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VISION

The vision of the journals is to provide an academic platform to scholars all over the world to publish their novel, original, empirical and high quality research work. It propose to encourage research relating to latest trends and practices in international business, finance, banking, service marketing, human resource management, corporate governance, social responsibility and emerging paradigms in allied areas of management. It intends to reach the researcher's with plethora of knowledge to generate a pool of research content and propose problem solving models to address the current and emerging issues at the national and international level. Further, it aims to share and disseminate the empirical research findings with academia, industry, policy makers, and consultants with an approach to incorporate the research recommendations for the benefit of one and all.

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Avinashilingam Institute for Home Science and Higher Education for Women

(Deemed to be University under Category 'A' by MHRD)
Estd. u/s 3 of UGC Act 1956
Re-accredited with A+ Grade by NAAC,
Recognized by UGC under section 12B
Coimbatore - 641 043, Tamil Nadu, India

UGC Sponsored National symposium on Eco Textiles and Green Consumerism

ETGC 2019

Under

Special Assistance Programme (SAP - DRS I)

March 22nd, 2019

Supported by

The South India Textile Research Association (SITRA)
Ministry of Textiles, Government of India, Coimbatore

&

The Southern India Mills' Association (SIMA)
Coimbatore

Organized by

Department of Textiles and Clothing

THE AVINASHILINGAM EDUCATION TRUST
COIMBATORE-641 043, TAMILNADU

Amarar Dr. T.S.Avinashilingam
B.A.B.L
Founder / President / Managing Trustee

Dr.T.S.K. Meenakshisundaram
M.A., M.Phil., Ph.D
Managing Trustee

MESSAGE

Eco consciousness is playing a vital role in selection of clothing all over the world. Industrialization and technical advancements has led to the increase in pollution. Environment issues are becoming the major factors in today's living. Consumers are aware of the eco-products and eco-friendliness in textiles is gaining importance. Eco-friendly, biodegradable products are available in the market and still have a wide demand. This has brought natural and unconventional fibres into focus again.

India has abundant natural resources and exploring this will give us numerable solutions to solve our environmental issues resulting in production of natural eco friendly textile products .The increasing interest on eco textiles also has raised the necessity of finding newer materials.

I am happy that, at this context the Department of Textiles and Clothing, Avinashilingam Institute for Home Science and Higher Education for Women is organizing the UGC Sponsored National Symposium on Eco Textiles and Green Consumerism ETGC 2019. I hope that the deliberations brought out in this symposium would benefit the students, academicians, researchers and all the stakeholders of textile industry. I also hope that the out comings be transferred to the community and help economical development as a whole.

I wish all the members of the department for the success of the symposium.

T.S.K. Meenakshisundaram
Managing Trustee

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Dr. P.R. Krishna kumar

Chancellor (Padmashree Awardee)

FOREWORD

Dear Delegates,

Warm greeting from Avinashillingam Institute for Home Science and Higher Education for Women!

It is indeed a great pleasure to welcome you all for the UGC Sponsored National Symposium on Eco Textiles and Green Consumerism ETGC 2019 organised by the Department of Textiles and Clothing.

Indian textile sector has been enjoying rich traditional reputation in the world market for a number of decades. In the recent years it has been the victim of many challenges that have come up in the context of industrialization. One of the most challenges for the human race today is the environmental problem. As a result individuals, business organizations, the judiciary and the government all over the world have recognised the need of eco-friendly textiles so as to avoid or reduce environmental issues. Industries on a global basis have to decide to modify their technology and production process in order to have an environmental friendly output to satisfy their customer needs.

Moreover textile industry is committed to produce eco-friendly textiles in order to face the global competition. Consumers on the other hand should engage in eco-friendly activities and should begin to look into more eco-friendly ways of living and doing business.

With this note, I am happy that the department of Textiles and Clothing is organizing a UGC sponsored National Symposium on Eco Textiles and Green Consumerism ETGC-2019 which is the need of the day. The symposium is likely to be one of the finest opportunities for scientists, technocrats, students etc., from all over India to participate and to share ideas. I am sure that the symposium would be beneficial to the researchers, students and the industrialists.

On this occasion, I extend my best wishes to the organizing committee. My blessings and good wishes will always be with the department.

P.R.Krishna kumar
Chancellor

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Dr. Premavathy Vijayan

M.Sc., M.Ed.,M.Phil., Dip. Spl. Edn. (UK), Ph.,D

Vice Chancellor

MESSAGE

Go "Green" is the growing trend in all aspects particularly in industries. Textile industry in spite of being one of the major employment generators, is also considered as the most ecologically polluting industries in the world. The issues which make the life cycles of Textiles and Clothing unsustainable are the use of harmful chemicals, high consumption of water and energy, generation of large quantities of solid and gaseous waste and use of non-biodegradable packaging materials. Chemical processing of textiles ranging from preparatory processing to dyeing and finishing causes serious environment hazard. Now -a - days environmental issues are becoming the major factors during the selection of consumer goods. Natural fibers being bio-degradable are now considered as earnest option to synthetic fibres for use in various fields. Moreover, global awareness on environmental issues demand natural fiber – based textiles, natural dyed and finished textiles in academic and industrial research.

I am happy to note that the department of Textiles and Clothing is organizing the UGC sponsored National Symposium on Eco Textiles and Green Consumerism ETGC 2019. This Symposium will provide a platform for all stakeholders to share their knowledge and expertise on key challenges facing the sector. I hope the gathering of young scientists and industrialists have an opportunity to interact and discuss on the current issues of sustainable textile production.

My best wishes to the organizers and all members of the department for the success of the UGC sponsored National Symposium.

Premavathy Vijayan
Vice Chancellor

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Dr. (Mrs) S. Kowsalya

M.Sc.,M.Phil., Ph.,D

Registrar

MESSAGE

Eco friendliness and sustainability are the concepts underlying textile manufacture and marketing of textile products. In India growing shortage of natural fibre producers lead the researchers to develop new environmental friendly textile products. Today Eco-fashion movement has developed that creates garments that are sustainable at every stage of their life cycle from production to disposal.

Going Green is the growing trend in all industries and textile industry is one of the most ecologically harmful industries in the world. Use of natural renewable source for textile production, processing and finishing helps in maintaining the ecological impacts. Renewable resources are gaining popularity among the people due to their positive effects on agriculture, environment and economy.

The concept of eco-textiles has already entered not only the shelves of natural textile shops but also of the largest retailers and brand owners. The demand for sustainable textiles is increasing and solutions need to be found to meet the requirements. It is appropriate that at this point the Department of Textiles and Clothing, is organizing UGC sponsored National Symposium on Eco Textiles and Green Consumerism ETGC 2019. I hope the concerted efforts of the experts in the field of specialization would pay way to sustainable strategies to not only stakeholders of the country but also to young researchers in India to fulfill the objectives of the National goals of development set by the Prime Minister of India.

I wish the symposium all success and my best wishes to the organizers and the participants.

S. Kowsalya

REGISTRAR

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MESSAGE

Years of human ignorance has deteriorated our natural resources and to very extent aged our planet. After realizing the importance of nature, now people are making an effort to change the way they are treating the planet. Textile industry has a huge impact on the whole environment as the current practices followed in the textile industries are unsustainable. Many environmentalist and consumers are looking at strategies for reducing the textile carbon footprint and started seeking the alternative sources to get back to the green environment.

Textile is the major part of the basic human needs. Going "Green" is the growing trend in textile industry.Therefore textile contributions to diminish global warming by developing eco-friendly fibres, eco-friendly textile processing, healthy production environment and non-toxic chemical usage in the textile unit.

Green clothing is catching up interest in huge group of consumers as people are aware of its hazards caused to human life. I hope this symposium will be an bombshell for all the researchers, environmental activists, industrialists and also academicians to think out of box in broader perspective towards green consumerism.

I wish the symposium, the very best and I am sure deliberation will be of great interest to all.

Dean, Faculty of Home Science

UGC Sponsored National symposium on Eco Textiles and Green Consumerism ETGC 2019

Organising Committee

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Avinashilingam Institute for Home Science and Higher Education for Women was founded by Dr. T.S. Avinashilingam in the year 1957 as Sri Avinashilingam Home Science College for Women. Sri T.S. Avinashilingam an eminent educationist, a true visionary, well known social reformer, an advocate of womens emancipation and a great institution builder, was the first Chancellor of the university in 1988. His noble vision touched the realm of reality through the dedicated perseverance of the first Vice-Chancellor Dr. Rajammal P. Devadas, the world-renowned nutritionist and educationist.

The institution aims at empowering women through education, incorporating a curriculum that is both need based and Holistic.The University is currently functioning under the leadership and guidance of Dr. T.S.K. Meenakshisundaram, Managing Trustee, Dr. P.R. Krishnakumar, Chancellor and Dr. Premavathi Vijayan, Vice-Chancellor.

The Department of Textiles and Clothing was established with a PG course in the year 1967. The department has industrial and academic collaborations and this has positioned the department as the highest stride of progressive changes and innovations. The department is effectively functioning with a team of 11 faculty members who are specialized in research areas like natural fibers, natural dyes, non-woven, knitting, wet processing, textile finishing, technical textiles, fashion designing, enzymology and bio-remediation of textile effluent.

OBJECTIVES OF THE SYMPOSIUM

A national Symposium on “Eco Textiles and Green Consumerism”, - ETGC-2019 will be held on March 22nd, 2019. It is organized by the Department of Textiles and Clothing, Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore, Tamil Nadu. The main theme of the symposium is on the emerging and cutting-edge advancements in the frontier areas of eco textiles, eco standards, quality and technical textiles.

It will be a common platform to bring together academician and experts from different parts of the country to exchange knowledge and ideas.It will help to update scientific and technological developments in Eco-Textiles and Green Consumerism.

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INVITED SPEAKERS

Dr. Anjali Karolia,	Dean, Faculty of Family and Community Sciences Professor, Department of Clothing and Textiles, The Maharaja Sayaji Rao University of Baroda, Gujarat, Vadodara
Dr. Saroj S.Jeet Singh	Professor, Department. Of Textile and Apparel Designing, I.C. College of H.Sc, CCS HAU, Hisar (Haryana), India
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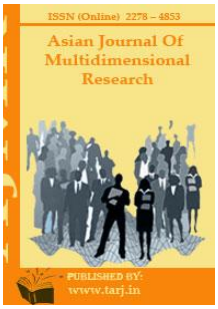
Dr.K.Selvaraju	Secretary General, The Southern India Mills' Association Coimbatore



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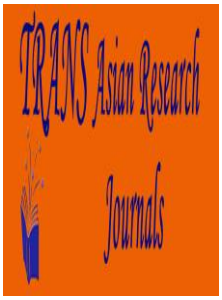

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ANALYSING THE EFFECT OF TERMINALIA CHEBULA ON WOUND HEALING

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ABSTRACT

Medical textiles are an innovative and growing sector in Technical Textile. Innovation in medical textiles are emerging due to the enlargement in the fields like Wound healing, Bandaging, implantable devices and expansion of new intellectual products. Innovative Researches on herbal based products are growing nowadays. For applying specific finish in textiles, it is mandatory to have various performances that may include: coating, spraying, padding etc. Such finishes must be applied in an infection-free environment or the finished product may be required to be sterilized before use. Nowadays an innovative idea of finishing the fabric with medicinal values using plant extract is emerging with a fair degree of tolerability. Instead of consuming medicines with side effects, we can rightly wear the health-giving fabric and get good effects in return. In order to combat a broad spectrum of microorganisms that cause infections in wounds, new and innovative herbal extracts have been applied onto fabrics with encouraging results.In this article, an attempt has been made to impart the properties of wound healing in medical textiles producing "Medicated herbal gauze". An eco-friendly natural finish has been equipped from the pharmaceutical herb – extracts to accomplish the properties of wound healing. Terminalia Chebula (Myrobalan) is an herbal seed which has a lot of medicinal values. In this study, Cotton gauze cloth is treated with Terminalia Chebula (Myrobalan) extract for wound healing purpose. The extract is being said to have wound healing or injury curing property. Therefore, this can be used in Medical Textiles products for curing different types of wounds.

KEYWORDS: *Cotton Gauze, Terminalia chebula (Myrobalan), Medical textile, wound healing*

INTRODUCTION

Medical Textiles are one of the important sectors of the global Technical Textile industry. The Majority of Health-care products manufactured worldwide is disposable, and the remaining can be re-used. Although textile materials have been extensively implemented in medical and surgical uses for many years, new uses are still being found. Research consuming new and surviving fibers and fabric forming performances has led to the improvement of medical and surgical textiles.

An important and the growing field in the application of medical textile have been developed such as wound care and precluding chronic wounds. A wound is an ailment in the outer layer of the skin. Wounds are usually caused by cuts or scrapes. Different kinds of wounds may be treated differently from one another, depending upon how they happened and how serious they are. Bandages and wound dressings are most frequently used because they are inexpensive and recyclable. Dressings are essential to preserve sterility and absorb blood and serum. Moisture improves the rate of epithelialization.

Gauze is a thin, translucent fabric with a loose open weave used for the wound or surgical dressings. Gauze offers a variety of options—woven or nonwoven, sterile or non sterile, plain or impregnated, and fenestrated (perforated or with slits)—and is available in various sizes, shapes, and thicknesses. Gauze can be used for cleaning, packing, scrubbing, covering, and securing in a variety of wounds. Closely woven gauze is superlative for additional strength or superior protection, while open or loose weave is enhanced for absorbency or drainage.

Terminalia Chebula is held in high esteem in Ayurveda for its properties to prevent and cure diseases. It has valued the chief place between medicinal herbs in India since ancient times. It is called the ‘King of Medicines’ and is always listed first in Ayurveda because of its extraordinary therapeutic benefits. This plant is used externally in wound healing, fungal infections, inflammations of the mucous membrane of the mouth, etc., It is also useful in asthma, piles, and cough.

REVIEW OF LITERATURE

Traditionally the term ‘Textile’ was devoted to fabric or especially woven fabric produced from yarns which were made from natural fiber [1-2]. Textiles are used in medical science in different ways from Wound care material to new prosthetic non-allergic devices. The longer the cotton fiber the easier it is to spin into a smoother, stronger yarn in turn this result in a more comfortable, more durable, more attractive fabric and garments [3].

Medical textiles account for a huge market owing to the widespread need for them, in the hospital, hygiene, and health care sectors. There has been a sharp increase in the use of natural as well as synthetic fibers for producing various medical products. Growth of medical textiles can be considered as one such improvement, which is really meant for changing the painful days of patients into relaxed days.

In today's health care atmosphere, textile products are ruling innovative presentations which were not presumable just a few years ago. The significance of textile materials in the medical ground is formed to their excellent physical properties, such as strength, extensibility, flexibility, suppleness, air and moisture permeability and wicking. Environment consciousness also ranks high buying potential. All these factors have led to an increased demand for medicated products preferably obtained from natural and renewable sources.

Wound-healing depends not only on medication but also on suitable dressing materials. Dressings should be easy to apply, should be painless on removal, should create the optimal environment for wound-healing, and should require fewer dressing changes, thereby reducing nursing time. Wound-dressing materials are mainly classified as absorbent and non-absorbent, depending on the type of fibers used. Dressings differ with the nature of wound and wound management. Bandages and wound dressings are most usually used because they are reasonable and ecofriendly.

Gauze and bandage fabric are very important in health care issues. It is mainly used for the healing purpose of the human body [4]. Cotton fabric is known for its soft and comfortable wear, it is worn close to skin because of its good moisture absorption qualities and charges of static electricity do not build up readily on the clothes [5]

Gauze is a loose open weave fabric it is translucent in nature. The plain weave is variously known as Calico or Tabby Weave [6].Cotton bandages and cotton gauze drop under the group of main wound dressings and are positioned next to the wound surface and are usually secured by materials of several types to absorb the wound discharge and minimize saturation. In technical expressions "gauze" is a weave arrangement in which the weft yarns are organized in pairs and are intersected before and after each warp yarn keeping the weft firmly in place. The basic requirements of gauze fabrics are revealed in table I,

TABLE I

S. No.	Characteristic	Requirement
1	Count of yarn (for guidance only) a) Warp b) Weft	17 to 25 tex (24s to 34s) (17 to 25 tex) 24s to 34s)
2	Threads/dm a) Ends, Min b) Picks, Min	75
3	Mass, g/m2	55
4	Length, m Tolerance	30 + 5
5	Width, cm Tolerance	As agreed - 2 percent
6	Absorbency	10 seconds, Max
7	PH value of aqueous extract	6.5 to 8.5
8	Scouring loss	1 Percent, Max
9	Freedom from optical whitener	Non fluorescence

Basic requirements of Gauze

This weave structure is used to add firmness to fabric, which is significant when using fine yarns loosely spaced. However, this weave construction can be used with any weight of yarn and can be seen in some rural textiles made from rough hand-spun plant fiber yarns. Some of the objectives of Gauze are

- To support wound healing.
- To decrease the discomfort of the wound.
- To arrest the wounded part of body.
- To safeguard the wound and surrounding tissues.

- To keep the wound clean and prevent infection by foreign bodies.
- To reduce the risk of bacterial contamination.

Consumers desire specific performance characteristics in fabrics. They want fabrics that will serve particular functions [7]. Terminalia chebula is a rejuvenative, purgative (unripe), sharp (ripe), anthelmintic, nerving, cough medicine, tonic, carminative, and hunger stimulant. It is also consumed by peoples who have leprosy (including skin disorders), anemia, narcosis, piles, chronic, intermittent fever, heart disease, diarrhea, anorexia, cough and excessive secretion of mucus, and a range of other illnesses and indications.

NEED OF THE STUDY:

During the past few years the world is starting to wake up to the idea of Ecofriendly fabrics. There is an increasing awareness to produce biodegradable products in healthcare textiles. Hence an attempt is made to finish the cotton gauze with ecofriendly herb extract which imparts wound healing properties.

OBJECTIVES:

- To select the Ecofriendly biodegradable cotton material
- To identify the natural wound healing herbs
- To select the proper method of application of herbal extract
- To analyze the Antimicrobial property and wound healing property with different proportion.
- To develop the medicated gauze which safeguard the wound?

RESEARCH METHODOLOGY

SELECTION OF FABRIC

A bleached white cloth or fabrics called medical gauze are used in bandages, dressings, and surgical sponges and are the most widely used in wound care dressing. Woven cotton gauze has a loose, open weave structure which allows fluids to be absorbed from the wound into the fibers that are wicked away, or passed through into other absorbent materials in the wound's dressing. So 100% cotton gauze is selected for the study.

SELECTION OF BINDER

The binder is a film-forming agent made up of long-chain macromolecules applied to the textile material. Citric acid is considered to be a good cross-linking agent or binder. Citric acid is used to carry out pH adjustment, replacement agent for more corrosive acids and textile finishing, based on the above the investigator selected citric acid as the suitable cross-linking agent for the present study.

EXTRACTION OF THE NATURAL SOURCE

The seeds of Terminalia Chebula were collected and it has been dried under the shadow of sunlight to remove the moisture content present in the seeds. The dried seeds were ground into powder. The powder is mixed with ethanol and the solvent is extracted by using Soxhlet apparatus at 78^{o} Celsius for about one cycle. This cycle is repeated many times, over hours or days. After many cycles, the required solvent extraction is removed and stored. The non-soluble percentage of the solid remains in the cover and is thrown out.

The extracted solution and water was taken in a beaker in three different proportions 50, 75 and 100 percent. The 100 percent extracted solution shows good healing activity. Hence it was chosen for this study.

METHOD OF FINISHING

The aim of finishing is to render textile goods fit for their specific purpose or end use [8]. All types of finish can be applied to fabrics by using the following methods:

- Exhaust – Ideal for batches of fabrics or even finished garment.
- Padding – Ideal for continuous production runs.
- Spray – Ideal for flexible sample production or as a possible
- Foam – Ideal for carpet treatment is normally added to other foam treatments when they were applied.

The padding treatment gives uniform application throughout the body of the fabric. Thus the padding process was selected for this study.

RESULTS AND DISCUSSION:

ABSORBENCY TEST RESULT (WICKING HEIGHT):

A well absorbent fabric behaves as a wick and water rise through it against gravity. If the water is stained with dye, the height of the water level moving through the fabric strip can be distinguished. Wicking height is greater for good absorbent fabric. The below table II shows the wicking behavior of both treated and untreated samples.

TABLE II

Samples	Wicking Behaviour		
	1 min	5 min	10 min
A	8cm	10cm	11cm
B	8cm	12cm	14cm

Absorbency Test

A – Untreated Sample, B – Treated Sample

The above results show that the treated sample has high absorbency and high wicking behavior.

ANTI-MICROBIAL TEST:

Antimicrobial textiles are a huge investigation focus in the textile industry. There is an apparent need for creating reusable and durable antimicrobial textiles [9]. First, the antibacterial test is done on the crude extract of the Terminalia Chebula using Disc diffusion method with different concentrations, before applied to the gauze fabric.

The Crude extract of Terminalia Chebula (Kadukkai) at different concentration (100, 200, 300 and 400µl) was tested against Protease mirabilis, Vibrio cholerae, Staphylococcus aureus, Pseudomonas spp, and H. pylori at 37^{o}C for 24 hr. The crude extract exhibited more bactericidal action (Table-1) with higher inhibition zone was found at 400µl concentration. Table III shows that H. pylori showed higher bacterial growth inhibition than the other bacteria.

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TABLE III

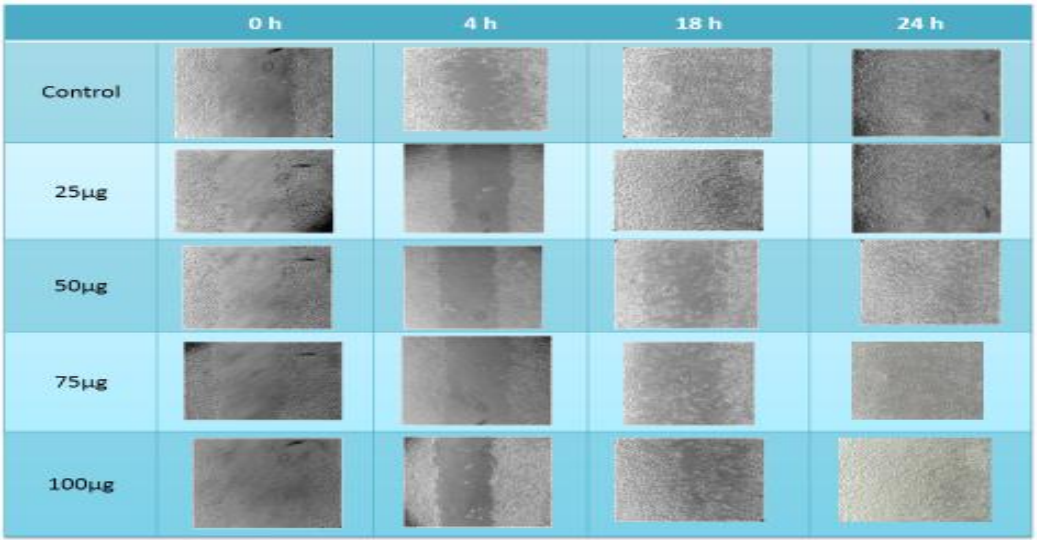
Test Micro organism	Zone of inhibition (mm)[2]			
	Different Concentration of crude Extracts (ul)			
	100 µl	200 µl	300 µl	400 µl
Protease Mirabilis	09	14	16	18
Vibrio Cholerae	7	10	13	16
Staphylococcus aureus	10	13	14.5	17
P Seudomonas sppa	07	11	13	16
H. Pylori	08	12	16	19

Antimicrobial activity

WOUND HEALING ACTIVITY TEST FOR TREATED FABRIC

L929 cells were grown in 24 well plates at a density of 1 × 105 cells/ml and cultured until ~ 80% confluency. A small linear scratch was created in the confluent monolayer by gently scraping with sterile cell scrapper as per the method described by Liang et al. (2007). Cells were thoroughly rinsed with 1 × PBS to remove cellular debris and treated with different concentrations of the test sample. Cell proliferation was monitored at different time points: 0 hr, 4 hr, 18 hr, and 24 hr. Figure I shows the images of the migrated cells were taken at all different time points in the inverted phase contrast microscope.

