natural dyes are therefore dyes or colorants derived from plants, invertebrates, or minerals. The majority of natural dyes are vegetable dyes from plant sources such as roots, berries, bark, leaves, and wood and other organic sources such as fungi and lichens. Therefore a dye can generally be described as a coloured substance that has an affinity to the substrate to which it is being applied. The dye is generally applied in an aqueous solution, and may require a mordant to improve the fastness of the dye on the fiber.

These natural dyes have a long and rich history in cultures throughout the world, representing centuries of art and craftsmanship. Many fiber colorants have always recognized the advantages of natural dyes such as excitement of unexpected results, not dependent on non-renewable materials, allow for endless experimentation, mature with age when exposed to sunlight and normal use and also have aromatic smell when simmering the plants. However, in spite of the merits of natural dyes, they are still not widespread due to non-availability of standard shade cards and standard application procedures. Most of the natural dyes have no substantivity for the fiber and are required to be used in conjunction with mordant, require large quantities in comparison to chemical dyes and also longer time required for natural dyeing.

Recently over 40 plants including Albizia coriaria (bark), Vitellaria paradoxa (bark), Curcuma longa Linn (roots), Indigofera arrecta (leaves), Syzygium cordatum (bark), Morinda lucida (bark), Morinda lucida (roots), Rubia cordifolia (roots), Mangifera indica (bark), Justicia betonica (leaves), and many others were identified in Uganda (Wanyama, 2010) with potential of yielding

dyes of good characteristics for application in the textile industry, however this study is limited by their turnover since relatively take a longer period to mature for color production. This therefore leads to a task of investigating on other plants whose turnover is good and lasting for a long time or continually engaged in a specific activity.

Stinging Nettle (Urtica mossaica) is therefore one of the identified plants to be investigated for color production (roots and leaves), it's a perennial herb that grows mostly in temperate regions. This plant is also called Stinging Nettle. As the name suggests, stinging nettle is a plant with numerous stinging hair on its leaves and stems. In case of direct contact with skin, these hairs cause painful stings that burn and itch for some time. Such hair known as trichomes, act as needles and inject a mixture of chemicals into the skin, causing this sensation. So, this plant is also known as burn weed, burn hazel, burn nettle, etc. It's also locally known to the society as Omunyango in Luganda. Even though the plant has stinging hair, it has a very long history of use as a source of fiber, food and medicine. Even today, this herb is used for treating various ailments. As mentioned above, nettle is one of those plants that have been used through the centuries for cooking as well as medicinal purposes. As far as the medicinal property of nettle is concerned, both the leaves and roots are used.

1.1.1 Natural fibers

Natural fibers are greatly elongated substances produced by plants and animals that can be spun into filaments, thread or rope. Woven, knitted, matted or bonded to form fabrics that are essential to society. Natural fibers are classified according to their origin and here they include; Vegetable fibers which are composed of mainly cellulose: examples include cotton, jute, flax, ramie, sisal, banana, hemp and many others. Animal fibers which mainly comprise of proteins such as collagen, keratin, and fibroin; examples include silk, mohair, alpaca, wool, catgut, angora and sinew. Animal hair (wool or hairs) and Mineral fibres which include, asbestos. Since natural fibers cover a wide range, focus will only be limited on cotton, and silk fibers.

1.1.2 Silk fiber

This is a fine, strong, soft lustrous fiber produced by silkworms in making cocoons. It's a protein fiber secreted by glands (often located near the mouth) of insects during the preparation of cocoons. It can be spun into yarn from which fabrics or garments can be made.

1.1.3 Cotton fiber

This is a soft fibrous substance which surrounds the seeds of the cotton plant and is used as textile fiber and thread for sewing. It's a cellulosic fiber and still remains the most miraculous fiber under the sun, even after 8,000 years. No other fiber comes close to duplicating all of the desirable characteristics combined in cotton. Cotton is noted for its versatility, appearance, performance and above all, its natural comfort. From all types of apparel, including astronauts' in-flight space suits, to sheets and towels, and tarpaulins and tents, cotton in today's fast-moving world is still nature's wonder fiber. It provides thousands of useful products and supports millions of jobs as it moves from field to fabric.

1.2 PROBLEM STATEMENT

Many common indigenous plants for example; Albizia coriaria, Vitellaria paradoxa, Morinda lucida, Rubia cordifolia, Mangifera indica, Justicia betonica and many others have been identified in Uganda to possess dye- yielding properties for textile application. However, these identified plants have a limited continuous supply in a specific activity due to their poor turnover especially those whose bark is to be used for color extraction. This therefore calls for further identification of other plant sources whose turnover is high and can yield good colors so as to continually engage in a specific activity. Stinging nettle plant therefore is one of the identified plants whose growth rate is relatively high and grows in large numbers in almost every part of the country which receive enough rain.

Also, the synthetic dyes used in today's textile industry have been found to be associated with a lot of toxic gases affecting human life and environment. They create skin diseases and lung problems to both the fabric users and textile processors.

1.3 OBJECTIVES OF THE STUDY

1.3.1 Main objective

- To investigate the potential use of stinging nettle (Urtica mossaica) dyes on silk and cotton fabrics.