Figure I



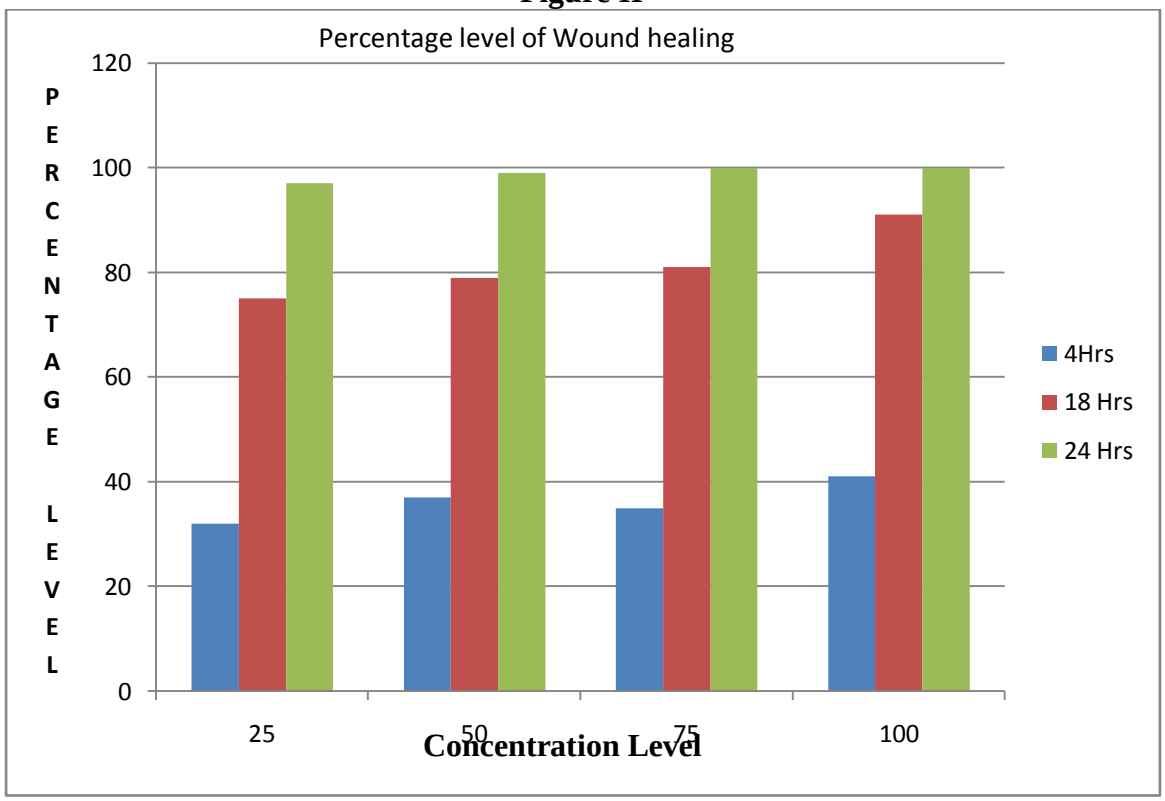
Images of migrated Cells at different time points

TABLE IV

Sample Name	Conc.(ul)	Wound area (um)	Time intervals (h) and percentage of healing (%)			
			0	4	18	24
Kadukkai Terminalia Chebula	25	107		32	75	97
	50	118		37	79	99
	75	112		35	81	>99
	100	112		41	91	>99

Wound Healing Test at different time intervals

Figure II



Wound Healing Test at different time intervals

Table IV and Figure II clearly explains the different percentage level of wound healing at different time intervals.

CONCLUSION

Wound healing is a natural process that starts with pain and ends with mark formation. The present review clearly revealed that nature provides a huge number of plants that show significant wound healing activities.

A novel approach for wound healing finish was developed. This approach reveals that Terminalia Chebula exhibits both Antimicrobial and wound healing property. Also, it can be observed that natural wound healing property such as Terminalia Chebula on cotton woven gauze was found to be good in its performance.

The present investigation shows the possibility of wound finish using natural herb on cotton fabric. The same herb may be treated with different medicinal fiber with different extraction methods to identify the best wound healing finish, in further studies.

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REUSE OF EFFLUENT TREATED WATER FOR WET PROCESSING– PRINTING

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ABSTRACT

Environmental protection has become a universal concern. In industrial countries, there is an increasing demand for eco textiles and eco garments. Eco textiles are those which do not contain any hazardous or toxic substances and which are biologically degradable so that they do not cause any damage to the environment and ecology. Water is probably the most important natural resource in the world, since without it life cannot exist and industry cannot operate. Water is the number one chemical on consumption list and no other chemical is being consumed in quantities in which water is consumed. More importantly there is no substitute of water. It is therefore important to control the quality of water and also take a rational approach to its utilization for economy.The environment is a legacy that the past has left for us to cherish and enjoy. Industrial growth is the driver for progress and economic well being in the future. It is now up to us to marry the two, and reap the resultant benefits for many years to come. Hence the major objective of the study is to reuse effluent treated water for wet processing– Printing.

KEYWORDS: *Resultant, Consumed, Degradable*

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1. INTRODUCTION

Industrial advancement has its cost in the degradation of natural resources. The awareness of the ill effects pollution created by uncontrolled human activity related to industrial development has resulted in looking at ways and means in reducing pollution.Water is probably the most important natural resource in the world, since without it life cannot exist and industry cannot operate. Water is the number one chemical on consumption list and no other chemical is being consumed in quantities in which water is consumed. More importantly there is no substitute of water. It is therefore important to control the quality of water and also take a rational approach to its utilization for economy. Hence the major objectives of the study are:

i) To reuse effluent treated water for wet processing- Printing

2. EXPERIMENTAL PROCEDURE

2.1 SELECTION OF MATERIAL

Cotton has always ruled the textile world, being, known as king among fibres. Cotton has a high versatility, aesthetic value, is a renewable source and an agricultural commodity views Ragavan (2001).The investigator selected grey cotton for the study. For this purpose, ten meters of pure cotton material was purchased from Erode.

2.2 FABRIC PARTICULARS

Fibre	:	Cotton
Fabric	:	Grey
Fabric Warp Count	:	20’s
Fabric Weft Court	:	16’s
Reed	:	54
Pick	:	48
Width	:	48”
Weave	:	Plain Weave
Price per meter	:	Rs.20/-

2.3 SELECTION OF SITE

The site selected by the investigator to collect effluent treated water, well water and softwater and to conduct the study was Sivasakthi Dyeing Unit, a small scale jig dyeing unit located in Sulai, VeerappanChatram, Erode. The Unit dyes cotton fabric in jig dyeing machine that has a capacity of dyeing about 500 kg of cotton cloth per day.

2.4 SELECTION OF WATER

Water is the only material that is used several hundred and thousand fold than any other chemical or material opines Manivasakam (1995).

The investigator has selected three different sources of water namely Soft water (supplied by the municipality), Well water (obtained from a well near the site) and Effluent treated water (obtained from the effluent treatment plant of the unit) and has subjected the cotton fabric to various wet processing treatments with the three different sources of water. The process of printing is discussed in this paper

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2.5 PROCESS PARAMETERS

The bleached and mercerized fabric was hand screen printed using the following recipe.

TCL Binder: Turpetine Oil = 1:8

Pigment- 5 g.

3. RESULTS AND DISCUSSION

3.1 EVALUATION OF PRINTED SAMPLES

The printed samples were evaluated for general appearance, evenness of print, texture, sharpness of print and lustre.

TABLE – 1 EVALUATION OF PRINTED SAMPLES

S.No.	Particulars		Judges Rating (in percentage)		
			PRS	PRW	PRET
1.	General appearance	G F P	90 10 -	85 10 5	92 6 2
2.	Evenness of print	E M U	94 4 2	94 6 -	94 4 2
3.	Texture	S M R	94 4 2	92 6 2	94 2 4
4.	Sharpness of print	S M P	90 10 -	90 8 2	92 6 2
5.	Luster	L M D	94 6 -	95 5 -	94 6 -

Key:	G - Good	E - Even	S - Smooth
	F - Fair	M - Medium	M-Medium
	P - Poor	U - Uneven	R - Rough
	S - Sharp	L - Luster	DYS- Dyed with soft water
	M-Medium	M-Medium	DYW- Dyed with well water
	D-Dull	D-Dull	DYET-Dyed with effluent treated water

From Table-1 it is clearly evident that the general appearance, evenness of print, texture, sharpness of print and luster of samples printed over fabric processed with all the three kinds of water were rated as good by almost more than 90 per cent of the judges. It may be noted that the samples printed over fabric process used effluent treated water has the good general appearance and sharp print.

4. SUMMARY

The need for water conservation is accepted regionally as well as globally. Textile Processing has a very high water consumption, which may vary from 30 to 50 m^3/l depending on the product and processing stages required. Hence steps have been taken to reduce the liquor/material ratio, increase the dye bath exhaustion, production modification and reuse of wash baths with or without intermediate precipitation filtration which has resulted in considerable reduction in water treatment cost and has led to enable repeated reuse of dye bath and wash water.

The main objective of the study was to evaluate the feasibility of using effluent treated water in place of soft water or well water for the chemical processing of textiles.To this end, a selected grey fabric was divided into three portions and each portion was desized, scoured, bleached, mercerized and printed under identical conditions, using soft water, well water and effluent treated water. The fabrics were evaluated for visual appearance in all the three cases.

5. CONCLUSION

The conclusions of this study are as follows.

i) The use of effluent treated water in place of well water or soft water is a feasible and economical alternative in chemical processing.

ii) The use of effluent treated water in dye houses will serve two purposes. One is that it will conserve the use of well water in these days of acute water shortage. The other and more important purpose is that it would result in large savings for dye houses that buy water in tankers, especially during the dry summer months, or if they do not have their own wells.

iii) The process of dyeing and printing require the use of soft water to get the maximum colour yield and money value from the processes. The use of effluent treated water, which has better characteristics than well water, will obviate the need for dye houses to establish expensive water softening plants.

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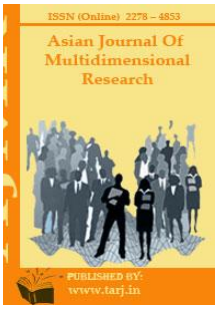

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UGC APPROVED JOURNAL

TRANS Asian Research Journals

PROLOGUE PAVEWAY OF HERBAL DYED MEDICAL PRODUCTS TOWARDS GREEN CONSUMERISM

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ABSTRACT

Green fibres in textiles provide a way for healthy, comfortable clothing, which ultimately will be fully biodegradable.Eco friendly textiles and fabrics cover a wide range of natural and recycled fibres. Eco textiles are those which are produced from eco-friendly manner and processed under eco-friendly limits. Eco friendly fabrics are considered eco-friendly, due to their availability from nature without any harmful effects. Due to increasing demand and to the higher profit resulting from the sale of products with environmental benefits, a new trend is gaining ground which is called as green marketing or green consumerism.Dyeing eco textiles using green herbal plants invoke green consumerism of utilised goods which serve consumers to a great extent,as are recently called as Herbal Textiles or Herbal Clothing's. Herbal Clothing is believed to help restore balance within the body's systems and strengthen the immune system. As major emphasis is now given to eco-friendly production technique such as herbal application on clothing, this study focusses on the selection of certain selected herbs and its application on eco-friendly fabrics,converting the same into medical products to heal certain common ailments.The outcome of the results from subjects proved to be satisfactory.

KEYWORDS: *Eco Textile, Green Consumerism, Herbal Textile.*

INTRODUCTION

Organic and eco textiles cover a wide range of natural and recycled fibres. The term "eco textiles" refers to a select group of textiles that have reduced carbon, energy, and pollution impact when compared to the standard methods used to produce textiles and manufacture clothing.The textile industry is today one of the biggest greenhouse gas emitters GHG) on earth owing toits size and scope. The eco problems in textile industry occur during any phase of development of a textile product. There are four major environmental factors associated with the making of textiles: water, energy, pollution and the use of non-renewable resources. Sheeba (2015) suggests therefore the need for eco textiles is very much felt in the textile world.

Renewable resources are gaining popularity among the people due to their positive effects on agriculture, environment and economy. The use of natural renewable sources for the generation of textiles includes lowest practical ecological impact during the growth stage and in the processing of textile products.Green textiles refer to clothing and other accessories that are designed to use organic and recycled material, raw materials, dyes, chemicals and textile processes.

Environmental activism among consumers has progressed due to more individuals adopting eco-friendly habits. Consumers are becoming increasingly very much conscious to environmental friendly consumer goods.They choose products which are non-toxic and cause no harm to both the human society and the environment. This tendency for eco-friendly products has been extended to textile and apparel products, particularly those products which directly come in to contact with the skin for prolonged period of time, states Kumar(2013). Consumers' eco-sensitive attitudes and behaviours have led to a new kind of shopping called as Green consumerism.

Dyeing eco textiles using green herbal plants invoke green consumerism of utilised goods which serve consumers to a great extent, as are recently called as Herbal Textiles or Herbal Clothing's. When the textile is dyed with the extractions obtained from various herbs, they are referred to as *Herbal Textile*. Herbal substances are a diverse range of botanical materials including leaves, herbs, roots, flowers, seeds, bark etc. When the dyeing is done with herbal extractions, no chemicals are used in its dyeing process. Medicinal plants offer alternative remedies with tremendous opportunities, states Arora et al. (2004).

The medicinal properties of herbs are known to cause no damage to the human body, declares Rangari et al. (2012). The herbs used for dyeing have traditionally been used for treating various ailments. Certain herbs contain natural energetic substances whose essence gently rectifies the underlying deficiencies. Therapeutic uses of medicinal plants in various ailments also have an additional important advantage of their easy availability suggestsPushpa (2013) The traditional medical practitioners widely use medicinal plants in their day to day practice. These Ayurvedic herbs are very effective in increasing the resistance of the body. This study was undertaken by the researcher keeping this in mind to cure certain ailments.

2 METHODOLOGY

2.1 SELECTION OF YARNS

The eco-friendly fibres likeorganic cotton and wool were taken in hundred per cent pure forms (100% C, 100% W) and were spun into yarns.

2.2 SELECTION OF FABRIC CONSTRUCTION

The selected hundred per cent organic cotton 100% C and wool 100% W yarns were then constructed into fabric by handloom weaving. Hence hundred per cent handloom woven organic cotton (100% HC) material and hundred per cent handloom woven wool (100% HW) material were taken for the study.

2.3 SELECTION OF HERBS

The medicinal herbs Oregano, Calotropis Giganteawere selected for the study. Singletary (2010) suggest that Origanumvulgare is a powerful anti-bacterial and anti-fungal agent, oregano also has anti-inflammatory, antioxidant and anti-parasitic properties.CalotropisGigantea commonly known as Milkweed is used in cases of cough, asthma, bronchitis, dyspepsia, swellings and inflammations describes Sethi (2014).The leaf of Oregano herb and Milk weed herb were taken to desired quantity, washed, dried in shade and powdered.

2.4 SELECTION OF MORDANT

For the study Rhubarb (*Rheum* spp) was selected as a natural plant mordant. The leaves of rhubarb when boiled acts as a natural mordant, which is good for almost all the fibres. It gives a vivid colour ranging from reddish orange to brown shades.The leaf of Rhubarb herb was collected freshly before the process.

2.5 PREPARATION OF HERBAL SOLUTION

The required quantity of each powdered herb of Oregano and Milk weed were taken separately and mixed with water in the ratio of 1:50. It was then boiled at 75 - 80 degree Celsius for one hour until the herbal solution becomes a viscous consistency. Then the extracts of Milk Weed and the extract of Oregano leaves were filtered and set aside separately. The filtered extracts of oregano leaves and leaves of milk weed herbs were thus kept ready for further application purposes.

2.6 PREPARATION OF THE MORDANT

The leaves of the rhubarb were finely chopped into small pieces and is mixed with water in the M:L ratio of 1:30. The solution was then boiled in low temperature for one hour. The herbal extract was filtered from the solution which became a thick viscous consistency. It was then cooled and kept ready for application. Care should be taken to boil the solution in a well ventilated area, as the fumes can cause problems.

2.7 DYEING PROCEDURE OF THE SELECTED HANDLOOM MATERIAL

2.7.1 PRE-TREATMENT PROCESS

The hundred per cent handloom woven cotton 100% HC and hundred per cent handloom woven wool fabrics 100% HW which were selected for the study was immersed in water for about 10-15 minutes prior to the dyeing process for evenness in dyeing .

2.8 DYEING OF THE SELECTED HANDLOOM MATERIAL

The oregano herbal solution was taken and mixed with water in the ratio of M:L ratio of 1:20. The mordant solution of rhubarb leaves were also taken in the ratio of 1:0.5 and mixed along with the herbal solution The pre-treated cotton 100% HC and wool fabrics 100% HW were immersed in the oregano herbal solution and was boiled for half an hour at 60 degree Celsiusfor cotton and 20-30 degree Celsius for wool material .The same process was thus repeated for the Milk weed herbal

solution. Thus the following four herbal 100% - Handloom woven organic cotton + Oregano herb (HCO), Handloom woven organic cotton + Milk weed herb (HCMw), Handloom woven wool+ Oregano herb (HWO) and Handloom woven wool +Milk weed herb (HWMw) dyed materials were made ready for the study.

2.9 SELECTION OF PRODUCTS

Since Oregano leaves are good in treating knee pain, knee band (*K)* was selected and prepared for the study. Hence, Knee band was prepared from hundred per cent cotton HCO and wool HWO materials.

Milk weed herb was found to relieve pain in the heel and foot. Hence heel socks (*S)* were prepared and selected for the study. So, a pair of socks were prepared from hundred per cent cotton HCMw and wool HWMw fabrics.

Finally, products like HCO*K*, HCMw*S*, HWO*K*, HWMw*S*, were prepared from the herbal dyed 100% handloom materials. Thus four products were prepared for the final study.

2.10 SELECTION OF EVALUATION /TEST METHODS

2.10.1 PERFORMANCE STUDY

A performance study from the selected prepared products HCO*K*, HCMw*S*, HWO*K*, HWMw*S* was conducted by a clinical trial in a Nature Cure Centre. Five patients suffering from pain in knee and heel were selected. The patients suffering from knee pain were given HCO*K*, HWO*K* and patients suffering from heel pain were subjected to HCMw*S*, HWMw*S*.They were instructed to carry out the washing of the products with natural detergents and to dry them in shade to retain the medicinal properties. They were also instructed to keep them in a cool and dry place prior to use like medicines. The knee bands were worn for 7 hrs in the morning and heel socks were worn at night time for 7 hours. The performances of the selected products were evaluated once in every week and the clinical trials were conducted for 4 weeks duration.Detailed feedbacks from the patients and also from the doctors were collected every week regarding the performance of the product. They were asked about the comfort of wearing the product, whether it caused any problems while wearing the product like itching, swelling, colour bleeding/staining. They were also asked whether wearing the product made any significant changes in the area covered. The details of the performance study were consolidated and are given in the results and discussions.

2.10.2 DETERMINATION OF COLOUR FASTNESS OF THE HANDLOOM DYED SAMPLES

The four herbal dyed hundred per cent handloom woven organic cotton and wool material dyed with oregano and milk weed extracts HCO, HCMw, HWO and HWMw were subjected to sunlight, crocking, washing, perspiration and hot iron to find out the colour fastness of the dyed samples. 10 consecutive samples were prepared and subjected to each testing methods. Results for each test were recorded in the results and discussion

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3 RESULTS AND DISCUSSON

3.1 EVALUATION OF THE PERFORMANCE STUDY

For the clinical study five patients suffering from knee pain and five patients suffering from heel pain were selected for the study based on their personal approval. Subjects uffering from knee pain were asked to wear the hundred per cent herbal dyed HCO*K* and HWOK knee bands. Similarly, Subjects suffering from heel pain were given hundred per cent herbal dyed socks pair HCMw*S* and HWMw*S*.

The knee bands were given to five patients having knee pain due to prolonged sitting and also while driving vehicles. Each subject was given HCO*K* and HWO*K* knee bands. The prepared knee bands were used while they were in the above conditions. The knee bands were worn for 7 hrs in the morning.

Heel socks were given to five patients having heel pain due to overweight and also stress placed on heels due to wearing improper sandals. Each subject was given HCMw*S* and HWMw*S* herbal heel socks. The heel socks were worn at night time for 7 hours.The results are given in a concise format in Table I

TABLE I: PERFORMANCE OF THE HERBAL DYED PRODCTS

Fabric	**Disease Selected**	**Product Developed**	**Performance of the product**					
100% Handloom Herbal Dyed			**Comfort**	**Itching**	**Swelling**	**Colour Bleeding**	**Colour Staining**	**Curative performance of the product**
HCO*K*	Knee Pain	Knee Band	Good	No	No	5	Nil	5
HWO*K*	Knee Pain	Knee Band	Good/ Excellent	No	No	5	Nil	5
HCMw*S*	Heel Pain	Socks	Good	No	No	4/5	Nil	5
HWMw*S*	Heel Pain	Socks	Good/ Excellent	No	No	4/5	Nil	5

Ratings: 5-Excellent, 4- Very good, 3- Good, 2- Fair, 1- Poor

The feedback collected along with the doctor from the subjects revealed that the patient felt comfortable while using the product. There was no discomfort from the product, for cotton and wool yarns, and the herbs gave them a smoothing effect after a prolonged usage which was a relief to the pain. They didn't have any itching, swelling or colour bleeding/staining from the product. Most of the patients also stressed their view that products made out of wool produced warmth effect which was smoothing at times of pain.

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3.2 EVALUATION OF COLOUR FASTNESS OF THE HANDLOOM DYED SAMPLES

The hundred per cent handloom woven and herbal dyed HCO, HCMw, HWO and HWMw materials were subjected to sunlight, washing, wet and dry crocking, acid and alkaline perspiration and to hot iron and the result is shown in Table II.

TABLE II: COLOUR FASTNESS OF THE HANDLOOM DYED MATERIAL

Fabric	Colour Fastness tests											
100% Handloom Herbal Dyed Material	Sunlight		Rubbing		Washing		Hot Iron		Perspiration			
									Acid		Alkaline	
	Cc	Cs	Cc	Cs	Cc	Cs	Cc	Cs	Cc	Cs	Cc	Cs
HCO	4	4	4	5	5	4	5	4	3	3	4	4
HWO	5	4	5	4	4	4	5	4	4	4	5	4
HCMw	3	5	3	4	4	4	5	4	4	5	5	4
HWMw	5	4	4	4	5	4	5	4	4	4	5	4

Ratings: 5-Excellent, 4- Very good, 3- Good, 2- Fair, 1- Poor

The hundred per cent handloom woven and herbal dyed HCO, HCMw, HWO and HWMw materials were subjected to sunlight, washing, wet and dry crocking, acid and alkaline perspiration and to hot iron showed no colour change. Colour staining was also very good in all the four samples. This showed good to very good to excellent results.

4 CONCLUSION

Textile contributions to diminish global warmingare of developing eco-friendly fibres and textileswhich is a remedial measure to reduce the environmental pollution.Herbal clothing is devoid of toxic chemicals and irritants and is absolutely organic and biodegradable viewsRangari et al. (2012). Herbal extracts and plant products are coated on textile surfaces and used in medical and protective textiles. Such products will have the functionality of textiles as well as the curative ability of the herbal compounds. Herbal dyes also enhances the aesthetic quality of fabrics in an eco friendly way. This eco-friendly green initiative isa highly supportive ingenuity with the low carbon foot print, mainly offering added advantage towards green living.

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SPECIAL ISSUE

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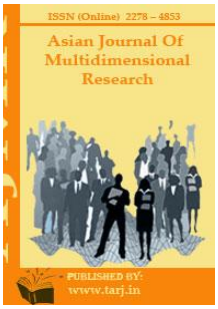

Asian Journal of Multidimensional Research (AJMR)

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A STUDY ON THE ECO FRIENDLY NATURAL DYEING OF SANDYNO WOOL YARNS

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ABSTRACT

Wool, a supremely oldest and universally valuable eco – protein fibre which can enhance other fibre properties when blended, extends its application into a new product playing a pivotal role in the textile industry. Natural dyes also provide a creative natural finish to the textile materials. Wool dyeing, to improve its quality and appearance both in the pure and blended form is a challenging art. Colouring of wool enhances its beauty and luster. Colouring started with natural resources and because of its limited shades and fastness synthetic dyes over took the natural dyes. This study focused on the selection of the new developed geno type sheeps wool from Sandynila, Ooty, Tamil Nadu and blending it with other natural vegetable and protein fibres which will result in obtaining of new spun wool yarns with selected proportions, eco dye the same and make wool as best suited for apparel production suitable for green consumerism.

KEYWORDS: *Eco Protein Fibre, Natural Dyeing, Wool.*

INTRODUCTION

Natural dyes also provide a creative natural finish to the textile materials annotates Thangavelu (2001) et al.India has a long, rich cultural heritage and tradition of dyeing textiles and handicrafts with natural dyes obtained from natural resources such as plants and herbs. Wool like cotton is considered a relatively easy fibre to dye. It is more readily dyed due to the polarity of its polymers and its amorphous nature. Wool dyeing, to improve its quality and appearance both in the pure and blended form is a challenging art. Wool is being dyed in India since long. Wool dyeing can be done in top, yarn or fabric stages. Colouring of wool enhances its beauty and luster. Colouring started with natural resources and because of its limited shades and fastness synthetic dyes over took the natural dyes. People started accepting these synthetic dyes due to their dark and vivid shades and good fastness properties. Now people are aware that these synthetic cause number of hazards to life like health, environmental etc. They are looking back for their renewal of natural dyes that can produce vivid shades with good fastness properties. Both the dyeing and spinning technicians have an upper hand in the job market. Shankar and Vankar (2005) predict awareness and concern for the environmental issues has led to extensive research for use of natural dyes for wool dyeing. In some parts of India, wool was dyed with natural dyes depending upon the availability of colour yielding raw materials and their end use.

2 METHODOLOGY

2.1 SELECTION OF WOOL FIBRE

Sandyno wool fibre obtained from Sandinila, Ooty, Tamil Nadu, was selected for the study.

2.2 SELECTION OF WOOL YARNS AND ITS BLEND

A pure wool yarn and two types of wool blended yarns, were spun as 100% Sandyno (100% S), 50:50 Sandyno (50:50 S) and 60:40 Sandyno (60:40 S) and taken for the study

2.3 SELECTION OF DYE

Eclipta, Turmeric and Sevalli were selected for the study. The dye materials were dried in shade and powdered. The dye per centage used for the study was 2%, 4% and 6%.

2.4 SELECTION OF MORDANTS

Bio-Mordants namely Karuvelam Bark and Myrobalan were undertaken for the study. The mordants were used in one per cent concentration.

2.5 SELECTION OF AFTER TREATMENT

Natural fixing agent Amaranthus Linn was used for the study.
[www.jungleseeds.com/AmaranthEdible, www.evergreenseeds.com/edamallred.html].

2.6 OPTIMIZATION OF DYEING VARIABLES

A series of experiments were conducted to determine the medium for dye extraction, optimum concentration of dye material, time of extraction of dye, dyeing time and concentration of mordants.

2.7 MEDIUM OF DYE EXTRACTION

Dye from Eclipta, Turmeric and Sevalli were extracted in aqueous medium.

2.8 METHOD OF MORDANTING

The wool samples were mordanted by four mordanting techniques. Pre-mordanting (mordanting before dyeing), Simultaneous mordanting (mordanting and dyeing together), Post mordanting (mordanting after dyeing) and Pad mordanting (mordanting is carried out before and after dyeing).

2.9 OPTIMIZATION OF DYE EXTRACTION TIME

Known amount of dye material was taken in three beakers, each containing 100ml of water and selected medium. The dye was extracted after soaking for 48 hrs, 30 min, 60 min and 90 min respectively. To each extracted solution known weight of woolen yarns were added and dyeing was carried out, per cent absorption was calculated for each sample and on the basis of results, time for dye extraction was optimized.

2.10 OPTIMIZATION OF DYE CONCENTRATION

To optimize the dye concentration dye solution of each concentration (i.e) 2%, 4% and 6% / 100 ml of water were prepared separately and optical density of each solution recorded before dyeing. After that wool samples were dyed in each of the respective dye solution. Optical density after dyeing was measured and per cent absorption was calculated for each sample. Based on per cent absorption, best concentration for Eclipta, Turmeric and Sevalli was optimized.

2.11 OPTIMIZATION OF DYEING TIME

Two dye solutions of Eclipta, Turmeric and Sevalli were prepared with optimized concentration of dye material and extraction time. To each solution known weight of woolen yarns were added and dyeing was carried out at 30 min, 45 min and 60 min respectively. Per cent absorption was recorded for each sample and based on results, best dyeing time was optimized for each dyes.

2.12 DYEING OF WOOLEN YARNS

After optimization of dyeing variables, known amount of woolen yarns were dyed with optimum concentration of dye at optimum dyeing time. Each 100% Sandyno, 50:50 Sandyno, 60:40 Sandyno wool yarn were dyed using eclipta, turmeric and sevalli natural dyes with 2%, 4%, 6% with bio mordant karuvelam bark, myrobalan 1% with four mordanting techniques pre, simultaneous, post and pad and finally dipped in bio fixing agent amaranthus linn. Using the following combination obtained 72 shades for each yarn, thereby obtaining a total of 216 shades for the study.

2.13 YARN TESTING

The yarn tests were carried out either after spinning or after dyeing to find out yarn count, yarn strength and elongation, colour measurement and absorption and colour fastness tests for yarn dyed samples.

3 RESULTS AND DISCUSSION

3.1 SELECTION OF OPTIMIZED DYEING VARIABLES

3.1.1 MEDIUM OF EXTRACTION

Dye for Eclipta, Turmeric and Sevalli were extracted using aqueous medium.

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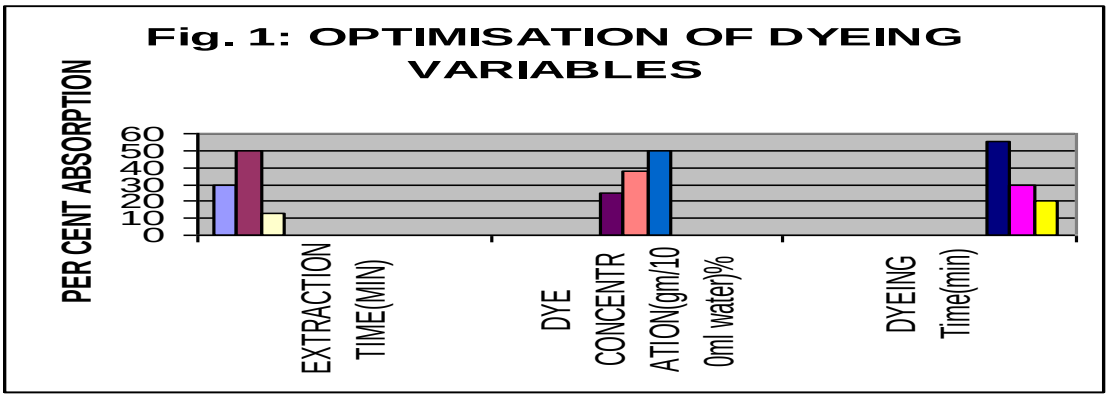
3.1.2 DYE EXTRACTION TIME

The dye was extracted at 30 min, 60 min and 90 min and the results are shown in Fig.1. Figure shows that maximum per cent absorption was found to be 60 min after soaking for 48 hrs, therefore it was selected as optimum.

3.1.3 DYE CONCENTRATION AND DYEING TIME

Woollen yarns were dyed with different concentration of Eclipta, Turmeric and Sevalli at different time. Maximum per cent absorption was obtained with 6% of dye per 100 ml of water and at 30 min dyeing time, as optimum and is shown in Fig.1.



3.1.4 SELECTED SHADES FOR WOOLEN YARNS

Out of the Seventy two shades obtained for each 100% Sandyno (100%S), 50:50 Sandyno (50:50 S) and 60:40 Sandyno (60:40 S), one shade was selected based on the visual evaluation by a panel of judges for each wool yarn as shown in Table I

TABLE I: SELECTED DYE SHADES FOR FINAL STUDY

S.NO	WOOL YARN	NATURAL DYE	NATURAL DYE %	BIO-MORDANT 1%	MORDANTING TECHNIQUE	BIO FIXING AGENTS
1	100% S	ECLIPTA	4%	KARUVELAM BARK	PRE	AMARANTHUS ASH
2	50:50 S	TURMERIC	6%	MYROBALAN	PAD	
3	60:40 S	SEVALLI	6%	KARUVELAM BARK	SIMULTANEOUS	

3.1.5 FASTNESS GRADES

The Colour Fastness Properties of 100% S, 50:50 S and 60:40 S, natural Colours extracted from Eclipta, Turmeric and Sevalli were found to be very fast on woollen yarn. The initial fastness grades shows 2-3. But after the application of fixing treatment to the woolen yarns the fastness grades increased to 4 – 5, which reveals that sunlight fastness was excellent in all the samples. No colour change and staining were noticed to washing. No colour staining was found in dry and wet rubbing whereas no colour change was there in dry crocking but negligible to slight colour change was found to be in turmeric dye in wet crocking. Dye was found to be resistant to perspiration. In

case of colour change negligible change was found in both acidic and alkaline perspiration but whereas no samples showed colour staining.

3.2 YARN TESTS

3.2.1 YARN COUNT

The yarn counts of 100% S spun wool yarn was 2.16s Ne, 50:50 S spun wool yarn was 1.74s Ne and 60:40 S spun wool yarn was 1.60s Ne.

3.2.2 SINGLE YARN STRENGTH TEST

The three spun wool and wool blend yarns were tested to find out their strength for original spun wool yarns and dyed wool yarns and the result is shown in Table II and Fig.2.

TABLE II: SINGLE YARN STRENGTH

S.NO	SPUN WOOL YARNS	MEAN STRENGTH (g)	S.D	S.E	CV%	t (PAIRED)
1	1o 1d	829.24 1756.71	185.41 139.94	41.46 31.30	22.36 7.97	18.469**
2	2o 2d	1438.19 1192.01	104.98 195.96	23.47 43.24	7.30 16.44	4.972**
3	3o 3d	2169.97 1859.14	144.63 246.64	32.34 55.15	6.66 13.27	5.428**

** - Significant at one per cent level

From the above Table II, it is evident that the strength of the dyed yarn has increased for 100% Sandyno Yarn. A maximum increase of 111.8 per cent is seen in between sample 100% Sandyno Yarn and the result shows that the strength of the original spun wool yarns and dyed wool yarns are significant at one per cent level.

3.2.3 SINGLE YARN ELONGATION

The spun three original spun wool and wool blend yarns and dyed wool yarns elongation is shown in Table III and Fig. 3.

TABLE III: SINGLE YARN ELONGATION

S.NO	SPUN WOOL YARNS	MEAN ELONGATION %	S.D	S.E	CV %	t (PAIRED)
1	1o 1d	19.71 12.09	2.45 1.33	0.55 0.30	12.42 11.02	10.764**
2	2o 2d	15.20 11.09	1.58 1.62	0.35 0.32	10.38 14.59	8.459**
3	3o 3d	13.84 12.27	1.55 1.17	0.35 0.26	11.20 9.57	3.750**

** - Significant at one per cent level

From the above Table III, it is clear that all the dyed wool yarns have reduced in their mean yarn elongation per cent and the result shows that the elongation of the original spun wool yarns and dyed wool yarns are significant at one per cent level.

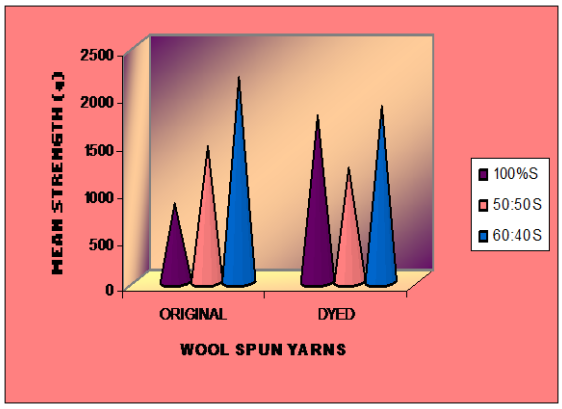


Fig. 2: SINGLE YARN STRENGTH

Fig. 3: SINGLE YARN ELONGATION

3.3 COLOUR MEASUREMENT AND ABSORPTION

The colour strength (K/S value) L, a, b values of D65 light at 10° absorber with its maximum wavelength and dye absorption % (Dye pick up) is shown in Figs. 4,5 and 6. It is evident that the dyed wool yarns had very good colour strength and the dye had absorbed to its maximum at the given wavelength

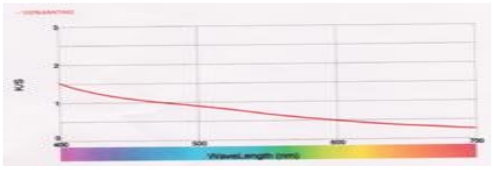


Fig. 4: 100% SANDYNO

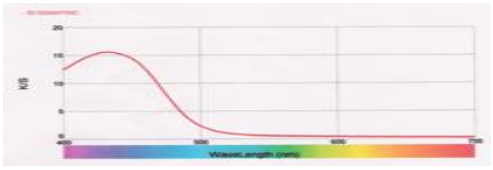


Fig. 5: 50:50 SANDYNO

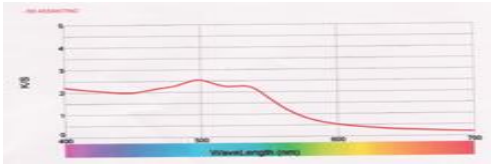


Fig. 6: 60:40 SANDYNO

Wool, a supremely valuable fibre which can enhance other fibre properties when blended, extends its application into a new product playing a pivotal role in the textile industry. Wool is an ideal fibre for use in the construction of clothing, attractive in appearance, pleasing to touch, dye easily and permanently and resilient enough to retain their shape. Wool never wears out, not absorb odors, afford protection from heat and cold alike and easily cleaned. In wool dyeing, with natural dyes, the depth of the dyeing was very good on wool under the same dyeing conditions as for other fibres. The natural products in general and natural dyes in particular are heading towards a period of renaissance nationally and internationally after one and half centuries. The increasing interest in natural dyes lately is due to the public awareness of ecological and environmental problems related to the use of synthetic dyes and the world of growing environmental consciousness, natural colourants have attracted the attention of everyone. A major emphasis is now given to eco friendly production technologies also. Due to increasing demand and to the higher profit resulting from the sale of products with environmental benefit, a new trend is gaining ground which is called as green marketing or green consumerism.

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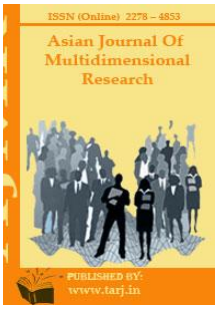

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UGC APPROVED JOURNAL

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DEVELOPMENT OF NONWOVENS USING COIR FIBRE AND IT'S BLENDS WITH OTHER FIBRES

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ABSTRACT

Needle punched nonwovens have been developed by blending natural fibers such as coir and sisal with recycled PET staple fibers in four different ratio's to improve the stability and to provide thermo formability to the nonwovens.. Physical properties such as tensile strength, elongation, stiffness, thickness and weight were studied for all the samples. It was observed that the sample S4 showed higher tensile strength, stiffness, air permeability, thickness with lower elongation and weight. The results depicts that fabric S4 can be applied as mulching sheet to ensure weed control due to its good strength accompanied with good moisture retention capacity. It suits well for most light weight structures in composites and in automobile applications as interior mats.

KEYWORDS: *Coir, needle punching, physical properties, sisal, web formation.*

INTRODUCTION

Natural fibres are gaining attraction in every segment due to their biodegradable and eco-friendly nature remark Kanimozhi and Vasugi (2012). According to Bhatia and Smith (2008) India remains as one of the leading producer of coir fiber in the world. Nearly 70% of these coir fibres produced remains squander. This fibre has good tensile properties with better resistance to microbial degradation. Blending of one or two fibres offers an effective means of projecting the positive attitude and overcoming the negative ones. Hence in this study an attempt has been made to develop needle punch nonwovens using coir fibre by blending with PET and sisal fibre.

Coconut fiber is commonly called as coir but it was also termed as palm peat, coco peat, cocos, kokos Morgan (2005). These fibers are commonly grown in the tropical regions, such as India, Sri lanka, Malayasia, Indonesia and Philipines say Vijayakumar and Vittopa (2006). Gupta (2005) suggests that there are two distinct varieties of coir- white fibre and brown fibre. White fibre is extracted from retted coconut husk. Brown fibre is extracted from unretted husk.

Coir is a multi cellular fiber with the length varying from 50 mm to 150 mm and the diameter varying from 12 to 24 microns. Among all the natural fibers coir has the highest tensile strength and it retains much of the tensile strength under wet conditions. It contains 30 to 300 or more cells in its cross-section. The cross-section of fiber is polygonal to round. The fiber is mainly composed of cellulose and lignin along with hemi cellulose, ash and pectin. Cells of the fiber are sometimes covered with silicised stigmata remark Mahish and Nayak (2007).

METHODOLOGY

The methodology consists of the following steps:

SELECTION OF FIBRES

The natural fibres namely coir and sisal were blended with recyclable PET fibers to improve the stability and to provide thermoformability to the nonwovens. Coir and sisal fibers were procured from local market in Salem, and PET fibers from Webtech Industries Chennimalai were selected for the study. The blend proportions used were indicated in Table.1.

TABLE 1 PROPORTION OF FIBRES TAKEN FOR MIXING

Samples	Proportion (per cent)		
	Coir	Sisal	PET
S1	50	-	50
S2	70	-	30
S3	25	25	50
S4	35	35	30

CONVERSION OF FIBRES INTO FABRIC

The Preparation of fibres includes preopening (fig.1), mixing (fig.2), coarse opening, fine opening and finally web former feeding.

Fig. 1 Fibre opening

Fig. 2 mixing of fibers

PRE-OPENING

The opening process mechanically separates the fibers from each other thus creates a 'cloud' of fibre. Rieter MBO type of machine was used for this study which produces smaller tuft fibres, thus creating a large surface area.

MIXING

The fibres after pre opening were intermixed before they enter into the card. The fibers were passed into the mixing zones by air suction.

FINE OPENING

Fine fiber opening was essential to improve the intimacy of the blend and to achieve good web qualities in the down-stream processes. So the fibre were passed through a Erko fine opener which suits best for opening and cleaning of natural fibers.

CARDING

The carding operation was done in order to remove any impurities and to separate fibers, thus align and deliver the fibers as a web opines Singh (2010).

CROSSLAPPING OR LAYERING

A single layer of carded web was too light to convert into a needle punch fabric. Hence crosslapping (fig.3) was done to control the thickness of the web.

NEEDLE PUNCHING TECHNIQUE

The web was passed into the preloom and then through the main loom for converting it into fabric by needle punching process (fig.4). Thus the integrity and strength of the web was improved (www.scribd.com).

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Fig. 3 Cross lapping

Fig. 4 Needle punching

EVALUATION OF THE FABRICS

BREAKING STRENGTH AND ELONGATION

ASTM D 5035 cut strip method was used for measuring strength and elongation of nonwoven fabrics. The samples were tested for tensile strength in Eureka cloth tensile strength tester. 10inches x 2inches specimen from each fabric samples were cut both in machine and cross directions. The specimen was placed between the upper and lower clamps. The dial reading was set to zero by adjusting the pendulum over the quadrant scale. The elongation pointer was checked for its position in zero. Before starting the machine the pendulum lock was released and machine was switched onto run. When the fabric started to break the machine was switched off and the dial reading in kilogram was noted. Elongation reading was recorded from the elongation scale. The specimen was removed and the machine positioned back to original and the five specimens of both the directions for each sample were tested and readings were noted.

FABRIC WEIGHT

Saini (2004) says fabric weight refers to the relative weight of the fabric not the absolute weight. It may be expressed as the weight of particular size, such as grams per square meter using ASTM D 6242. The samples were cut using GSM cutter by rotating the handle with pressure. The cut specimens were weighed using digital weighing balance. The value in grams multiplied by 100 gives the final value. This was repeated for five readings to get accuracy.

FABRIC THICKNESS

Thickness of the fabric was defined as the distance between the upper and lower surface of the fabric measured under a specified pressure. The thickness of needle punched fabric was measured using thickness gauge following ASTM D 5736 standard. It is a hand operated instrument, which has a dial that reads the thickness of the fabric. Two clamps are attached to the dial. Each of the samples were placed between the clamps and pressed. Thickness was measured at ten different places for each sample at random.

FABRIC STIFFNESS

Stiffness was an important characteristic of a fabric. The principle behind the stiffness test was to measure a particular length of a fabric specimen of specified dimensions which when used as a cantilever bends to a constant angle under its own weight (ASTM D 5732).

As per Basu (2007) the stiffness of the samples were determined by Shirley stiffness tester. The specimen from original samples of six inch were cut using template provided with the tester. Each rectangular strip was mounted over a horizontal platform and pushed along with the template to overhang until the edge of the fabric coincides with the index line. The readings were taken for each specimen with each side up, first at one end then the other. This was done on both machine and cross directions. The experiment was repeated for all the samples.

AIR PERMEABILITY TEST

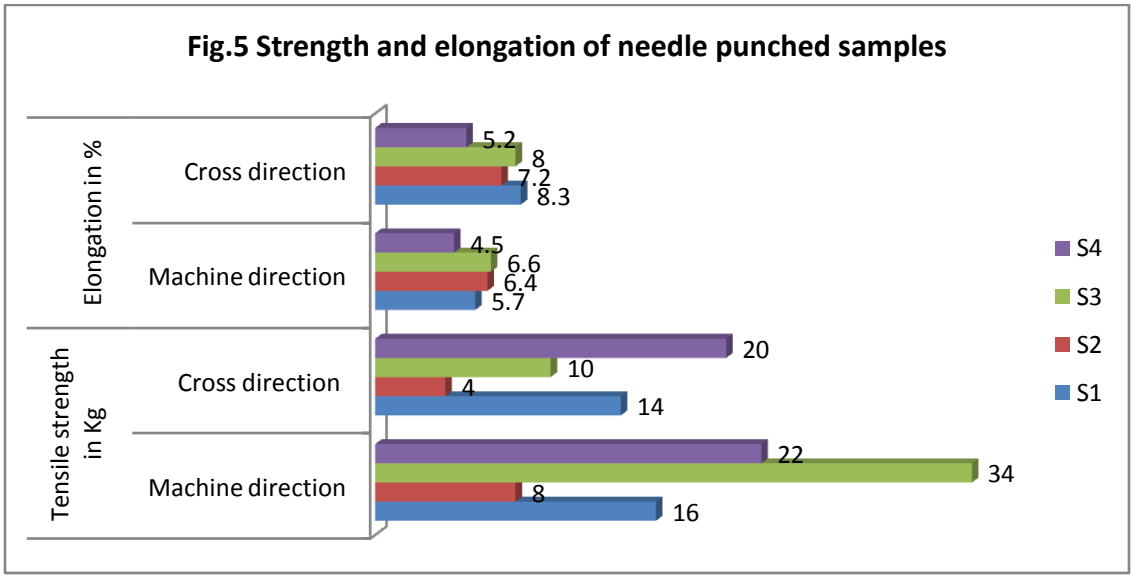
The test specimens were preconditioned in the standard atmosphere, which was 21 ± 1°C (70 ± 2°F) and 65 ± 2% relative humidity. The specimen was placed onto the test head of the test instrument and the test was performed. Water pressure differential of 125 pa (12.7mm or 0.5in of water) was used. The individual results were recorded in S1 units as cm^3/cm^2 and in inch-pound units as $ft^3/min/ft^2$ rounded to three significant digits as per ASTM D 737-04.