1.3.2 Specific objectives

- To extract the dyes from the roots, stems and leaves of stinging nettle plant.
- To apply the dye on silk and cotton fabrics using a pre-Mordanting technique with ferrous sulphate and alum mordants.
- To determine the wash, light and rub fastness properties of this dye on the above mentioned fabrics.

1.4 JUSTIFICATION

This research project serves to help many Uganda fabric/fiber artists identify dyes with potential for coloration of cotton and silk fabrics with locally existing stinging nettle. This therefore builds confidence in dyers since they will know the colours which can be obtained from different parts of the nettle plant, hence easy substitution of synthetic dyes, due to the fact that this natural dye and fibers are biodegradable, nontoxic, non-allergic to skin, non-carcinogenic, easily available and renewable, this will encourage environmental conservation and continuous supply in a specific activity.

This selected plant is also commonly found in almost all parts of the country, has a high turnover with ever green leaves and can be found near roads, edges of the wood and neglected gardens. The plant thrives nearly everywhere but has a preference for a good fertilized soil as by compost hills or at the edge of a field and also performs better in areas with enough rainfall. Therefore Ugandans who will engage in cultivation, harvest and sale these dyes from this plant will be able to earn themselves a living at same creating employment opportunities to the citizens of the community. Also the choice of the plant was based on the fact that it's one of those plants that have been used through the centuries for cooking as greens as well as medicinal purposes As far as the medicinal properties of nettle are concerned, both the leaves and roots are used. Even Today, people still use

Nettle Root for the treatment of rheumatism, eczema, allergic rhinitis, internal and external bleeding, anemia, and acute arthritis.

1.5 SCOPE OF THE PROJECT

In investigating the potential use of dyes from nettle plant, i concentrated on the extraction of dyes from the leaves, stems and roots of stinging nettle plant, dyed silk and cotton fabrics using ferrous sulphate and alum as mordants and dyes extracted from each part of the plant (roots, stems and leaves) alongside their controls and finally determined the wash, light and rub fastness properties for the dye on these fabrics and then make a comparison for shade fading of the two natural fibers used in this study. All this was done from Nytil laboratory.

REFERENCES

1. Anna H. and Christian R. V. (2003). The pot**No table of figures entries found.**ential use o organically grown dye plants in the organic textile industry. Experiences and results or the cultivation and yields of dyers chemimile (AnhemistinctoriaL.), Dyers Knotweed (PolygonumtinctoriaAit) and Weld (Reseda luteolaL).J.Sustain. Agric., 23 (2): 17–40.
2. Rattanaphol M, Tharapong V (2007). Dyeing and colour fastness properties of silk and cotton fabrics dyed with eucalyptus leaves extract. 6th International Conference, June 5-7, Liberec, Czech Republic. Department of Textile Chemistry, Faculty of Textile Engineering, Technical University of Liberec, Czech Republic. Samanta AK, Agarwal P (2009). Application of Natural dyes on Textiles. Indian J. Fibre Text. Res., 34: 384-399.
3. Bhuyan R. and Saikia C. N. (2005).Isolation of colour components from native dye-yielding plants in northeastern India. Biores. Technol. 96 (3): 63–72.
4. Bhuyan R. and Saikia C. N. (2008).Extraction of natural colorants from roots of Morinda angustifolia Roxb.Their identification and studies of dyeing characteristics on wool. Ind. J. Chem.Technol. 10 (2): 131–136.
5. Carter J, Felber G. and Schmidt K. (2007). Local forest-based enterprises: supporting the livelihoods of the poor? Info Resources Focus No. 2/07. Debajit M. and Tiwari S. C. (2005).Natural dye yielding plants and indigenous knowledge on dye preparation in Arunachal Pradesh, Northeast India. Curr. Sci. 88 (9): 1474–1480.
6. Hall J. B. and Swaine M. D. (1981).Distribution and ecology of vascular plants in a tropical rain forest. Forest Vegetation in Ghana. W. Junk, The Hague.
7. P. A. G. Wanyama1, B. T. Kiremire, P. Ogwok and J. S. Murumu (2010) Indigenous plants in Uganda as potential sources of textile dyes: Full Length Research Paper
8. Kadolph J. S. (2005). Identification of plant residue with commercial potential as natural dye stuffs. Leopold Centre Progress Report 14: 55–58.
9. Kar A. and Borthakur S. K. (2008). Dye yielding plants of Assam for dyeing handloom textile products. Ind.J. Tradit. Knowl.7 (1):166–171.

10. Dr. Erik Sundström (2004) what is a "Mordant" and why use them: CHROME AND CHROMATES

11. Erica Schrader (2007) Comparison of aluminum mordants on color fastness of natural dyes on cotton and Bamboo fabrics: University of Missouri-Columbia

12. Paula E. Burch (2007) all about hand dyeing: What's the difference between mordants and other chemical assistants used in dyeing?

13. P. I. Tzenov & H.Z. Lea (2006) Silk Handcrafts Cottage Industries and Small Enterprises in Africa, Europe, Central Asia and the Near East