RESULTS AND DISCUSSION

FABRIC STRENGTH AND ELONGATION

Fig.5 reveals the mean strength and elongation of nonwoven samples. In machine direction the sample S3 has the maximum strength of 34kg followed by S4 of 22kg which was followed by the samples S1 and S2 of 16kg and 8kg respectively. In cross direction the highest strength was found in S4 with 20kg followed by S1 of about 14kg which was followed by S3 and S2.

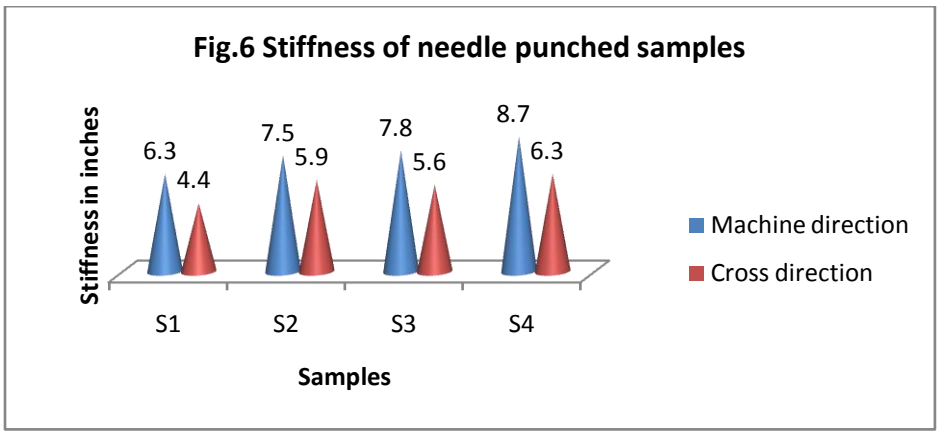
Elongation of the sample in machine direction was found to be higher in sample S3 of 6.6 inches followed by S_2, S_1 and S4 with 6.4, 5.7 and 4.5 inches respectively. In cross direction, the highest elongation was seen in sample S1 with 8.3 inches followed by S3, S2 and S4 which was 8.0, 7.2 and 5.2 inches respectively.



STIFFNESS OF NEEDLE PUNCHED FABRIC

The stiffness of needle punched fabric samples in both machine and cross directions were shown in fig.6. The stiffness in machine and cross direction was maximum for the sample S4 of about 8.7 and 6.3 inches respectively. Thus the stiffness along machine direction reduces gradually from sample S4 to S1. In cross direction, the stiffness was found to be maximum in S4 which was followed by

S2, S3 and S1 with 5.9 inches, 5.6 inches and 4.4 inches respectively. It could be declared that stiffness was maximum for the sisal blended samples.



WEIGHT AND THICKNESS

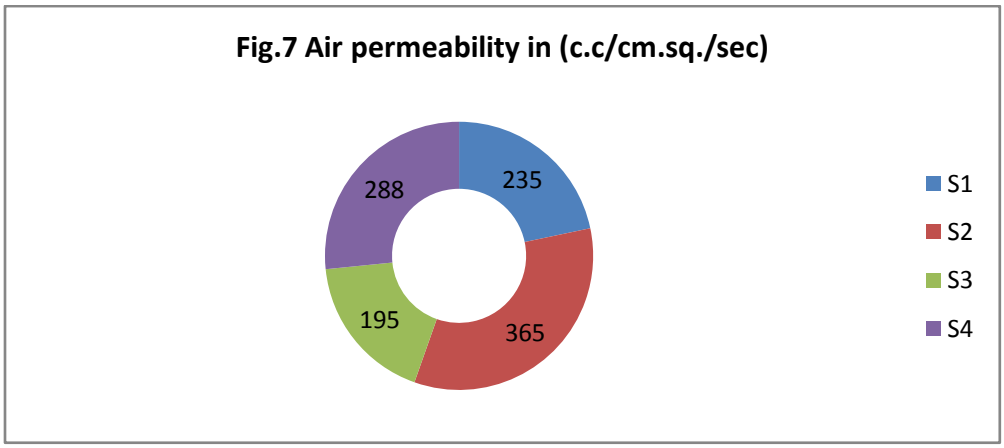
From the Table II it was clear that weight was maximum in sample S1 of 521.5 followed by sample S2. This variation may be due to the difference in the fibre density. Thickness of the fabric depends upon the punch density of the needles. The sample S3 and S4 had the maximum thickness of 5.3mm followed by S2 and S1 with 4.2mm and 3.5mm respectively.

TABLE II WEIGHT AND THICKNESS OF NEEDLE PUNCHED FABRIC SAMPLES

Test	Samples			
	S1	S2	S3	S4
Weight (GSM)	521.5	480.5	370.5	346.5
Thickness (mm)	3.5	4.2	5.3	5.3

AIR PERMEABILITY IN NEEDLE PUNCHED FABRIC SAMPLES

As per fig.7 the air permeability was maximum in sample S2 with 365c.c/cm.sq./sec followed by S4,S1 and S3 with 288, 235 and 195c.c/cm. sq./sec respectively. This implies that the sample S2 had highest air permeability and sample S3 had the lowest air permeability. The statistical analysis of air permeability between the needle punched fabric samples showed one per cent significance.



CONCLUSION

Considering the environmental issues and the potential market growth for nonwoven materials fabrics with coir and sisal were produced by needle-punching technology. From the fabric evaluation it was concluded that nonwoven sample S4 with its compact structure has higher tensile strength, stiffness, air permeability, thickness and lower elongation. The results depicts that fabric S4 can be applied as mulching sheet to ensure weed control due to its good strength accompanied with good moisture retention capacity. It suits well for most light weight structures in composites and in automobile applications as interior mats.

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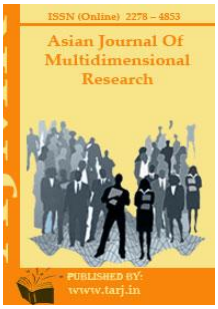

Asian Journal of Multidimensional Research (AJMR)

(Double Blind Refereed & Reviewed International Journal)

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EXTRACTION AND EVALUATION OF NYCTANTHES ARBOR-TRISTIS DYE ON SILK FABRIC

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ABSTRACT

Silk has always been the symbol of royalty due to its lustrous appearance, peach like softness and strength. The coloration of this royal fibre is also an art form. There are numerous ranges of dyestuff available for use of silk dyeing. India has a rich biodiversity and harbours wealth of useful resources and there is no doubt that the plant kingdom is a treasure house of diverse natural produces. Production of synthetic dyes involves many violent chemical reactions and products have to be discharged in water or in atmosphere. Harmful effects of synthetic dyes have prompted the researcher to revive the old art of dyeing with natural dye obtained from stalk of Nyctanthesarbor-tristis commonly known as night flowering jasmine by simultaneous and post mordanting technique. The dyed fabrics were subjectively and objectively analysed.

KEYWORDS: *Eco-friendly, Dyeing, Mordanting, Nycanthes arbour-tristis, silk.*

INTRODUCTION

The world is becoming increasingly aware of environmental issues through discussions about the green house effect, ozone layer depletion, water pollution and waste disposal. This in turn has led to a traditional or "more natural" way of life. The natural dye ensures that the discharge of dyeing unit is devoid of any toxic chemicals and heavy metals protecting the precious water resources. Silk is the most beautiful of all textile fibres is rightly called queen of textiles. It is cool to wear in the summer yet warm to wear in winter. It has a look and feeling of richness that no other materials can match.

Nyctanthesarbor-tristis popularly known as Parijatin India is a species of Nyctanthes. Parijat is also considered to be a divine tree. This plant has many common names like Indian Night Jasmine and the scientific name arbor-tristis. The flowers have been used as a source of yellow dye for clothing (Chandra, 2010), considering the above facts in mind the investigator selected to study on **"Extraction and Evaluation of Nyctanthesarbor-tristis Dye on Silk Fabric"** with following objectives:

- To collect and extract dye from *Nyctanthesarbortristis* flowers
- To optimize the dye concentration, temperature, time, pH and mordanting technique
- To dye the silk fabric with extracted dye
- To evaluate the constructed fabric subjectively and objectively

MATERIALS

SOURCE

Nyctanthesarbor-tristis has many medicinal properties. The flowers are fragrant with five to eight lobed white corolla with an orange-red centre. It provides an assured remedy for various body disorders ranging from common cough and cold to arthritis. The Parijata is regarded in Hindu mythology as one of the five wish granting trees (Chandra, 2010).

MATERIAL

The Indian silks are known for their quality, lustrous sheen and traditional colours. The silk fabric is characterized by its good insulation properties, warm in winter, cool in summer, good elasticity, absorbency, stronger and good affinity to dye. It is very comfortable for clothing. Hence 100% silk fabric was selected.

SELECTION OF MORDANT

The mordant is the chemical link that fixes the dye to a substrate by combining with the dye pigment to form an insoluble compound.A mordants help to keep dyes from fading, changing colour, washing out or rubbing off. Keeping the above points in mind the mordants such as amla powder, orange peel powder, alum were selected for the pilot study.

TECHNIQUES USED FOR MORDANTING

Mordanting is the process of impregnating textiles with a mordant usually salt or acid to fasten the dye stuff which applied before or after mordanting; sometimes a mordant is applied along with the dye stuff. The mordanting techniques selected are given below:

1. Without mordanting
2. Mordanting

- Pre mordanting

- Post mordanting
- Simultaneous mordanting

The study was conducted among pre mordanting, post mordanting and simultaneous mordanting. Out of this post mordanting gave best results. So, the investigator selected post mordanting technique was selected for the study.

PRE-TREATMENT OF THE FABRIC

The aim of the preparatory process is to improve the quality by removing impurities and foreign matters thoroughly and uniformly from the fabric and makes the fabric suitable for follow up process (Anthappan et al., 2006).

- **DEGUMMING:**

Degumming removes accompanying substances like fats, oils, naturals pigments and mineral components (Choudhury, 2006).

RECIPE:

Weight of the material	- 100gms
MLR	- 1:10
Wetting agent	- 0.5 g/l
Natural soap	- 20 g/l
Soda ash	- 2 g/l
Temperature	- 90-95^{o}c
Time	- 90-120 min

PROCEDURE:

The selected material was degummed in a bath containing 20gm of natural soap, 2g of soda ash and 0.5 g of wetting agent in 100 ml of water MLR 1:10 at 90-95^{o}c for 1½ - 2 hours. Then temperature was brought down to 70^{o}c. After degumming the material is washed thoroughly with warm and cold water successively.

- **BLEACHING**

Bleaching is removal of yellow colour matter from the raw silk. Bleaching helps to add desired colour to the silk (Ananthanarayanan, 2008).

RECIPE:

Hydrogen peroxide	- 2 per cent
Sodium silicate	- 3 per cent
Wetting agent	- few drops
Soda ash	- 2 per cent
MLR	- 1:20
Time	- 30 min
Temperature	- 85^{o} c

PROCEDURE:

The selected material was bleached in a bath containing 2gm of hydrogen peroxide, 3gm of sodium silicate, 2gm of soda ash and few drops of wetting agent in a 100 ml of water MLR 1:20 at 85°c for 30 min. After bleaching the material was taken out and rinsed thoroughly and dried.

PROCEDURE FOR DYEING THE FABRIC

The silk samples were dyed using following receipe.

RECIPE:

Material liquor ratio	- 1:40
Dye soaking time	- 1 hour
Dye extraction temperature	- At boil
Dyeing temperature	- At boil
Mordant soaking time	- 1 hour
Mordanting temperature	- At boil
pH for dyeing and mordanting	- 7
Dye extraction medium	- Aqueous medium

The dyed samples were taken out rinsed thoroughly and soaping was done by boiling the samples with 2g/lit of non-ionic detergent powder at 60°c for two minutes. Finally the samples were thoroughly rinsed and dried in the shade.

RESULTS AND DISCUSSION

SUBJECTIVE EVALUATION

VISUAL INSPECTION

The 20 Post graduate students from Textiles and Clothing department were selected for evaluating the dyed fabric as given below.

TABLE I VISUAL INSPECTION

S.No.	Sample	Rating in percentage														
		General appearance			Texture			Evenness in dyeing			Brilliancy of colour			Lustre		
		Good	Fair	Poor	Good	Fair	Poor	Good	Fair	Poor	Good	Fair	Poor	Good	Fair	Poor
1	Silk dyed fabric	93	7	-	86	14	-	90	10	-	80	15	5	96	4	-

Majority of the judges (90%) ranked Silk dyed fabric sample as good in evenness in dyeing. Eighty percent ranked good regarding brilliancy of colour whereas (86 per cent) ranked good regarding

texture and (96 per cent) ranked good for lustre and (93 per cent) ranked good for general appearance.

COMFORT PROPERTY

DRAPABILITY

The fabric drapability of grey, bleached and dyed silk fabric and analysis of variance are shown in Table VII and Figure 1.

TABLE II DRAPABILITY

Drapability	Test sample	Mean	Gain/loss Over original	Percentage of gain/loss over original	F test
SILK	S1	0.2762	-	-	497.831**
	Bsf	0.3912	0.115	41.63	
	Sdf	0.5800	0.303	91.08	

** - significant at 1 per cent (p<0.01)

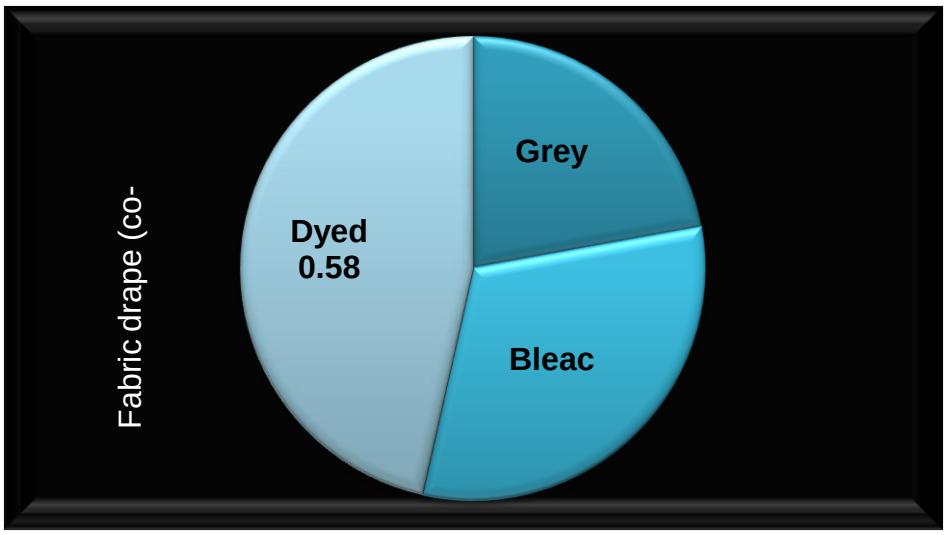

FIGURE 1: FABRIC DRAPABILITY TEST

From the Table II and Figure 5 it is evident that the Drapability of bleached (41.63 per cent) and dyed (91.08 per cent) increased when compared to grey fabric. The processing of silk has improved its drapability.

COLOUR FASTNESS TESTS

COLOUR FASTNESS TO SUNLIGHT, WASHING, PRESSING, DRYING AND CROCKING

The table III shows that the colour fastness to sunlight, washing, dry and wet pressing and dry and wet crocking of dyed silk fabric.

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TABLE III COLOUR FASTNESS TO SUNLIGHT, WASHING, PRESSING, DRYING AND CROCKING

Sample	Sunlight		Washing		Crocking				Pressing			
					Dry		Wet		Dry		Wet	
	Colour Change	Staining	Colour Change	Staining	Colour Change	Staining	Colour Change	Staining	Colour Change	Staining	Colour Change	Staining
Sdf	5	5	4	4	5	5	4	5	5	5	4	5

5 – Excellent 4 – Very good 3 –Good 2 –Fair 1 – Poor

The above Table III shows that colour fastness to washing, sunlight, colour fastness to wet and dry crocking, colour fastness to wet and dry pressing of dyed samples. Regarding the colour fastness to sunlight it gave an excellent result. There is no change in the colour of the fabric due to the sunlight as well as heat.

The colour fastness to washing was very good with regard to crocking method both wet and dry tests. In the wet condition the result was very good. But in the dry condition the result was excellent, there was no colour bleeding.

Colour fastness to pressing in both wet and dry conditions was done. Due to the wet pressing it loses some colour but in staining it was very good. In dry pressing did not show any difference in the colour and the rating was excellent.

CONCLUSION

Natural dye extracts from medicinally rich herbs, plants, flowers, fruits, stems, barks and minerals makes the whole production cycle devoid of any chemical use with almost no carbon footprint. Natural dyes are not only biodegradable, but also have medicinal properties like anti-bacterial, anti-inflammatory and anti-allergic which are beneficial for the skin of the person using it.

Nyctanthesarbor-tristis is an eco-friendly, natural dye. It will not cause any side effect and it has anti viral and anti oxidant property. The flowers are used as carminative, astringent to bowel, antibilious, expectorant, hair tonic and in the treatment of piles and various skin diseases and in the treatment of ophthalmic purposes. The leaves and flowers are applied in the treatment of bone fracture, cough, dysentery, fevers, rheumatism, malaria, snake bite and ulcers. Since Nyctanthesarbor-tristis has enormous medicinal properties, the dye can be commercialized.

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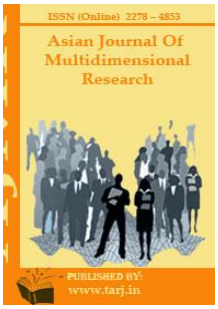

Asian Journal of Multidimensional Research (AJMR)

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AYURVEDIC DYEING OF COTTON FABRIC USING MICHELIA CHAMPACA SOURCE

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ABSTRACT

Ayurveda is described as science of life. Ayurveda has the ability to treat the many diseases, which are untreatable in the modern medicine. Ayurveda clothing and its products is very useful as it is considered to help in bringing back balance in our body's system. It also supports our immune system. This clothing is free of all kind of chemicals and certain toxics which are harmful to the human body. They are considered to be full organic, sustainable and biodegradable. Considering this fact Michelia Champaca, commonly known as Swarna Champaca was selected as herbal source to make ayurvastra. Reviewing the uses of this tree it is clear that the flower bud & fruits can be used to heal wounds and skin disease. Therefore, Cotton fabric which has good absorbency and has more softness was selected for the study. The pseudo stem was used as mordant to increase the colour and medical property.

KEYWORDS: *Ayurveda, Michelia Champaca, Pseudo Stem.*

INTRODUCTION:

The Ayurvastra is an ancient technique used to dye the cloth with herbal dyes, which then acts as the barrier to attack the various microorganisms. The most effective time to wear the Ayurvastra cloth, when the body is at rest, such as sleep, relaxation or medication, that time the natural body will be healing and re-establishing balance. The Ayurvastra includes product like Sleepwear, bed sheets, towels, meditation clothes and cotton mats. (Rangari et.al, 2012).MicheliaChampaca L. is commonly called as Swarnachampaca, and this tree is tall with yellow fragrant. This micheliachampaca is widely used for many traditional herbal preparations. MicheliaChampaca also have properties of wound healing, (Dwajani, 2009). It is used for ayuveda and siddha medicine and the flower of this plant is used for healing ulcers, wounds and skin diseases, (Varier PS, 2003).

MATERIALS AND METHODS:

SELECTION OF FABRIC:

The 100% cotton fabric were selected for study. The cotton fabric is very soft, cool and comfortable for human body. The cotton fiber is often blended with other fibers, (Thomas, 2006). The cotton fiber is most important in the textile industry. The cotton fabric has good appearance, easy care and durability. The cotton fiber is a major fiber for blended fabrics, (Gienandt, 2006).

SELECTION OF SOURCE:

MICHELIA CHAMPACA:

The MicheliaChampaca Linn belongs to the family of Magnoliaceae, (Rout, 2006). Different species of MicheliaChampaca is available. The threespecies of MicheliachampacaareMichelia Alba (white chempaka), Micheliachampaca (orange chempaka) and Micheliafigo (dwarf chempaka). Among the three species Michelia alba and MicheliaChampaca is most popular, (Ibrahim, 2005).

TRADITIONAL USES OF MICHELIA CHAMPACA:

- The most widely used for Ayurveda and Siddha medicine (Khan, 2002).
- The Micheliachampaca is mostly used for traditional healers and herbal preparations, (Rajagopalan, 2000).

Dried MicheliaChampaca

MORDANT:

The use of mordant is to enhance the fixation of the natural colorant to fabric(Maulik, 2005). The dye is not properly interacted to the fabric and the natural dyes need mordant to fix the dye on fabric andprevent the colour from bleeding. (Siva, 2007).

The mordant is used for the dyeing the fabric to give bright and fast colour, (Jain, 2010).

The Banana Pesudostemwere selected as mordant.The banana pesudostem are have huge biomass are generated. The Simultaneous Mordant technique were selected. In this method of dyeing system, both the substrate and mordant are immersed simultaneously in the dye bath solutionin a definite quality and the dyeing is usually done with pre-determined condition, (Dayal et al., 2006). One of the main advantages of this technique is the good absorption capacity and it is take less time for dyeing.

PRETREATMENT OF THE FABRIC:

DESIZING:

The Desizing process was carried out to remove the sizing material from fabric.The Desizing process were done naturally using soap nut. The soap nut was soaked in water for one hour, after that water is used for desizing process.

BLEACHING:

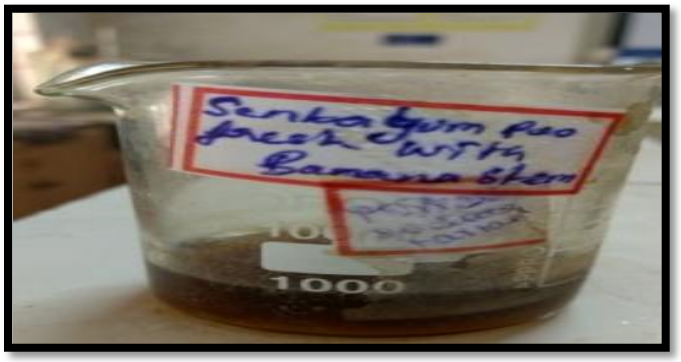
The Bleaching is used for brightness of the fabric. The Bleaching process are done naturally in Sunlight for 1-2 Days.

DYEING PROCESS:

The selected dye source was immersed in 100ml of water and boiled for one hour. Then kept for 2-3 Days for dye absorption and intake of medicinal property into the fabric.

TABLE I MATERIALS

Materials	
Desizing	Sea salt
Bleaching	Cow urine, Milk and Honey
Fabric	Cotton
Dyeing	MicheliaChampaca
Mordanting	Banana Pseudostem
Washing	Soapnut



MicheliaChampaca Dye

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RESULT AND DISCUSSION:

COLOR FASTNESS PROPERTY:

TABLE II COLOR FASTNESS TEST

Sample	Sunlight		Washing		Crocking				Pressing			
					Dry		Wet		Dry		Wet	
Dyed Fabric	Colour Change	Staining	Colour Change	Staining	Colour Change	Staining	Colour Change	Staining	Colour Change	Staining	Colour Change	Staining
	5	4	5	4	5	4	4	4	5	5	5	4

5- Excellent 4- Very Good 3- Good 2- Fair 1- Poor

Colour fastness to sunlight showed a excellent result. The colour fastness to washing showed very good result. In the wet condition the result was very good and the dry condition of crocking test ranked as excellent, and there was no colour bleeding.

Colour fastness to pressing in both wet and dry conditions was done. In pressing the wet conditions result was excellent. But in dry condition of pressing there is slight difference of dyed fabric and showed a very good result.

CONCLUSION:

Increasing awareness in environmental and challenges has led to the development of natural biodegradable resources. Various research and development are being made for producing better natural dyes and its products whichhave several properties like non-toxic, non-allergic effects and create less pollution.The natural dyeing has become a thrust area in the field of textile research. The natural dyed fabric is considered as eco-friendly for the environment. The herbal dye is eco-friendly fabric and does not affect the skin. The eco friendly clothing is another feather to herbal dye.

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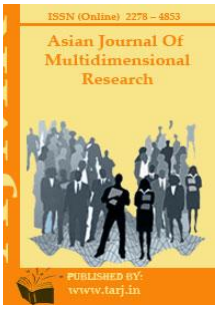

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BIOSORPTION AND REUSE POTENTIAL OF ASPERGILLUS NIGERFOR THE REMOVAL OF MALACHITE GREEN FROM AQUEOUS SOLUTIONS

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ABSTRACT

Dyes are extensively used in the textile industries and they cause severe deleterious effects when discharged into aquatic and terrestrial ecosystem. Dye removal is a key environmental concern in the industrialized countries and has been the subject of scientific research. Biosorption using fungus for the removal of dyes seems to be a cost effective and eco friendly remediation process when compared to physico-chemical methods. The present study deals with the biosorptive potential of Aspergillusniger for the removal of malachite green from the aqueous solutions. Aspergillusniger was isolated from the textile effluent discharged soil and the removal of malachite green was assessed at various ranges of dye concentration (100 – 500mg/L), biosorbent dose (100-500g/L), pH (3,4,5,6,7,8,9), temperature (20ºC, 25ºC, 30ºC, 35ºC, 40ºC) and incubation period (1-10 days). The decolourisation percentage of the dye by A. niger was assessed at regular time interval. The fungal biomass after biosorption was treated with 0.1N HCl and 0.1N HNO_3 as desorbing agent to remove dye from aqueous solution. The results depict that under optimal conditions the maximum removal of malachite green (93%) was observed in the medium amended with 200mg/l of malachite green inoculated with 300g/L of biosorbent in pH 5 at 30ºC on 5^{th} day of incubation. The desorbing agent 0.1NHCl desorbed 90% of dye from the fungal biomass which reveals that the desorbed biomass can be reused for further sorption studies. Hence, the biosorption potential of Aspergillusniger may be exploited efficiently for the uptake of dyes from textile industrial effluent, which seems to be an environmental friendly approach technology.

KEYWORDS: *Malachite green, Aspergillusniger, Optimization, Desorption*

INTRODUCTION

Large volumes of water and chemicals are consumed by textile industries for wet processing of fabrics. Over 7×10^5 ton and around 10,000 diverse dyes and pigments are produced per annum globally, in which about 10% may be found in wastewater (Devecie*t al*., 2004). When compared to natural dyes, synthetic dyes are complex aromatic molecular structures which have been used in the textile and dyeing sector in large manner due to its easiness, cost-effectiveness in synthesis, perseverance, high stability to light, temperature, oxidizing agents, detergents and microbial attack. The use of variety of synthetic dyes imparts colour and are biologically non-degradable. Hence the coloured solutions when discharged into environment may cause distress to the biota(Robinson*et al.*, 2002 and Han and Yun, 2007).

As a widely used dye, malachite green (MG) is a basic cationic dye which is used as a strong antimicrobial and antiparasitical agent in fish farming (Mall *et al*., 2005). It is also used for the dyeing of cotton, wool, silk, paper, and leather. It is known to be highly toxic to mammalian cells and acts as a tumor-enhancing agent. This dye may enter into the food chain and could possibly cause carcinogenic, mutagenic and teratogenic effect on humans (Srivastava*et al.*, 2004).

The existence of dyes in aquatic bodies, even at extremely low concentration, is greatly visible and disagreeable (Park *et al.*, 2007). In generalcolour is evident at a dye concentration higher than $1mgL^{-1}$ and an average concentration of 300 mgL^{-1} has been documented in effluents from textile sector (Goncalves*et al*., 2000 and O'Neill *et al*., 2000). Colour not only affects the aesthetic value, but also hampers sunlight penetration and reduces photosynthetic activity within the ecosystem, inhibits the growth of aquatic flora and fauna and also interferes with gas solubility in water bodies (Banat *et al*., 1996).

Various physical and chemical methods have been employed for the treatment of dye bearing industrial effluents but their downside aspects in recent years suggest them as a costly and not an eco friendly approach due to high amount of sludge generation resulting in pollution load (Crini, 2007). In comparison, the microbial-based biological treatment system is a competent, eco-friendly and cost effective remedy to decolorize or degrade the recalcitrant's by mineralization the target compounds. However, the success of this treatment method relies upon the endurance and adaptability of microbes during the treatment processes. Hence an effort has been made to study the ability and potential of *Aspergillusniger* towards the remediation of malachite green under optimal conditions.

MATERIALS AND METHODS

CHEMICALS AND MEDIA

The dye Malachite Green (C.I. 42000), Rose Bengal Chloramphenicol agar mediumand Sabauroud dextrose agar medium were obtained from HiMedia laboratories Pvt. Ltd, Mumbai, India. The chemicals used in this study were of analytical-grade.

COLLECTION OF SOIL SAMPLE

The soil sample was collected near the textile dyeing industry in Tiruppur district, Tamil Nadu, India. The lumps in the soil sample were crushed using a porcelain mortar and pestle and stored at ambient temperature in cloth bags for subsequent analysis.

ISOLATIONOF MALACHITE GREEN DECOLOURISING FUNGI

Ten grams of soil sample was serially diluted upto 10^{-8} dilutions and pour plated on sterile Rose Bengal Chloramphenicol agar medium(Dextrose - 10g, Peptone - 5g, $MgSO_4$-5g, KH_2PO_4- 5g, Rose Bengal - 0.03g, Chloramphenicol - 0.03g, Distilled water - 1000 ml, Agar - 20g, pH - 5.0 ± 0.1) separately. The plates were incubated at room temperature (28ºC) for 5 days and after incubation period; the fungal colony which predominated in the media was isolated and maintained on Rose Bengal Chloramphenicol agar slants at 4ºC for further study.

IDENTIFICATION OF DYE-DEGRADING FUNGI

The fungal isolate was identified macroscopically and further subjected to microscopic identification by lactophenol cotton blue(Phenol Crystals- 20 g, Lactic acid- 20 ml, Glycerol - 40 ml, Cotton Blue (1% aqueous)- 0.05g (2 ml), Distilled water -100 ml)staining method (Cuppuchino and Sherman, 1999).

INOCULUM PREPARATION

A loopfull of the isolated fungal colony was inoculated into 100ml of Sabauroud dextrose broth (Peptone - 1g, Dextrose – 4g, distilled water – 100ml) separately. The broth was incubated at room temperature for 5 days and the fungal growth obtained in the culture broth was used as inoculum for the decolourisation study.

OPTIMIZATION PARAMETERS AND DECOLOURISATION ASSAY

To determine the optimal conditions for malachite green decolourisation, the fungal isolate was inoculated into a series of Erlenmeyer flask containing different concentrations of dye (100 - 500mg/l), at varying biosorbent dose (100-500g/L).The pH was adjusted to different ranges (3,4,5,6,7,8,9)by adjusting with 1N HCl or 1N KOH. At each pHthe fungal colony was inoculated and incubated at different temperatures (20ºC, 25ºC, 30ºC, 35ºC, 40ºC) for a period of 1-10 days. After incubation period, the sample was removed, centrifuged at 10,000rpm for 10 minutes and the supernatant was analysed for its colour intensity at 700nm in a spectrophotometer. The percent decolourisation was calculated using the formula,

$$\text{Per cent decolourisation} = \frac{\text{Initial absorbance - Observed absorbance}}{\text{Initial absorbance}} \times 100$$

Under the above stated optimal condition*Aspergillusniger* was inoculated into malachite green solution and the percentage decolourisation was recorded.

DESORPTION STUDY

In order to evaluate the practical efficacy of the biosorbent, desorption experiments were conducted. The malachite green loaded biosorbent was treated with the eluents namely 0.1N HCl and 0.1N HNO_3optimized conditions. At the end of the incubation period the percentage desorption efficiency of the dye was determined

RESULTS AND DISCUSSION

IDENTIFICATION OF SELECTED FUNGAL ISOLATE

Based on the macroscopic view and lactophenol cotton blue staining the fungal isolate was identified as *Aspergillusniger*. The taxonomic position of the *Aspergillusniger*was determined microscopically based on the conidial morphology, size and shape under low and high power objectives. The colonies were covered with white fluffy arial mycelia when immature. The colonies exhibited salt and pepper effect with black spores when mature. The hyphae are aseptate with large black to brownish conidial heads. The conidia are globose, radiate and then split into divergent spore columns. The conidiophore is a erect hyaline or brownish near the vesicle

OPTIMIZATION STUDIES FOR MALACHITE GREEN DECOLOURISATION

The result of various physicochemical parameters on the decolourisation of malachite green by *Aspergillusniger* was presented in Fig 1(a-e).The decolorization of dye was greatly influenced by thecritical factor, the dye concentration. When the concentration of the dye was increased in a medium the growth response of fungi and the decolourisation rate decreases in relation to its incubation period. The maximum decolorization (91%) was observed in the medium amended with 200 mgL^{-1} dye and further increase in dye concentration from 300–500mgL^{-1}showed reduction in the colour removal by *Aspergillusniger* indicating the toxicity of dye (Fig 1a).Similar such findings was observed by Khehra*et al.* (2005) and Kalme*et al.* (2007) stating that high concentration of dye stuff strongly inhibits the growth or may have toxic effect on the growth of dye degrading microbes. The dyes may also block the active sites of the enzymes degrading the target compounds with different structure (Saratale*et al*., 2009). Ali et al. (2009) reported the potential of *Aspergillusflavus* and *Alternariasolani* to degrade or decolourise different concentrations of malachite green (10-50 micro molar) to 96% within 6 days of incubation. Parshetti*et al.*(2007)also observed that decolorization of ReactiveBlue-25 by the mycelium of *Aspergillusochraceus* NCIM-1146 required 20 days of incubation to decolorize100 mgL^{-1}dye and elevated concentrations of the dyeproved to be toxic for fungal growth. This implied that the decolorization is inversely related to the concentration of the dye in the aqueous medium.

The dye adsorption based on the amount of fungal biomass was investigated for five different biosorbent dosages (100 – 500g/L). It was observed from Fig. 1b that the dye removal efficiency was maximum in the medium amended with 300mg/L (92%) of biosorbent dose and there was no considerable removal efficiency after optimal condition. The increase in decolourisation efficiency might be due to the interaction of dye with the high number of available adsorption sites in the biosorbent in lower dose. Whereas, as the dose increases the active sites on the biosorbent gets saturated or the biomass gets aggregated and blocks the dye to bind with then and thereby the decolourisation rate decreases (Ozer, 2006).

For the ideal biosorption the relationship between the adsorption of dye and contact time is important. At the earlier stage of incubation period the adsorption of dye to A. niger was high (94%) at 5^{th} day and it started to decline thereafter (Fig 1c). This might be due to the fact that physical and rapid adsorption of dye molecule onto the active surface site of the fungal biomass has occurred. The decrease in the adsorption of the dye after 5^{th} day of incubation might be due to the complexation or micro precipitation or saturation of binding sites in the fungal biomass (Daneshwar et al., 2007).

Optimization studies with reference to initial medium pH against dyedecolorization showed that decolorization in creased with an initial increase in pH and peaked at pH 5.0 (93%) after 5 days of incubation. There was a decrease in pH level when it was increased from 6-9 (Fig 1d). It was observed that an optimum pH for growth favoring textile dye removal by different fungi varied between pH 4 and 6 which was reliant on the dye present and the composition of the decolorization medium (Asgher*et al*., 2008). The medium pH also influenced the surface electrical charge of the fungal biomass which inturn influenced the adsorption of charged groups or ionic forms of the dye in the solution (Fu and Viraraghavan, 2002).There exist an electrostatic repulsion between the positively chargedsurface of the biosorbentand the positively charged dye molecule at lower pH, thereby resulting in the decreased amount of malachite adsorption onto the biosorbent. Also, at lower pH, the hydrogen ions in the biosorbent effectively compete with cationsof the dye causing a decreased adsorption (Mall*et al*., 2005 and Porkodiand Kumar, 2007).

Temperature plays an important role in the treatment of waste water biologically. The consequence of temperature on the decolorization efficiency using *A. niger* was studied at the range of 20–40°C at an initial dye concentration of 100 mg/l. Maximum decolorization ability of malachite green (90%) was observed at a temperature range of 30°C which was selected to be optimal (Fig 1e). Temperature above 30°C resulted a decline in the extent of decolorizationwhich might be due to the increased surface activity and kinetic energy of each dye molecule(Kaushik and Malik, 2009).The results revealed that there is no thermal deactivation of decolorization activity under optimal temperature.

Thus under optimal conditions the maximum removal of malachite green (93%) was recorded in the medium amended with 200mg/l of malachite greenat 30ºC with 300g/L of biosorbentat pH 5 on 5th day of incubation.

DESORPTION STUDIES

The frequent accessibility is an essential feature for a biosorbent. Such biosorbent should not only acquire higher adsorption potential, but also show enhanced desorption, which will drastically decrease the overall expenditure for biosorbent. The desorption efficiency was high in 0.1N HCl (90%) followed by 0.1N HNO_3 (81%).

Thus to conclude that fungus *Aspergillus niger* have theprospective to hastily, efficiently and successfully remove malachite green. Moreover the biosorption method could beimplemented as an less economic and resourceful approach for decolorizationof effluents and it may be an substitute to moreexpensive resources such as activated carbon.

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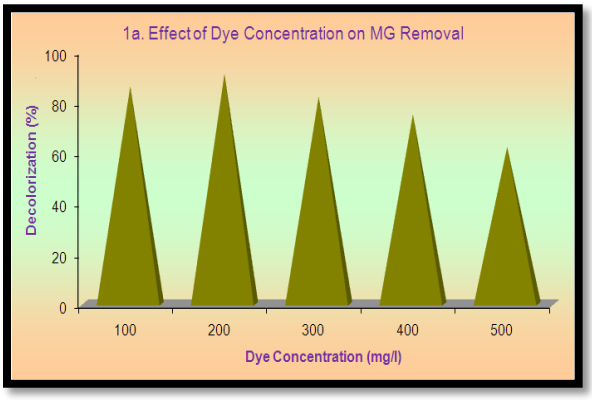
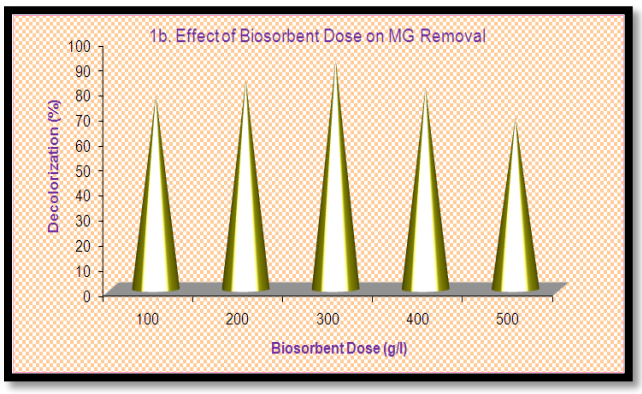
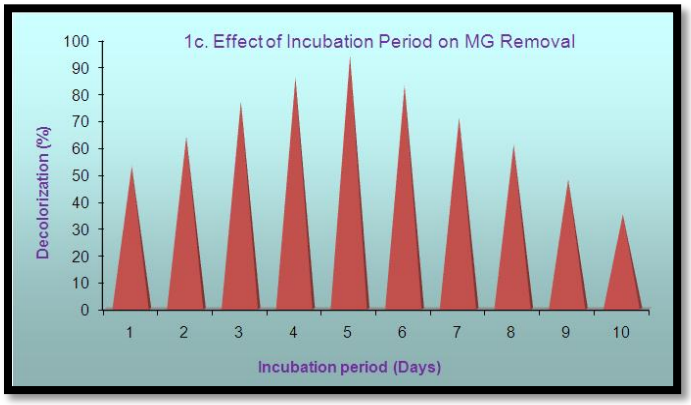
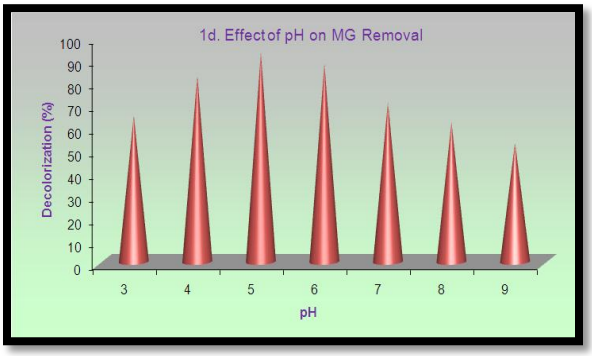
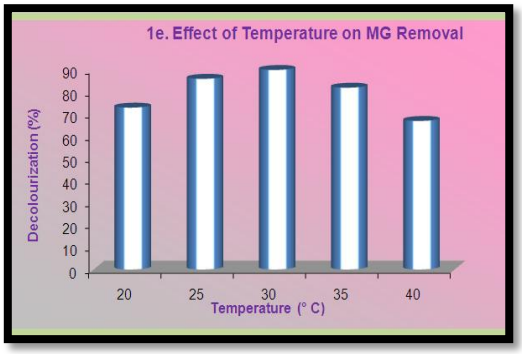
Fig 1(a-e) : Optimization parameters for Malachite Greendecolourisation using *A.niger*











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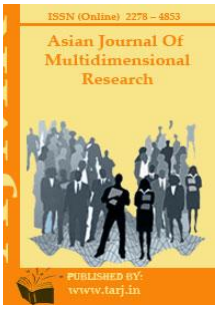

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PREPARATION OF COIR BIODEGRADABLE COMPOSITES USING STARCH EXTRACTED FROM POTATO PEEL

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ABSTRACT

Conventional plastics and synthetic resins are fossil fuel product that is widely known for environmental pollution. These product are non-degradable and when burned release large amount of carbon dioxide and other toxic gases which will harm every living organisms. The world wide usage of plastics has become a major problem. The ease and the comfort it provides have made it to become a part of our lifestyle. It is nearly impossible to avoid the usage of plastics in our sophisticated lives. The only solution is to find a product that can replace plastic and other petroleum products which also does not harm environment. Bio plastic is a compound made from renewable resources which can degrade over time. It can be used to make several products that can replace the conventional plastics. A composite is a material composed of two or more materials like matrix, fiber and interface. In this paper an attempt has been made to create a bio—composite from starch based polymer and coconut waste. The starch is extracted from potato peel that is intended to be thrown away and which has no economical value. Since all the materials used are natural sources, the coir-bioplastic composite is 100% degradable. The absorbability and the density of the composite were examined to determine the application of the product. Since coir and starch are hydrophilic in nature, the composite was found to be able to absorb high amount of moisture. The density was apt to be able to utilise as material for packaging items for short span time.

KEYWORD: *Absorbability, Bio-Composite, Bio-Degradation, Bio Plastic, Coconut Waste Or Coir, Density, Potato Starch.*

INTRODUCTION

Plastics are non-degradable long chain synthetic polymer obtained from crude oil. It is widely used because of it mechanical and physical properties. The characteristics of plastic make it possible to mould and create variety of products according to our needs. Plastics makes our life easier and cleaner. Due to its world wide use, a huge amount of plastic waste has accumulated in the environment which is a major problem to all living organisms. The hazards that followed plastics and other petroleum compounds is increasing to an alarming rate that an immediate action had to be taken. Bio based polymers have garnered considerable interest recently as they are non-pollutants to environment. These are macro molecules obtained from polysaccharide, proteins, polyamides found in sources like starch, algae, plants, and other natural resources. Bio based polymers can replace conventional plastics and can be pollutant free.

A composite is a constituent of more than two materials of different properties when combined produces a characteristic different from individual material. A fibre reinforced composite consist of a matrix like resin and fibre like sisal, hemp, coir etc,. A bio composite is a compound in which the materials used are renewable natural sources which can degrade over time. It neither pollutes nor discharges harmful gases to the environment. Starch based bio plastic is used as matrix and coir fibre is used to make a bio-composite. The chemical formula of starch is (C6H10O5) n. It is the main source of carbohydrates for growing seeds and leaf tissue development and is found in tubers, fruits, leaves, and seed. There are two types of starch molecules: amylose and amylopectin. Amylose is linear chain while amylopectin has many branches spread in all direction.

POTATO STARCH FOR BIOPLASTIC:

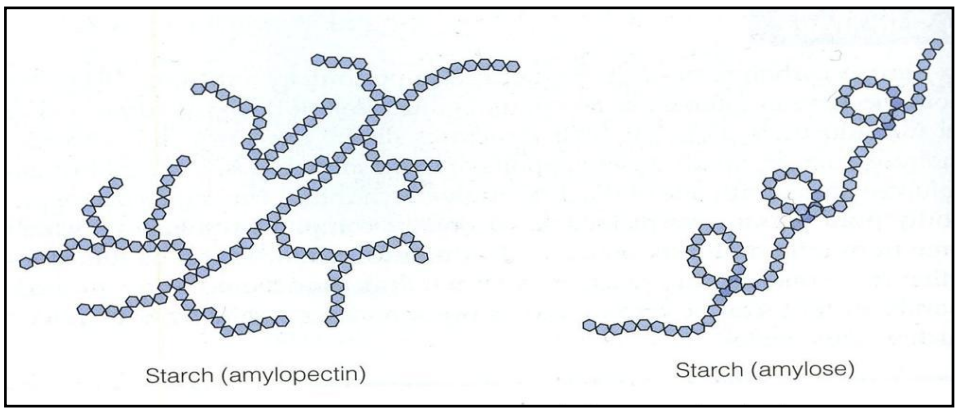

Fig.1 Starch constituents

Starch is extracted from potato waste (peel) which has no economical value and are meant to thrown away. Starch consist of 25% amylose and 75% amylopectin. Amylopectin is responsible for plasticising characteristic and amylose is responsible for degradation characteristic. The granular size ranges between 5 to 20 microns. Here, starch is obtained from potato waste in order to utilise a natural substance to its maximum potential. It has good absorption capacity, rapid gel forming property, cheap, and widely available.

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FIBER SELECTED:

Coir can be used to make fiber reinforced composites due to its mechanical and physical characteristics. Coir finds application in various industries due to its strong and abrasion resistance feature.

Fig.2. Coir fiber

Considering the above facts, this study is framed to extract starch from vegetable waste namely potato waste and bind it with coir to develop 100 percent composite. The major objectives of the study are

2. OBJECTIVES

To extract starch from potato waste.

To create a bio-composite using starch extracted from potato skin and coir fiber

To study the absorbance and density of the developed bio-composite

3. METHOD

The experimental process was carried out following the steps discussed below

3.1 SELECTION OF MATERIALS AND EQUIPMENTS

Potato starch (peel) , distilled water, glycerin as plasticiser, diluted acetic acid or vinegar, shade dried coconut husk(coir), a vessel to mix the materials, a wooden or silicon spatula, silver foil to make a mold and oven to dry the sample.

3.2 COLLECTION OF MATERIALS

3.2.1 EXTRACTION OF STARCH FROM POTATO

The potato waste (peel) that ends up as waste is collected and grinded using a mixer. It is immersed in water and let to boil for 20 to 30 minutes. This must be done with continuous stirring. Then it is sieved and the water obtained is left to settle overnight. The starch will be settled at the bottom of the vessel which can be separated by letting off excess water. It is dried and weighed.

3.2.2 PREPARATION OF COIR

The coconut husk (coir) is carefully collected and shade dried for 1 week to remove the moisture in the fibre. The dust and other waste particles are removed from it before further proceedings.

3.3 MAKING OF BIO PLASTIC

15g of potato starch, 5ml of glycerin, and 5ml of diluted acetic acid is added to 50ml of distilled water. These contents are poured in a vessel and kept to boil for 10 to 15 minutes. It is continuously and thoroughly stirred till gel is formed. (Pillai (2011))

3.4MAKING OF BIO COMPOSITE

The bio plastic and dried coir fibre is mixed thoroughly and spread evenly onto a mold made by silver foil. It is left to dry for 24 hours. (Sen et al., 2015).

3.5. EVALUATION

3.5.1 ABSORBABILITY

Absorbability of the sample can be calculated by change in weight percentage method. First, the sample is kept in oven for 30 minutes at 110oC to remove the moisture content and it is weighed. Then the sample is dipped in a beaker containing water. It is removed after 30 minutes and it is again weighed. Water absorptivity (M%) of sample can be calculated as:

$$\text{Absorptivity M\%} = \frac{(M1-m0)}{M1} \times 100$$

Here, M1 = mass of the wet sample in grams. M0 = mass of dry sample.

3.5.2 DENSITY MEASUREMENT BY ARCHIMEDES PRINCIPLE METHOD.

$$\text{Density} = \text{Mw} = \frac{\sigma w}{Mw-Ma}$$

Here, Ma = mass of the sample. Mw = mass of sample weighed in distilled water for 1 min and = density of distilled water at NTP.

4. RESULT

The absorbability test was conducted and the absorptivity of the bio composite was found to be 39.48%. The density of the composite was also determined and was found to have 2.798g of weight. From the obtained results, this materials can be successfully used to make bio degradable composite.

5. CONCLUSION

The need to go eco friendly is very important now than ever before. The accumulation of non degradable plastic in the environment is hazardous to every life. It is imperative to replace synthetic polymers with biodegradable polymers .The bio composite prepared from starch, water, glycerin, acetic acid and coir is 100% degradable. It was found to have good moisture absorbability and enough density required to utilise it to create packaging materials.

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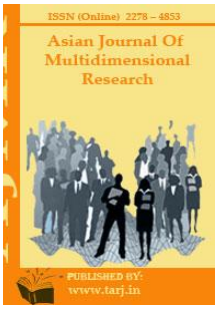

Asian Journal of Multidimensional Research (AJMR)

(Double Blind Refereed & Reviewed International Journal)

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FTIR ANALYSIS OF WATER RETTED BAST FIBERS

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ABSTRACT

In the present scenario of environmental concern and issues, several approaches of research and developments are being made in the application of natural fibers as they are abundant, renewable , biodegradable and eco- friendly features. Two medicinal bast fibers (Castor and Turmeric) were extracted bydifferent retting process. Retting plays a vital role in the extraction of fibers. The different retted fibers were compared through visual inspection. It resulted water retted fibers shows a better quality. FT-IR analysis were carried out for the two pool retted fibers to find out the functional groups present in it.

KEYWORDS: *Bast fibers, Castor, FTIR analysis, Retting, Turmeric.*

INTRODUCTION:

Natural fibres have been widely use in the applications of textiles. It has began to focus in becoming the main alternative source in most of the industries as natural fibers are biodegradable, renewable, abundance and low cost. The potential uses of natural fibers came into more light because of the growing awareness in sustainability and certain environmental issues and challenges. Natural fibers are also one of the effective and proficient material that can replaces various synthetic products for less weight as well as energy conservation.(Sanjay et al,2016). However, the major issuesof natural fibers is that they have irregular consistency in quality when compared to synthetic fibers. The inconsistency is due to certainreasons like climatic condition, crop variety, extraction process etc.

The process of Retting plays a vital role in the extraction of natural fibers. It is one of the major issues associated in the extraction of fibers and a highly complex scientific natural microbial process. It is the degradation of non-fibrous matter, removal of non-cellulosic components like pectin, hemi-cellulose, waxes, fats etc. Improper retting can result in poor separation and quality degradation of the fibers. So, the process has to be carried out with great importance as it has several effects in fiber yield and quality (**Ruzica et al, 2015**)

The objective of this study was to extract fiber from two bast fibers (Castor and turmeric) by different types of retting process. FT-IR (Fourier transform infrared) were analysed for the pool retted bast fibers as they produce a better result through visual inspection when compared with other retting process.

2. MATERIALS AND METHODOLOGY

2.1Selection of the plant Source- The source of the study were selected after conducting a pilot study. Two plants (Castor and turmeric) were selected for the study. Castor plant were sourced and collected from the roadsides of Madhampatti village, Coimbatore. The turmeric stem werecollected from Virudhunagar District, Coimbatore.

2.1.1. **Castor, RicinuscommunisL**. Is a flowering plant species. It belongs to a genus Ricinus. It is an important medicinal plant which belongs to family Euphorbiaceaethat possess properties like anti-inflammatory, anti-oxidant activity, anti-tumour, analgesic, antipyretic, cardiac tonic and anti-asthmatic. The castor stalk is round covered with a waxy bloom that gives red or green stems and shows a bluish appearance on the field. The colour of the stem may vary from green, red or purple. The cortex of castor stalk primarily contains mostly of long fibers.The stem generally becomes hollow with age.

2.1.2. **Turmeric** (*Curcuma longa*) is a flowering plant of the ginger family, Zingiberaceae . It possess natural anti-inflammatory, anti- ulcer properties, contains bio-active compounds. The plant is rhizomatous, herbaceous and perennial, and is native to the Indian subcontinent and Southeast Asia, and requires certain temperatures in between 20 and 30 °C . It needs a significant amount of annual rainfall to thrive.

2.2EXTRACTION PROCESS OF FIBER

Retting: It is the process to dissolve or rot away the cellular tissues, pectins, waxes, dirts surrounding the bundles of the bast fibers by the action of micro-organisms and moisture on plants to help in the separation of the fiber from the stalk of the plant. One of the main retting techniques is the water retting. It results in better quality of the fiber. (NIIR Board, 2005)

Dew-retting: It usually depends upon the climatic condition. In this method, the fiber remains on the ground or the field of about 2 weeks and 2 months for the rotting away of the cellular tissues. The exposure in the rain and sun, several enzymatic action degrades the pectinous substance that bind fibres. The stem has to be turned over during retting process so as to evenly ret the plant stalk. It normally continues for a month or more depending on the condition of the stalk. This method produces good quality of fibres with the least pollution.

Mechanical Retting: It is also known by the name Vat retting. In this, the stalks are immersed in wooden vats of warm water at temperature ranging from 75 to 90^0F, fasten the decomposition of the woody bark. After removing from the vats, it is pass between rollers to crush the decomposed bark. This method shortens the process of retting and is used primarily in certain European countries (Corbman, 1983).Mechanical separation of fibres can also be carried out by using decorticating machines, steam explosion (STEX), ammonia fibre extraction. In this study the fibers were decorticated by the decortications machine at Production laboratory, Avinashilingam Institute.

Water retting: It can be of two types- pond retting and stream retting. Pond retting is one of the fastest retting. The fiber is usually kept in a pool of water for a couple of days or weeks. Stream retting takes longer than pond retting, usually left in the stream for around 2 or 3 weeks.

In this study, the pond retting process was performed by submerging the bundles of stalk in the stagnant water tub. The Castor stalk and Turmeric stem were submerged in different normal water tub. The process was carried out for 17 days by changing the water in alternate days. In the process of water retting, certain bacteria which are responsible for the retting mechanism enter through the stomata for breaking the pectinous substances that binds the fiber bundles in the plant stalk. During the process, the stalks were beaten by a woodenhammer to separate the fibers until it becomes loose.

For the castor stalk, it was observed that the fibers were seen separated from the outermost layer, epidermis of the castor plant as seen in the figure 2.a. and 2b. The turmeric stem fiber were extracted by following the same procedure of castor stalk. Water retted fibers images were shown in Figures 3a and 3b. For this fiber, the extraction was also carried out by mechanical decortications in a decorticator machine. It was observed that the water retting process provides a better result in the extraction of fiber. After the retting operation, proper separation of the fiber was carried out by manual process so as to get a better and uniform fibers. After the separation, both the fibers were dried in the shade for 24 hours at room temperature.

Dew retting process was also carried out by spreading in the ground for both the castor stalk and turmeric stem. The stalks were beaten by a wooden hammer and water was sprinkle in every morning to fasten the process and to make the fiber easily separated. The process was carried out for 1 month. It resulted that the castor stalk and turmeric stem became more dried, brittle and difficult to extract the fibers.

The following tables show the comparison of different retted fibers through visual inspection.

Figure 1. Comparison of different rettedfibers through Visual Inspection

Samples	Parameters			
	Colour	**Texture**	**Lustre**	**General Appearance**
Castor pool retted	Good	Good	Fair	Excellent
Castor dew retted	Fair	Poor	Fair	Fair
Castor decorticated fiber	Good	Poor	Fair	Fair
Turmeric pool retted	Good	Excellent	Good	Good
Turmeric dew retted	Fair	Fair	Fair	Fair
Turmeric decorticated fiber	Good	Fair	Fair	Fair

Figure:2a Castor stalk

Figure: 2b separated fibers

Figure: 2 c Dried retted fibers

Figure :3a Turmeric stem

Figure: 3b Dried retted

3. RESULTS AND DISCUSSIONS

A. Fourier Transform Infrared Spectroscopy (FTIR Spectroscopy)

It is an analytical technique which are normally used for identifying organic, polymeric and inorganic materials. In this analysis, infrared lights were use to scan the samples to observe the functional groups present in it to examine the chemical properties. FTIR spectroscopy can be serve as the first step in the process of material analysis. If there is a change in the characteristic pattern of absorption bands, then it clearly indicates a change in the composition of the material or the presence of contamination. The technique is useful for analyzing the chemical composition of minute particles, which are of around 10 -50 microns, as well as larger surface areas.

Here in this study, as the pool retted fibers gives better result so these fibers were analyzed for knowing the presence of functional groups in FTIR- Shimadzu. Figure 4a and 4b expressed the FTIR analysis of the Castor and Turmeric fiber samples. The figure showed the peak level in certain functional groups.

In the Fig.3a shows the FTIR spectra of Castor fiber sample which indicate the frequency ranges from 4000 to 400 cm^{-1}. Prominent peaks were observed and noted in between 3000-2850 cm^{-1}

indicating the presence of Alkanes (C-H group) with a few absorption bands in the infrared spectrum. Several peaks were also noted which indicates the presence of Ester (C=O) between 1750-1730 cm^{-1}, Alkene (C=C) between 1680-1600 cm^{-1}. Peaks were noted from 1400-1000 cm^{-1},785-540 cm^{-1} and < 667 cm^{-1}indicating the presence of Fluoride, Chlorides and Bromides, iodides functional groups.

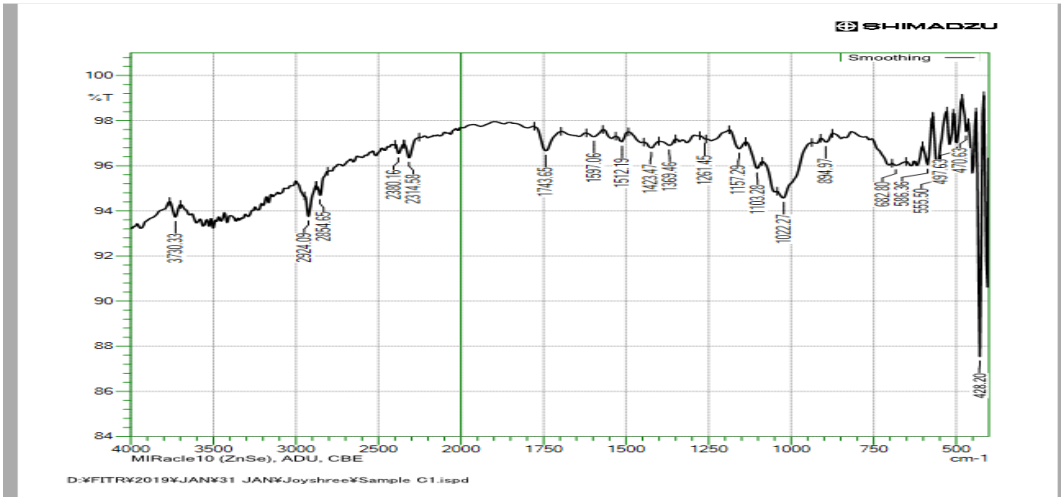

Figure4a :FTIR spectra for Sample Castor fiber

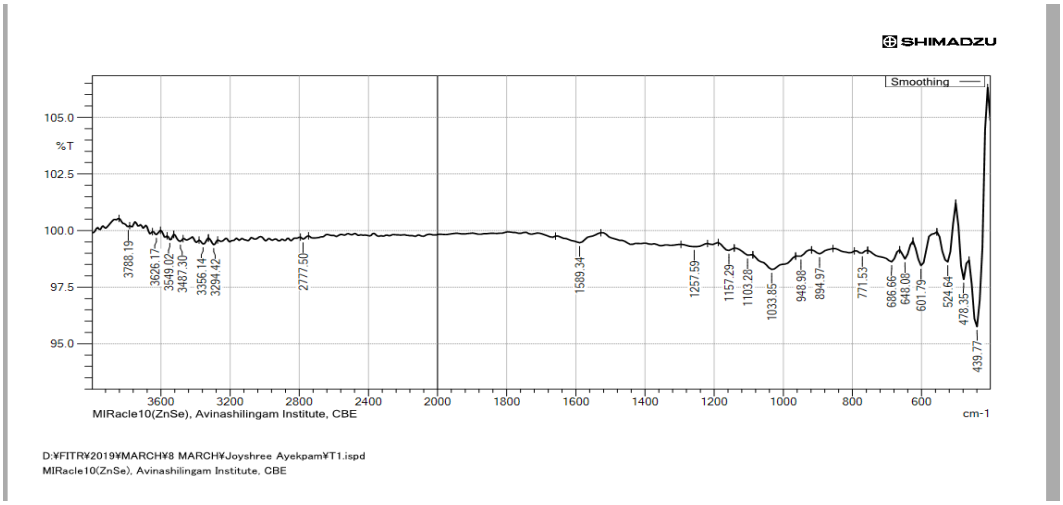

Figure 4b: FTIR spectra for Sample Turmeric stem fiber

The Fig.3b shows the analysis of FTIR spectra of Turmeric fiber sample indicating the frequencyranging from 4000 to 400 cm^{-1}. Prominent peaks were observed and noted in between 3400-2400 cm^{-1} that indicates the presence of carboxylic acids (O-H group). Peaks noted between 3650-3600 shows the presence of free alcohols and phenols functional groups. The Primary and secondary amines and amides in the bend form were also present as there was a peak in the frequency between 1640-1550 cm^{-1}. The frequency between 1350-1000 cm^{-1}, 1000-650 cm^{-1}, 785-540 cm^{-1} and < 667 cm^{-1} indicates the presence of Amines (C-N), Alkenes(C-H), Chloride ,Bromide and Iodide (C-X)groups.

4. CONCLUSION

Environmental awareness has created everyone to focus for the better development of the sustainable and environmental friendly products. In the application of technical textiles, the utilization of renewable natural fiber resources are increasing in order to replace several synthetic fibers. In this paper, Castor stalk and Turmeric stem fibers were successfully extracted through the process of water retting. All the retted fibers were compared through visual inspection and it was found that the water retted fibers give good result in texture, luster, colour and general appearance. The pool retted fibers were then analysed by FTIR. The result shows the presence of Alkanes, Ester, Alkene, Fluoride, Chlorides and Bromides, Iodides functional groups in the sample of Castor stalk fiber. And in the case of Turmeric stem fibers there shows a group of free Alcohols and Phenols functional groups, Primary and secondary amines and amides,Amines (C-N), Alkenes(C-H), Chloride ,Bromide and Iodide (C-X) groups.

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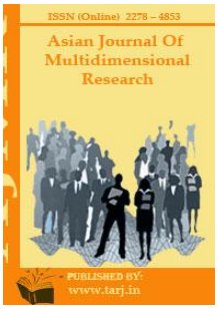

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A STUDY ON THE ETHICAL WAGES TO CONSERVE THE ECO FRIENDLY KHADI WEAVERS IN VAVAKKAD

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ABSTRACT

KHADI – is the most sustainable and eco friendly fabric which played an important role in the Indian independence movement headed by Gandhiji. The making of khadi is eco-friendly since it does not rely on electric units and not generates any toxic waste during production. The Gandhi Smaraka Grama Seva Kendram is one of the earliest centres in Kerala which adopted Gandhiji's ideals of rural self-employment and self reliance. The investigator conducted a study in Vavakkad near North Paravur to study the characteristics of khadi as an eco friendly fabric and to study the problems of weavers in context with their wages. The government is initiated many schemes to support these weavers financially, but these were not sufficient enough to lead a family in this present scenario. Due to this, many weavers switched over to sea food industry which is near to this place and the wages paid there is much higher when compared to weaving. Some of the women have still sustained in the weaving field only because of the respect they get being a weaver and has an alternative source of income for running a family. These skilled women weavers have to be sustained by providing ethical wages inorder to sustain the eco friendly khadi fabrics.

KEYWORDS: *Khadi, Eco Friendly, Weavers, Ethical wages*

INTRODUCTION

KHADI – is the most sustainable and eco friendly fabric which played an important role in the Indian independence movement headed by Gandhiji. The term **Khadi** or **Khaddar** is a term for handspun and hand-woven cloth from India, Bangladesh and Pakistan mainly made out of cotton. India is said to be the original home of cotton where the cultivation of cotton is said to have started about 8000 years ago. The Khadi is considered as eco friendly because it is the most sustainable products, which does not use any electrical support. It is the only textile activity which does not depends on fossil fuel (Sharma Yovesh Chandra,1999). The production of one meter khadi fabric consumes three litres of water whereas a conventional textile mill would need 55 litres. The production of khadi does not generate any toxic waste products.

The Gandhi Smaraka Grama Seva Kendras were founded in several parts of the country with an intention to promote Gandhiji's ideals and khadi products. The Gandhi Smaraka Grama Seva Kendram of North Paravur was founded in the year 1956 by U.N.Dhebar, president of Indian National Congress and was inaugurated by Morarji Desai in 1957. The centre involved local communities in several khadi village industries. There are 12 weaving units functioning under this Kendram in the around Ernakulam district

REVIEW OF LITERATURE

Khadi is a soft, comfortable and durable fabric to wear in all seasons. Babji Y, mentioned in his blog about the characteristics of Khadi and also mentioned that different Indian states produce different varieties of Khadi

A press report by Menon Anasuya on the khadi weavers of Nanthiattukunnam, in North Paravur, brought into light that the Khadi women weavers were struggling to continue this job. It also reported that the artisans were continuing this tough job because they don't have another option.

A report published in The Hindu, titled "Chendamangalam's hour of woes" presented the problems and new crisis of the handloom sector in Ernakulam district. The industry is mainly concentrated in Paravoor taluk of the district and within the taluk, Chendamangalam weaving centre has a traditional reputation. The report focused on the inability of handloom sector to adjust itself to the changing times

According to a report in Daily Pioneer, the Khadi and Village Industries Commission (KVIC) increased the wages of khadi artisans by more than 100 percent and approved a Market Development Assistance (MDA) for the artisans. The wages rose from Rs.90 to Rs.190 which came into effect from 1st April, 2016.

The CSR journal reports that the Union Ministry of Micro, Small and Medium Enterprises (MSME) has approved to increase the wages of artisans by over 36%. This results in an increase in the wages from Rs.5.50 per hank to Rs. 7.50 per hank. Modified Market Development Assistance (MMDA), will be implemented from 15th August , 2018.

OBJECTIVES

- To study the characteristics of Khadi as an eco friendly fabric
- To study the problems of weavers in context of their wages

METHODOLOGY

In order to accomplish the objectives of the present study, the investigator selected the women weavers from the training unit of Gandhi Smaraka Grama Seva Kendra in Vavakkad village near North Paravur, which is 25 kms from Ernakulam District in Kerala. This unit was started in the year 2008 to support the traditional weavers and train the present generation in weaving for reviving these eco friendly fabrics.

The characteristics of khadi fabric was studied by observing the fabric produced by the weavers of the Vavakkad unit.


INTERVIEW METHODS:

The Investigator conducted a detailed survey by conducting interviews with the women weavers and in house trainers regarding the challenges faced by the weavers


RESULT AND DISCUSSIONS

The Gandhi Smaraka Grama Seva Kendram is one of the earliest centres in Kerala which adopted Gandhiji's ideals of rural self-employment and self reliance. Under this Kendra there are 12 weaving units in and around Ernakulam district. One such unit in Vavakkad near North Paravur has 12 trained women weavers. It was started to support the traditional weavers and to train the present generation of Vavakkad village. There is an in-house spinning, weaving and dyeing unit and the weavers produce 100% fine khadi cotton fabrics. The khadi fabrics had a beautiful array of colours and it provided immense possibilities for the fashion designers to explore. The weavers are trained on regular basis by in-house trainers. These women weavers are not restricted to an eight hour time schedule but instead they can come according to their convenience and hence the time is flexible. The weavers are paid on the basis of meters of fabric that they weave. An amount of Rs.33/- is paid per meter as wages. Production based incentives and marketing development assistance (MDA) are provided by the Government as an additional incentives. Even after the Government support the weavers are not satisfied with their wages as it is not sufficient to lead a family in this present scenario. Due to this many weavers, both traditional and trained, have switched over to shrimp cleaning job in a sea food industry which is located near to this place. The main reason for this job change is the wages paid in seafood industry is much higher and less labour intensive when compared to weaving. But some of the women who have still sustained in this

weaving field is only because of the respect they get being a weaver and has an alternative source of income for running a family.

In order to attract more women into this profession, ethical wages have to be given. The term Ethical wages conveys the wages deserved by the weavers for this labour intensive job. Ethical wages has become the imperative aspect of the local weavers. It helps to improve the standard of living of the Khadi weavers and to retain and sustain the Khadi weavers, thereby increase the productivity of Eco friendly fabrics.


CONCLUSION

The eco friendly fabric has become the need of the hour to conserve the earth. The weavers of Vavakkad village produced 100% fine khadi cotton fabrics which had a beautiful array of colours and it provided immense possibilities for the fashion designers to explore. There has been a significant decline in the employment generated by the Khadi sector. The entry barrier to Khadi needs to be removed which will help in the increased production of khadi fabrics. The eco friendly Khadi has to be sustained by sustaining the weavers through ethical wages thereby empowering the younger generation.

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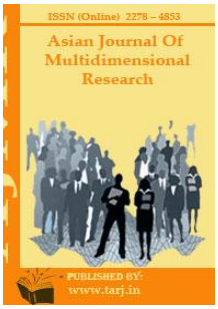

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MOBILTECH IN CONSUMER PRODUCT-CAR VARIANTS AS A CANDIDATE

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ABSTRACT

The automotive ecosystem is dynamic and vast, launching various new products in developing countries including India. Today, every global automotive company is introducing new innovative models with improved technologies, reduced fuel emission, active safety and drive assistance especially in cars to compete on a global scale. Informed customers are also seeking cars which afford the needed comfort, safety aspect and user-friendly approaches. Mobiltech entail the technical textiles that are used in the automotive sector. It has becomes a part and parcel of automotive industries by which they consume a lot of textile material in car manufacturing, which afford the needed comfort and safety in car interiors. Mobiltech application is seen in carsin two ways: Visible components and Concealed components. In automotive industry the rate of consumption of Mobiltech segment is directly proportional to the growth of passenger cars and commercial vehicle segment. This article is about consumer preferences and behaviour regarding comfort, safetyand style provided with the active incorporation of Mobiltech fibres or materials in corporated in car interiors as well as in their concealed components.

KEYWORDS: *Concealed components, User-Friendly, Visible components.*

INTRODUCTION

The automotive sector is one of the largest sector launching new products everyday with number of features incorporated in it. The upcoming models have updated version of technical features including safety and drive assistance for user's wellbeing. The preference over the product is being increased and users start seeking for many innovations, value additions in addition to technical features (i.e., safety, comfort, and style. Utmost preference isprovided to the customer side and the automobile industry offers a large platter of car segments ranging from A1 to A6, B1, B2 and SUV (as per SIAM classification), which roll out as different variants.

Price: A car's features like length, comfort, safety, and security determine the price and it is popularly classified into A, B, C, D and SUV segments.

Body type: A car body has been divided into three areas such as engine, seatingand luggage area (www.indiamarks.com/car-segmentation-society-indian-automobile).

In line with the segments and technical features adopted in the car, textile material used also plays vital roles in ensuring safety, comfort and style to the product. Technical textiles put to use adopted in the automotive industry is known as ***Mobiltech***.The application of Mobiltech is seen in various components in cars.

Segments Available	*Car types*
A	***Mini cars or city cars***
B	***Subcompacts, Super mini***
C	***Compacts***
D	***Mid-size***
E	***Full size, Non-luxury***
F	***Full size, luxury***
S	***Sport coupes***
SUV	***Sport Utility Vehicle***
M	***Minivan and Multi Utility Vehicles***

The Technical textiles are functional fabrics. The applications of technical textiles are seen in various sectors including automotive sector, civil and construction sector, agriculture sector, health sector etc.Source: (www.textileassociationindia.org)

With this backdrop, the need for a research work was felt imperative to study the consumer behaviour exhibited by a selected sample population on technical and safety aspects incorporated with Mobiltech products in cars and the showrooms which sold cars.

RESEARCH METHOD

As Coimbatore is a hub for many engineering good industries especially motors and textile accessories, Coimbatoreans have the drive for trying out the new arrivals and value additions incorporated in consumer products. Therefore Coimbatore was the study area chosen adopting purposive sampling. A sample of 100 was selected for conduct of the studyto obtain the primary data from car users/owners. The survey of consumers belonging to both the genders (20 each) from different occupational backgrounds such as Doctors, Professors, IT Employees, Government Employees and Business persons was the method chosen and the sample on whom a structured interview schedule requesting details on the cars possessed was administered. The selected area boasted of accommodating a cluster of 12 exclusive car showrooms dealing with MNC and Indian make cars. A field survey using an interview schedule as a tool on a purposive sample was

done.Through direct personal interview on selected sample details were collected on the cars for the knowledge on Mobiltech.

SALIENT FINDINGS

The survey revealed that from the selected sample of 100 the consumers were to be the owners of totally 69 multinational cars and 58 cars of Indian origin. It is clear that the consumers of the cars were very cautious and conscious about the value for money. The customer's preferences were majorly seen in the area of technical, safety aspects incorporated in the product.Some technical and safety components embedded in the carswere made up of technical textile products.

Mobiltechis the part of technical textiles is used in various sectors for the fabrication of such as automobile products, ships, aircraft, railways and spacecraft.
Source: www.technotex.gov.in

1. The survey conducted in showrooms pointed out rather enlightened the investigator on the presence of Mobiltech in various interior and exterior components of the cars. With this technical knowledge owners of the cars were to find out the awareness of the sample on the use of mobiltech in the cars possessed by them.
2. The finding of the study revealed the following. The car owners were aware of the presence of mobiltech in components of the cars. It was evident that the mobiltechwas used mainly to ensure technical and safety aspects in cars.

Visible components and Concealed components are the two main categories in Mobiltech products. The visible components include seat upholstery, carpets, seat belts, headliners, airbags, etc. The concealed components include Noise Vibration and Harness (NVH) components, insulations,car tyre cords and liners.
Source: www.technotex.gov.in

3. The mobiltech was found to be used in visible components like seat upholstery, mats/carpets, seat belts, wipers, steering cover, air bags, door interiors, and the line.Mobiltech products such as tyre cords and liners that come under the concealed components in the car were also found. Concealed value addition to comfort and safety like insulation, gaskets, and thermal insulations also come under this category.
4. Preferential differences were visible in the choice of airbags offered in different variants /models and upholstery in terms of materials and fabrics and tailoring done. Airbags came with several safety features like passenger knee airbag, standard air bag, thorax airbag, front airbag, driver and passenger airbag etc. Higher the variant larger the options. In several cars, the cabin quietness was achieved using Mobiltech products such as mats, insulationmaterials, and Noise Vibration and Harness (NVH) components.

CUSTOMIZATION:

Nowadays, consumers are looking forward to customising their car according to their wish. The customization is mostly done with visible components such as seat upholstery, carpets, seat covers, mats, Steering wheel cover, and car cabin interior colours. Today several customization car centres are rolling out to satisfy the consumer needs and desires. The application of Mobiltech products is high in these customization processes.

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CONCLUSION:

Awareness on variants /models in cars was found to be higher. Nevertheless, car owners were not much aware of Mobiltech used in cars despite revealinghigh preference for upholstery,carpets/mats, insulations, comfort, thermal efficiency, safety, and the like.

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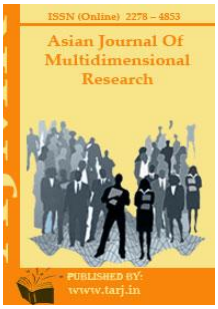

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COLOUR FASTNESS OF PELTOPHORUMPTEROCARPUM FLOWERS ON COTTON AND BANANA FABRICS

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ABSTRACT

People the world over are increasing consciousness about ecology, and preference for natural products and dyes is increasing. Increasing awareness on a global level on the benefits of using natural fiber has been the lead cause for development of agro based fibers. India has abundant natural source and there is ample scope to explore and rebuild the use of natural fibres and traditional dyeing methods to meet the needs of the consumers. The possibilities of using non conventional natural fibres in regular basis need to be explored. Today banana fibre products are done in small scale. Value addition such as natural dyed banana fabrics can be of use in providing better oppurtunities and income generation for the farmers and developing agrobased small scale rural industries. India has abundant dye source and there is ample scope to explore and rebuild the traditional dyeing methods. This study has been for extracting coloring materials from flowers of Peltophorum pterocarpumand use of natural mordants and pretreatments for a pollution free dyeing process and assessing the colour fastness.

KEYWORDS: *Natural dye, mordant, eco pretreatments, banana fabric, Peltophorum pterocarpum*

1. INTRODUCTION

There is a rising interest in the use of natural fibres and natural dyes in the textiles due to ecological reasons and awareness among the consumers. Uses of non conventional fibres are also increasing due to various factors like sustainability, eco friendly, commendable properties and low cost.Banana is a well known important fruit crops grown in all over the world and can also be used as alternative source of useful quality fibres. Banana farming generates huge quantities of biomass most of which goes as waste due to non-availability of suitable technology for its commercial utilization. (Sarma & Deka, 2016).

All varieties of banana plants have fibers in abundance. In India, the fibers are being used for preparing handicrafts, ropes etc., which otherwise can be used for making fabrics, home furnishings and good quality papers.This plant has long been a good source for high quality textiles in many parts of the world, especially in Japan and Nepal. (Vigneswaran et al, 2015).Value addition such as natural dyeing on banana fabrics may enhance its application and end use.The alarming increase in pollution level demands us to immediately alter for ecofriendly processes and finishes. Though natural dyes have some limitations such as availability, fastness , dyeing process and reproduction of shades, they have their own place in the market.Not only dyes but the pretreatments, process, and mordantsused in preparation also need to be eco safe. This study attempts to evaluate the colour fastness of dye from flowers of*Peltophorumpterocarpum*on cotton and banana fabric.

2. SELECTION OF FABRICS

Increasing awareness on a global level on the benefits of using natural fiber has been the lead cause for development of agro based fibers. In India, banana fibre is primarily used in cottage industry situated in Southern India. .(Ray 2013). Banana fibre is known for its good qualities and now its applications are increasing in various fields. Due to its distinct characteristics like low cost, less weight, biodegradability etc there appears to be good scope of profitable use of this fibre in textile. Number of value added products can be developed from bananafibre and it has bright scope for performance in the forthcoming years. Cotton is an ideal fabric for wear in all seasons and also possesses number of suitable technical qualities like high tensile strength, good dyeability. It is commomnly used fabric. Hence cotton and banana fabrics were used for the study. Woven Fabrics with banana yarn in the warp and weft and warp cotton yarn and weft banana yarn and 100% cotton fabric was used for the study.

2.1.FABRIC PRE TREATMENTS

The woven fabrics were desized by soaking the material in boiling water for fifteen minutes. Later the fabric was washed in five percent detergent solution and thoroughly rinsed in soft water.Treating the fabric with butter milk is traditional method of treatingfabrics (Shenai, 1997). The desized material was soaked in buttermilk for 24 hours as pretreatment. The fabric was then rinsed thoroughly and dried.

3. DYEING

3.1.DYE SOURCE

Peltophorum pterocarpum commonly called as Yellow flame tree is a commonly found shade tree. Flowering occurs from March-May, although sporadic flowering may occur throughout the year particularly in young trees (Orwa et al, 2009), Flowers orange-yellow, each about 2.5 cm in diameter, fragrant, particularly at night, with rust-coloured buds. Flowers of Peltophorumpterocarpum (Tamil: Iyalvakai) were collected dried in the shade and powdered.

3.2.SELECTION OF MORDANTS

The natural dyes having limited substantively for the fibre, require use of the mordant which enhances the fixation of the natural colorant on the fibre by the formation of the complex with the dye (Prabhu and Bhute, 2012). The metallic mordants produce bright and fast colours, but are not always eco-friendly. Some of the metallic mordents are hazardous (Siva,2007). Considering the same points natural mordant myrobalon was selected for the study. Mordanting techniques used were pre, post and simultaneous mordanting

3.3. DYEING PROCEDURE

The weighted quantityof dye powder was dissolved in 100ml soft water. Mordanting solutions was prepared in 100ml soft water.

Different variables were attempted for dying process. This included mordant concentration, mordanting technique, dyeing time and mordanting time. The optimum concentration of dye source was found by varying dye concentration. Five and ten grams of dye powder/100ml of soft water were taken. The soaking time was kept constant for all concentration. The samples were visually inspected and based on the results ten percent was decided as the optimum dye concentration.

TABLE 1 .PARAMETERS OPTIMIZED FOR DYEING

PARAMETERS	OPTIMIZED PARAMETER
Dye Concentration in %	10
Dyeing time in minutes	60
Mordant concentration in %	5
Mordanting time in minutes	45

Based on the optimization results the materials were dyed using the dye source, mordant and mordantingtechnique.

All the samples were soaked in soft water prior to dyeing. Later they were taken out, squeezed and shaken to avoid crease formation. The dye powder was dissolved in the required quantity of soft water and boiled for the specified temperature. The wet material was boiled at the chosen temperature for the specific duration with occasional stirring. The mordanting solution was prepared by dissolving the mordants in water. The material was mordanted following the suitable technique selected. Each dyed sample was rinsed thoroughly in soft water and dried in the shade.

3.4.SELECTION OF WASHING METHOD

Vast majority of people still do their washing manually. Hence the samples were given hand washing by using kneading and squeezing method.

The samples were soaked in detergent solution for ten minutes and washed by kneading and squeezing. It was rinsed in three changes of soft water and dried in the shade.

3.6.7. NOMENCLATURE OF SAMPLES

Nomenclature of the dyed and washed samples are given as follows.O-cotton fabric, CB- warp-cotton yarn/ weft- banana yarn fabric, BB – warp and weft banana yarn fabric, 1- pre mordanting, 2- simultaneous mordanting, 3 - Post Mordanting; W - Washed samples.

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3.7. EVALUATION

The dyed and washed samples were visually evaluated and rated for their eveness of dyeing, texture, luster and general appearance.Objective evaluation includes fabric thickness, tear strength, and colour fastness

4. RESULTS OF THE STUDY

4.1.VISUAL INSPECTION

The visual examination reveals that the samples were evenly dyed. They had maximum luster and medium texture. The general appearance was rated to be fair.

4.2. OBJECTIVE EVALUATION

4.2.1. FABRIC THICKNESS

Dyeing increased the thickness of all samples but washing reduced the same slightly. Sample O3W had a maximum decrease of twelve percentages.

4.2.2. TEAR STRENGTH

Dyeing reduced the tear strength of all samples in the warp direction. Sample O3PW had a maximum loss of ten percent. While sample BB3P had a minimum loss of two percent. Washing further reduced the strength of all dyed samples. Dyeing improved the tear strength sample BB3 by three percent in the weft direction. Washing reduced the tear strength of all dyed samples.

4.2.3. COLOURFASTNESS

TABLE.3. COLOUR FASTNESS

S.No	Samples	**Washing**		Pressing				**Crocking**				**Sunlight colour change**
				Wet		Dry		Wet		Dry		
		Colour change	Staining	Colour change	Staining	Colour change	Staining	Colour change	Staining	Colour change	Staining	
1.	O1	¾	4	4/5	¾	5	4/5	4	4	4/5	4	¾
2.	O2	¾	4	4	¾	4	4/5	4	4	4/5	4	¾
3	O3	4	4	4/5	2	5	4/5	4	¾	4/5	4	4
4	CB1	2	4/5	4	3/4	4/5	4/5	4	¾	4/5	4	4
5	CB2	¾	4/5	3/4	¾	4/5	4/5	4	¾	4	4	3/4
6	CB3	4	4/5	3/4	4	4/5	4/5	4	¾	4	4	4
7	BB1	¾	4/5	¾	3/4	5	4/5	¾	¾	4/5	4	2
8	BB2	¾	4/5	¾	4	5	4/5	¾	¾	4	4/	2
9	BB3	4	4/5	4	4	4/5	4/5	3/4	3/4	4	4/5	3/4

Note : 1 - very poor ½ - 2 - poor ¾ - Fair 2/3 - 3 – Moderate 4 - Good 4/5 Very good 5 - Excellent

As regards colourfastness samples BB3 and CB3 had good wash fastness while CB1 had poor fastness to washing.

In wet pressing samples O1and O3 had very good fastness and excellent colour fastness to dry pressing. Staining tests also proved that all samples had very good fastness. Samples had good to

fair fastness to wet crocking and very good fastness to dry crocking. Samples O3, CB1, CB3 and CB3 had good fastness to sunlight. Staining test proves that samples were good to colour fastness.

5. CONCLUSION

It may be concluded that banana fabric may be used as an eco-friendly substitute in textile industry finisning with natural dye, as it reduces the effluent. Though the fastness properties are only fair further treatments and research may improve the dye ability . It may be useful for the rural population through generation of employment in the fiber producing and processing industry. Also value added products would enhance the profitability of banana farmingThis also reduces the chemical usage in fabric pre treatments and can produce eco friendly fabrics.

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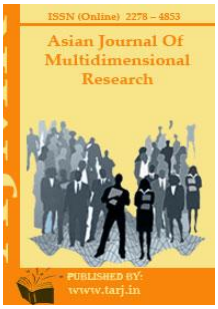

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DESIGN AND TECHNOLOGY INTERVENTION – NEED OF THE HOUR FOR THERENAISSANCE OF ECO HERITAGE CRAFT - KALAMKARI

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ABSTRACT

The Traditional Block printed Textile Industry of India involves Craftsmen with intrinsic traditional wisdom of Natural Dyeing and Hand Block Printing using indigenous and eco-friendly substances. The port town Machilipatnam/ Masulipatnam of Krishna district is known as the birth place of the heritage craft Kalamkari, practiced since 15th Century. The craft isslowly getting transitioned to the use of synthetic dyes and screen printing with pigments causing hazardous effluent and adverse environmental impacts. An attempt was made to highlight the aesthetic, utilitarian and market-oriented changes that Kalamkari has experienced under the influence of modern urban markets as the Kalamkari artists attempt to shift from sustainable craft tradition. A survey was conducted with the master craftsmen of Pedana. The results and findings of the survey emphasises the need for reviving the traditional craft of Kalamkari and re-establishing the skilled craft communities. This paper is suggestive of an integrated design and technology intervention based on triple bottom line approach (social, economy, environmental) and includes multiple interventions like awareness generation, skill up-gradation and product development to strengthen and improve the value chain of natural dyed/printed textiles of India. This will result in mainstreaming the eco-craft products and reduce the impact of pigments and other related chemical substances on eco-system.

KEYWORDS: *Eco Textiles, Textile Crafts, Block Printing, Kalamkari, Technology Intervention*

INTRODUCTION:

The Coromandel Coast of southern Andhra Pradesh of India was once a world renowned source of fine hand-printed textiles. Unlike the Kalamkari of Sri Kalahasthi (known for exclusive pen work) Masulipatnam practiced the art of application of resists in combination with mordants using printing blocks producing intricate Persian stylised motifs. Vegetable colours derived from plants like Chiruveru, Chiranji, Manjijstha, Madder root, Karakkaya, Jaji leaves, Indigo, Myrobelon Flowers and Pomegranate rind are used for dyeing, Tamarind seed powder used as gum, fermented solution of date palm Jaggery and rusted iron for black out lines on myrobelon treated fabrics, Blocks made of teak wood, specialised process of natural bleaching by soaking in goat/buffalo/cow dung and washing in flowing river water are significant to the craft.

Figures 1&2: Block Printed Kalamkari and Block with Traditional motifs carved

Picture Courtesy: All pictures are original from the craft site

CHANGING SCENARIO OF THE CRAFT:

Figure 3 & 4: Screen Printed Kalamkari using Pigments; Image courtesy: Google Images

The MachilipatnamKalamkari got the GI status in 2008 (Application no 90). With the onset of mechanization and changing social values, machine-made clothes reduced the demand for hand block printed textiles while demand for original craft form faded away. Falling demand pushed the cash-starved printers to undercut each other's wages at the cost of quality. Moreover, as running water started to dry up, the falling trust within the cluster reduced the propensity to collaborate for the revival of crumbling infrastructure. Search for survival led to finding easier ways for making money and closed all avenues related to building of new knowledge base and progressive working on improving productivity, survival and sustainability of the craft. The Craft at present is facing a new challenge producing machine made imitations products which are cheaper and almost

indistinguishable to end customer. Machine made imitations are quickly becoming more successful than the originals because of cost advantage and also for use of bright and fast chemical pigments in place of natural dyes.

With the influence of screen printing (once practiced only by local printers of that area for domestic products like *kerchiefs, lungis*and bedsheets), which is 10 to 20 times faster and much cheaper offered a severe threat to the traditional craft of block printed *Kalamkari*and swept the mass market with near similar products being prepared both by block and screen printing.

METHODOLOGY:

A sample of ten Master Craftsmen of Block printed *Kalamkari*, who are also members of the "Vegetable Hand Block *Kalamkari* Printers Welfare Association, Krishna Dt. of Andhra Pradesh were chosen for the study out of the population of master crafts men distributed in the established geographical areas of Kalamkari production, which include *Machilipatnam* town and surrounding villages namely *Guduru, Polavaram and Kappaldoddi* and also *Chirala* of *Prakasham* Dt. The study was a result of several field visits undertaken and also documentation of the craft as it is practiced in their units located at *Pedana*, which contribute a major share of *Kalamkari*production.

Personal Interview was chosen as a method of primary data collection with individual master crafts men initially followed by a group discussion with all members gathered at one place. An in depth interaction was undertaken with major focus on understanding the present status of the craft (Post GI) in terms of its continuation of practice of *Kalamkari*in its traditional / sustainable form, Reasons for the shift from block printing with natural dyes to screen printing using pigments, improvement in the livelihood of artisans, Required interventions for the sustenance of craft and present positioning of the craft in the market.

FINDINGS OF THE STUDY:

- The Traditional process of Block printing is intermittent and time consuming, resulting in less production and low profits (as cost of production is comparatively high to that of screen printing)
- Process gets interrupted in rainy season and also in summers due to lack of canal water; Thus resorted to pigment printing which doesn't require flowing water
- Limited range of natural colours, demand for bright and fast shades resulted in use of pigments for second and third colours/ filling colours; which also reduces need for washing in between kalamkari production process.
- Units disorganised with low level infrastructure and no ergonomics observed
- Emergence of many small units who undertake job works for screen printing
- Practice of traditional process majorly for items of export as they can charge at premium for GI registered the craft, which is well honoured by export markets
- Lack of guidance /monitoring by Govt. or GI officials; which led to severe abuse of craft; no financial assistance or marketing support
- Need for a common facility center, raw material bank, Design assistance and technology intervention for few processes related to fabric preparation and dyeing
- Lot of resistance by the residents and local formers for the use of canal water for washing of pigment printed fabrics posing major threat of contamination of water table
- Recent investigation by AP pollution board certified that the water in which fabric with pigments is washed is not advisable to purify for drinking purpose.

- District collector has imposed a ban on using canal water washing pigment printed kalamkari and initiated an enquiry on use of chemicals and estimation of hazard

PROPOSED RESEARCH INTERVENTIONS:

The survey indicatedthe need for the technology integration in the craft as a means to retain craftsmen from shifting to other crafts by providing alternate means of eco- friendly processes and technologies for achieving quality products in less time for more production. Based on the findings of the research and analysis, the following possible interventions are suggested to achieve the overall objective.

1. STANDARDIZATION OF NATURAL DYE

- Developing new colour palette of Natural Dyes in bright shades with improved fastness
- Use of Scientific methods of extraction for better yield of colour and reproducibility of shade or standardisation of production norms

2. TECHNOLOGY INTERVENTION:

- To conduct method study and time study and related ergonomics of the craft
- Identification of the processes/stages requiring technology intervention
- Exploring technology as an alternate means for achieving best quality in less time and for more production

3. ORIENTATION WORKSHOPS AND SKILL TRAINING: EDUCATE TO SUSTAIN

- Dye extraction and application processes
- Quality control, Testing for Colour fastness
- Skill upgradation for implementation of technology intervention
- Imparting entrepreneurial skills and financial literacy
- Development of Training modules and assessment of impact of trainings

4. PRODUCT RANGE:

Developing a range of Fashionable clothing (as a result of pilot intervention) consisting of a smart range of sustainable Eco- Fashion products & Ethical luxury clothing (Men /Women/Kids) there by adhering to standards of global safety forusing energy efficient production processes

5. ESTABLISHING MARKET CONNECTS:

Local to Global: Sustainable linkages and trust has to be evolved between Natural dye plant cultivators, aggregators, research institutions/testing laboratories, suppliers, traders, industry players and destined markets to achieve transparent and ethical business through fair trade practices. Exhibitions may be conducted for Buyer seller meets.

6. BRANDING AND PROMOTION:

- Development of Natural dye kitsand booklets of literature pertaining to selection and application of Natural dyes
- Catalogues featuring the story line of the socio economic profile of the traditional artisans practicing the craft and characteristic features significant to the craft
- Designing packages and brand labels; Craft souvenirs

NEED FOR THE IMPLEMENTATION OF VARIOUS GOVT. SCHEMES OF DEVELOPMENT OF HANDICRAFTS:

The office of the Development Commissioner (Handicrafts), an attached office of Ministry of Textiles, Government of India formulates & Implements various schemes for the development of Handicrafts in the country. The following Govt. schemes when implemented can bring a positive harmonious change in the craft.

- **Design and Technology Upgradation Scheme:** The objective of the scheme is to develop newprototypes to suit the tastes and preferences ofcontemporary market using the traditional skill ofartisans and introduction of new techniques and technologies for enhanced production

- **Mega Clusters** – The objective for setting up these clusters is to assist the artisans & entrepreneurs to set up world-class units with modern infrastructure, latest technology, and adequate training and HRD inputs, coupled with market linkages and product diversification, design of clusters following Standard Models of units of SSI and SME with infrastructure that is customized to give a competitive edge and these centres have greater potential to become globally competitive.
- **Research & Development Scheme**is to generate feedbackon economic, social, aesthetic and promotionalaspects of various crafts and artisans in the sector.The interventions carried outunder this component are conducting Surveys & Studies on different topics, Problem relating to availability of raw material, technology, design, common facilities,Registration of Crafts under GI Act & necessary follow up onimplementation,Assisting handicrafts exporters in adoption ofglobal standards like bar coding, includinghandicrafts mark for generic products, Financial Assistance for taking up problems relating to brand building and promotion of Indian handicrafts, Conducting of seminars on issuesof specific nature relating to handicraftssector.

CONCLUSION:

To conclude, we can say that in India, arts and crafts are not necessarily practiced for commercial reasons alone; they also serve a social, ritualistic or decorative purpose. Aesthetics in everyday life is common to all communities and can be found across the mediums. Introduction of natural colours in the form of trendy market led products (Fashion apparel, Home furnishings and accessories) and its strategic promotion will help the revival of the dyeing craft. Product diversification into utilitarian items coupledwith technologyintervention would be a prudent idea. With the advent of synthetic dyes and pigments, it seemed that natural colours would lose their importance for ever. However, the uniqueness of these materials, properties, processes and the glorious colours produced remained unmatched. The demand for eco-friendly dyes has been a resurrection in their use on textiles and in art. Raw material producers, Craftsmen, Designers, industrialists and marketers will be the key agents to create sustainable value chain for the Natural dyes and henceforth, creating job opportunities for themselves.

Research in this area provides an opportunity for experimentation and innovation. The consumers are also quality/eco/fashion conscious and socially responsible. Thus, in order to address these challenges and to provide tangible & Sustainable solution to the indigenous heritage craft industry, there is a dire need to re-invent the sector and devise pragmatic strategy for the overall benefit of the stakeholders/ communities at large.

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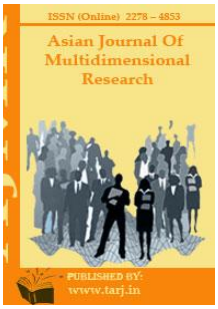

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FACTORS INFLUENCING THE CONSUMER BUYING BEHAVIOR OF HANDLOOM PRODUCTS IN HYDERABAD

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ABSTRACT

Understanding consumer interests and buying behavior is very important to make products and to get a better chance of gravitating consumer towards specific products. This article includes a survey of 50 consumers to understand their influencing factors to choose handloom products when they go out for shopping

KEYWORDS: *influencing, Agriculture, consumer*

1. INTRODUCTION

Indian textile industry is the 2nd largest industry next to agriculture. Handloom industry is one of the main contributors to it. Production of hand-woven / handloom fabric from India constitutes 95 percent of global production. A value of US$ 355.91 million handlooms were exported from India in 2017-18. Though it has great value worldwide. Handloom industry in India losing its glory in Indian market. It is important to have local consumers to regain its glory. Understanding the buying behavior of the consumer is the most important as the seller has a better chance of gravitating them towards specific products.

2. RESEARCH OBJECTIVES:

1. To understand the knowledge of the consumers towards handloom fabrics
2. To understand factors influencing of the consumer to choose the handloom fabrics

3. LITERATURE REVIEW:

A study conducted by Paul, R., & Goowalla (2018) in Dimapur District-Nagaland explains that Quality and comfort are the most major factors which influence the buying decision of handloom customers followed by price and location. A self decision is the most major persuasion which influences the buying decision of handloom customers followed by parents spouse and children. Similarly, in another study conducted by Gayathri V Nair and Kinslin D (2016) in Trivandrum district revealed that consumers are more aware of handloom product but not much aware of descriptions and quality checking methods. Hence enough measures have to be taken place in order to increase the awareness to make handlooms as a sustainable Industry in the mind of a customer.

4. METHODOLOGY:

50 questioners were filled by personally interviewing the consumers who are going for the purchase of garments in the city of Hyderabad, India.

The questionnaire was structured as follows. The first part includes demographic questions such as age, gender educational qualification, annual income and dichotomous questions with Yes and No as two possible responses. These questions are to understand the consumer and measure general consumers' knowledge about handloom fabrics. The second part of the questionnaire consisted of factors variables in a 5-point scale to understand the factors influencing of the consumer to choose the handloom fabrics. The survey scale is adapted from Roberts and Bacon's (1997) Ecologically Conscious Consumer Behavior (ECCB) scale. Scores on the scale items varied from a low of 1 (strongly disagree) to a high of 5 (strongly agree), with disagree, neutral, and agree as interval points. Mean, standard deviation techniques were used to analyze the results.

5. RESULTS AND ISCUSSION:

Among the 50 respondents, 100% are married 64 %of the respondents were females and 36 % males with mean age ranging from 21years to 50 years where 83 % are aged between 21 to 40 years. 84 % of them for graduates and above. 54% of them are having household income between 3 to 5 lakhs per annum.

Among the respondents, 100% female respondents have knowledge about handloom fabrics, where 88.9% of male have knowledge about handloom fabrics. 84% of the responders are the consumers of the handloom fabrics. 78% of respondents mention that handloom fabrics are sustainable.

Majority of the respondents, i.e.; 94% hear about handloom fabrics from their family and friends.

5.1 Mean analysis of factors influencing consumer choice

Factors	Mean (M)	SD
Handlooms fabrics are uniquely different from other materials	4.04	1.11
Handlooms fabrics feel good on skin	3.92	0.92
Handloom fabrics are made authentically	3.56	0.91
Handlooms fabrics have the cultural value	4.44	0.93
Handlooms fabrics have unique colors	3.26	0.90
Will buy Handlooms fabrics for festivals and special occasions	4.36	0.90
Do you buy handloom fabrics because those are eco friendly	4.28	1.14
Handloom fabrics are highly priced	4.72	0.78
Will buy handloom fabrics because of its value for money	4.68	0.71
Can you identify the difference between handloom and power loom	2.26	1.16

SD-Standard

DEVIATION

Above table demonstrates that though consumers agree about high price of the handloom fabrics with a mean of 4.72 and SD of 0.78 , they likely to buy the handloom fabrics due to its value for money (M=4.68, SD=0.71) followed by its cultural value (M=4.44, SD=0.93), Eco friendliness (M=4.28, SD=1.14) and uniqueness of the handloom fabrics(M=4.04, SD =1.1). Most of the responders buy handloom fabrics manly for festivals and special occasions (M=4.36, SD=0.90).

6. CONCLUSION

Most of the consumers are aware of handloom fabrics. Consumers show more interested to buy handloom fabrics in festivals and special occasions. Though most of the consumers choose to buy handlooms due to its value for money, they are not sure whether they are buying handloom or power loom fabrics. hence it's very important to create awareness among consumers on how to identify handloom fabrics, hence consumer is sure about the product what they are paying for.

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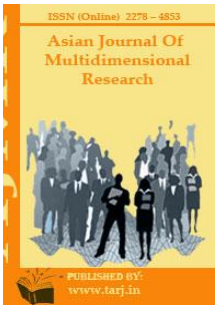

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EXTRACTION AND DEVELOPMENT OF NONWOVEN FABRIC USING ARECA CATECHU AND COTTON FIBER BLENDS

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ABSTRACT

The growing environmental problems, the problem of waste disposal and depletion of non renewable resources have stimulated the use of green materials compatible with the environment impacts; natural fibers seem to be a good alternative since they are abundantly available. Number of possibilities to use all the components of fiber yielding crop, one such fiber yielding plant is ***Areca Catechu*** *the husk of this plant yield fibers. Along with all the natural fiber-reinforcing resources, areca appears to be a capable material because it is inexpensive; accessibility is rich and a very high potential constant crop. It belongs to the species* ***Areca catechu L****., under the family* ***palmecea****.Husk fiber are characterized by length is high, high cellulose fiber. These fibers are easily biodegradable therefore we can look this fiber as a sustainable resource for manufacturing and technical application. Extraction of fibre made in two method, one is conventional method another one is chemical extraction Detailed discussion is carried out a method of extraction in this paper.*

KEYWORDS: *Areca Catechu, Conventional method, chemical extraction.*

INTRODUCTION

Nowadays, the urge to replace synthetic fibre with natural fibre is increasing due to environmental concerns. Synthetic fibres are commonly used in non woven fabrication, owing to their excellent mechanical properties. However, synthetic fibres are non- biodegradable; hence many attempts are made to find alternatives for synthetic fibre. Natural fibres are available everywhere, and researchers are attracted towards them as promising alternative material to traditional glass fibres due to their good specific strength, low cost, renewability, market appeal, fully biodegradable nature, and non-abrasive character (Jawaid and Khalil 2011).

Environmental issues have resulted in considerable interest in the development of new non woven materials based on biodegradable resources. The thrust on developing innovative and weight less material from locally available, cheaper and renewable sees was of greater interest. Presently the annual production of natural fibers in India was approximately 14.5 million tons. The natural fibers have been classified into many types such as bast, leaf, seed, fruit and wood fibers. These fibers were traditionally used for various purposes such as rope, roofing, house hold appliance, bandage etc. The main advantages of these natural reinforced composites are high specific strength and modules, availably, low cost, high weight, recyclability, bio degradability, lack of health hazards and nonabrasive nature (Sathis Kumar, 2013). The application of natural fiber are growing in many sectors such as automobiles, furniture, packaging, and construction etc. (Sanjay ,2016)

The husk of the areca constitutes about 60–80% of the total weight and volume of the fresh fruit. The husk fiber is composed of cellulose with varying proportions of hemicelluloses, lignin, pectin and protopectin. The average filament length (4 cm) of the areca husk fiber is too short compared to other bio fibers. Mainly two types of filaments are present – one very coarse and the other very fine. The coarse ones are about ten times as coarse as the jute fibers and the fine are similar to jute fiber (Srinivasa, 2011).The Areca catechufiber traditionally used as a housing insulation material and fabrication of value added products such as cushion, hand craft and nonwoven fabrics (lazim,2014).Lignin is the main constituent of Areca catechufiber, responsible for hardening of plant cell wall and the reason for the fiber stiffness.Areca catechufiber is a hard fibrous portion covering endosperm, mainly composed of hemicellulose (Padmaraj, 2013).

EXPERIMENTAL PROCEDURE

SELECTION AND COLLECTION OF SOURCES

In majority of places the Areca catechu shells are wasted which become a breeding ground for mosquitoes used as fuel. All natural fibers are mostly used for reinforcing material Areca appears to be budding fiber as it is inexpensive, abundantly available, and very high potential perennial crop. So the researches utilized the study. The areca husks were collected from Palakkad in Kerala. Many varieties of areca husk are available in the varieties depend on cultivated places, soil and climatic condition. About two kilograms of dried areca husk was collected.

EXTRACTION OF ARECA CATECHU FIBER

The fiber extraction of Areca catechu was done in retting method. The cold water retting process was selected for the extraction of fiber from Areca catechu. The dried Areca catechu empty fruit husks were soaked in cold water, for required number of days. The soaking process loosened the fibers and fibers were extracted easily and quickly. Areca catechu fibers were removed from the fruit and separated. Finally, the fiber were washed again with water and dried. Thus the areca nut fiber was extracted.



Plate I Areca Catechu Fruit Plate-II Cold water retting process Plate III Areca catechu fibre

NEED AND SELECTION OF SOFTENING SOURCES

Areca catechu fiber is a strong, stiff, and natural fiber. The fibers contain lignin and hemicelluloses. There are responsible for the dark color and harshness. The spinning property of the fiber was less because of poor elongations and high flexural rigidity. Hence the present study confirms aim to soften the fiber using eco friendly method and make the fiber suitable for fabric formation .Natural enzymes used for fiber softening selectively remove the lignin content without the, properties of fiber like color softness are improve by using natural enzymes. Natural enzyme was selected for softening process; three plant sources (papaya peel, potato peel and cabbage peel) were selected for enzyme preparation for the softening of Areca catechu fiber. The softening was find out the visual evaluation .The papaya peel gave good result than the other in softening process. Hence the investigator select of natural papaya peel which is rich source of pectinase for softening Areca catechu fiber.


Plate -IV Enzyme process Natural enzyme natural enzyme (papaya peel)

SELECTION OF SOFTENING PROCESS

Based on the pilot study, the papaya peel was selected for softening process. The papaya peel was cleaned and weighed. From the selected natural enzyme the treatment of cold water and hot water at two hour's were carried out. Among the two treatments the best result was given by the cold water method and it is carried out further process. The softening treatments which make the fabric more flexible and important the impression of softness are known as softening.

Plate -V Fiber softening process

SELECTION OF FIBER BLENDING

Cotton is the world's most used fiber .It is cool, soft and comfortable and principle clothing fiber of world (Singh, 2009). Cotton fiber is composed primarily of cellulosic; it is very absorbent good drape ability (Mishara, 2009). Hence the cotton fiber select for blending with Areca catechu husk fiber .The Areca catechu husk fiber was short fiber and does not have crimp .Fibers were blended to give good properties of the fabric. The blending proportion is 50:50 ratio of Areca catechu fiber and cotton fiber.

Plate VI - Blending

CARDING PROCESS

Carding is a process to individualize and parallelize to the fiber .The carding process was the final step in individualizing fibers before they were collected from a web like state into the silver strand. The main purpose of the carding machine is fiber individualization, which is absolutely essential for the uniform placement of fibers during the formation of a high quality web. The process are provides the ultimate cleaning of the fiber mass by elimination of the remaining impurities of even the smallest size, such as dust (Batra, 2012).

The carding is a mechanical action. In which the fibers are held by one surface while the other surface combs, the fibers causing individual fiber separation (Clifton G. overholser, 2013). The carding process with Areca catechu fiber and cotton fiber is blend with 50:50 percent ratios.

Plate -VII Carding process Plate- VIII Web formation

FABRIC FORMATION OF NEEDLE PUNCHING

The separated soft fiber was converted into fabric using needle punching technology. Needle punching is a method of bonding fibers fleeces mechanically. The fiber are mechanically entangled to produce a fabric by reciprocating barbed needles through a moving batt of fibers in a needle loom .The needle punching process is well suited to produce medium and heavy weighted nonwoven from 300 GSM to 3000 GSM (Subhankar maity, 2012).The web was placed on the feed rollers, which the webs pass through the loom. The needles are carry bundles of the fiber through the bed

plate holes. A fiber from the needle after the materials comes out through the needle loom. The needle punched fabric is drawn out from the machine by taken up rollers.

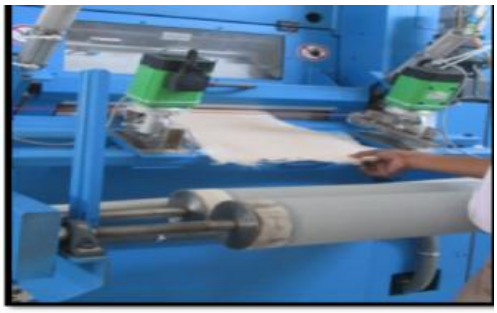


Plate – IX Needle punching process

Plate –X Unsoftened needle punched fabric

Plate – XI Softned needle punched fabric

EVALUATION OF THE NEEDLE PUNCHED FABRIC

FABRIC WEIGHT

The weight of a fabric can be expressed in weight per unit area or the weight per unit length. The term that was in use before the arrival of the GSM (grams per square meter) was 1b/100yard. This expression is used by the British standard for measuring this there is a template and a quadrant balance. The GSM cutter is used to cut the fabric and weight is measured using a balance (Amutha, 2016). The GSM cutter on the test sample and rotate the knob of the cutter. The blades provided on the cutter will cut the fabric. The sample of 100 cm and weighted the electronic balance to obtain the grams per square meter. The reading was recorded.

FABRIC THICKNESS

Determination of thickness of fabric samples in laboratory is usually carried out with the help of a precisian thickness gauge. In this equipment, the fabric thickness is to be determined is kept on a flat anvil and a circular pressure foot is pressed onto it from the top under a standard fixed load. The dial indicator directly gives the thickness in MM (textilelearners.blogspot.in).The eureka thickness gauge was used for the measurement of the fabric thickness. The sample is placed in anvil plate and the lower of the pressure foot is release very slowly. Pressed slightly on the sample. The reading were taken then mean value was calculated.

FABRIC STIFFNESS

A bending test measures the severity of the flexing action of a material. The bending length is a measure of the interaction between fabric weight and fabric stiffens in which a fabric bends under its own weight. The stiffness of a fabric in blending is very depend on its thickness. The thicker the fabric is stiffer (Jinalian Hu, 2008).The test is carried out using Shirley stiffness tester. A

rectangular strip of fabric, six inch to one inch is mounted on a horizontal plat form in such a way that it overhangs. The fabric is bends downward from the length one and the angles 0, a number of values are determined. The samples were tested both in warp and weft direction to determine the stiffness of the sample. The readings are noted and the mean value was calculated.

TABLE I NOMENCLATURE OF NEEDLE PUNCHED FABRICS:

S.No	NOMENCLATURE	PARTICULARS
1	OACF	Original Areca catechu Needle punched fabric
2	SACF	Softened Areca catechu Needle punched fabric

RESULT AND DISCUSSION

FABRIC WEIGHT

The fabric weight and analysis of variance of the sample OACF and SACF are shown in Table II

Fabric Weight (GSM)

Samples	Mean ± SD	Loss/gain	Percentage of Loss/gain	't' value
OACF	2.36 ± 0.50	0.78	33	4.629**
SACF	3.14 ± 0.01			

** - Significant at 1% level (p<0.01)

From Table II, it is evident that the mean weight of the SACF was increased 3.14 when comparison made with OACF. There was 33% of weight gain in SACF due to the enzyme treatment. To make the fiber more soft and closer the fiber each other. Statically analysis also proved that there is a significant difference at 1%level between the samples, OACF and SACF with the "t' value of 4.629.

FABRIC THICKNESS

The thickness and analysis and of variance of the sample of OACF and SACF are shown in Figure 1.

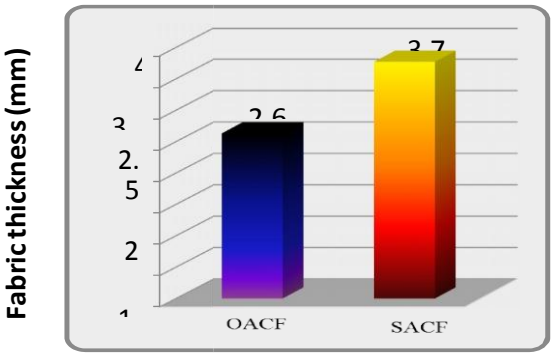


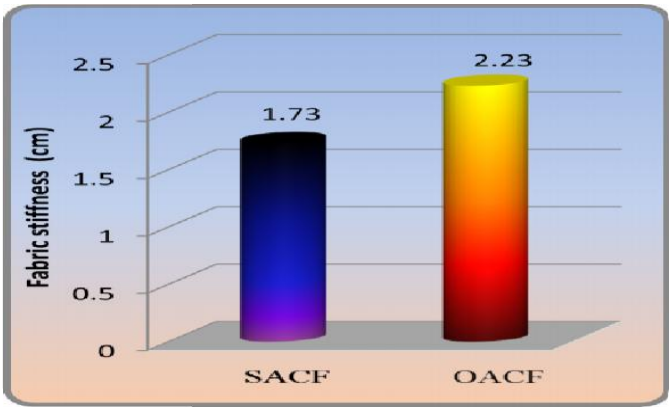
Figure 1 Fabric Thickness

From Figure 4, it is evident that the mean value of the SACF was increased in 3.77. When comparison made with OACF .There was 43.3 percent of thickness increased in SACF due to the enzyme treatment to make the fiber softened and closer to each other .So the thickness was increased in SACF sample. Statistically analysis also prove that there is a significant difference among the sample at 1%Level with t' value of 7.591.

FABRIC STIFFNESS

The stiffness and analysis of variance of OACF and SACF are presented in the Figure 2.

Fabric Stiffness



CONCLUSION

Environmental consciousness, new rules, and legislation are forcing industries to seek new materials that are more environmental friendly. In a textiles industry to replace synthetic fiber with natural fiber is increasingly due to environmental issues. Softened areca husk fibre to be utilized for needle punched fabric production. Areca husk fibre is blending with cotton fibre and it is suitable for nonwoven fabric. The softened needle punched fabric has good physical properties to compare with unsoftened needle punched fabric. The evaluation of fabric weight, fabric thickness, was increased in after natural enzyme treatment but the stiffness ,air permeability and pore sizes was decreased because the fibres are closely interlocked after enzyme treatment.

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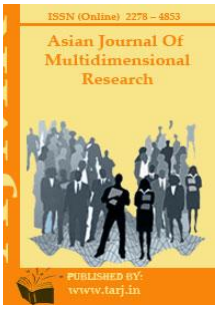

Asian Journal of Multidimensional Research (AJMR)

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EFFICACY OF NATURAL PRINTING ON COTTON

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ABSTRACT

Mother Nature has provided mankind with all abounded sources to satisfy all his needs. Among them colourful clothes rank the highest priority. Recently environmental issues have focused man to think about natural colouring agents. Considering this printing uses natural sources and thickening agents is focused in this study. The trials were undertaken to print the cotton fabric with natural dye extract such as Lawsoniainnermis L (henna) and natural thickening agent such as seed of the Tamarindusindica L (tamarind) with the help of wooden blocks. Aloe Vera is used as mordant for pre mordanting. The block printed sample was tested for thickness, GSM, stiffness, colour fastness to washing and crocking.

KEYWORDS: *Dye source, henna, thickening agent, tamarind seed, block printing*

1. INTRODUCTION:

Printing is the technique of applying colour to the required designs and patterns in the fabric. Printing paste is required to print the fabric. Printing paste is made up of dye pigments, thickening agent and the water. The fabric printing cannot be done perfectly without the use of the thickening agent. The main function of thickening agent is to provide the viscosity to the printing paste andto prevent the thickening agent from spreading and bleeding. Both synthetic thickeners and natural thickeners are used to print the fabric. But synthetic dyes and thickening agent has lot of disadvantages such as longer drying time, cause pollution to the environment. Natural dyes and thickening agent does not affect the environment and are biodegradable.

Henna leaf powder is used as dye source. Henna has many advantages such as antiviral, antibacterial and antifungal properties.They are used as colouration of hair, skin and fingernails. Henna also has many health benefits. It helps to relieve headaches, detoxify the body, improve nails, protect the skin, boost hair health, cool the body, reduce inflammation and speed healing.It has been used for dyeing and printing fabric such as cotton, silk and leather.

Aloe Vera is used in many areas such as cosmetic, pharmaceutical and food industries. It has antioxidant and antimicrobial properties. It helps to accelerate the healing process.Without the mordant the dye will not fix with the fabric well. Synthetic mordant have more of chemicals which doesn't consider as eco-friendly printing and cause lot of problems to the environment. Aloe Vera is not only used for mordanting but it also works as antibacterial and antiviral. Tamarind seed is used as thickening agent which is renewable and sustainable. Tamarind seed has 65% of gum and remaining are protein, fibre and ash. The tamarind seed gum is used to increase the viscosity of the printing paste which is very important factor in printing.

Considering the above factors the study on printing cotton fabrics using henna, tamarind seed and Aloe Vera has been framed

The main Objectives are

- To collect the natural sources
- To pre mordanting the fabric with Aloe Vera
- To extract dye pigment from henna
- To extract thickening agent from tamarind seed
- To prepare printing paste
- To print cotton fabric using prepared printing paste
- To evaluate the fabric

2. METHODOLOGY:

2.1. SELECTION OF SOURCES FOR PRINTING:

Henna has been used since antiquity; it is a material and a method of making design. As dye, it has been used in sticking and staining on various substrates which it penetrates either by itself or through a mordant (Udeani-2015). Hence, Henna leavesare selected as dye source. It was collected from the trees in the neighbourhood. The leaves were thoroughly washed. It is dried in shade and made it as powder.

2.2. SELECTION OF THICKENING AGENT:

Thickening agent is used to hold the printing paste on the fabric. It is also used to get the required viscosity of the printing paste. The tamarind seed kernel has 11.4-22.7 moisture content, 15-20.0 protein, 3.9-16.2 oil, 7.4-8.8 crude fibre, 50-57 carbohydrates, (Kumar et.al., 2008)Tamarind seed is used as thickening agent for the study. It is dried and ground into powder.

2.3. SELECTION OF MORDANT

Metal salts of aluminium, iron, chromium, copper and tin are used as mordants. But they are not eco-friendly. Hence, Aloe Vera is used as mordant. In this study Aloe Vera gel is extracted and directly applied onto the fabric.

2.4. FABRIC PRE-TREATMENT

Cotton fabric is sized during the weaving process. It is applying on the cotton yarn during warp winding for the stiffness. Desizing is used to remove the sizing material from the fabric. Starch used as sizing material. Sizing material makes dye difficult to adhere to the fabric. The fabric is boiled in the water containing 5% detergent for 100 degree Celsius for 3 hours. The fabric was removed washed thoroughly and dried.

2.5. PRE-MORDANTING

Aloe Vera is used as mordant. Ten gm of Aloe Vera is mixed with the 100ml of water and stirred well. The fabric sample is dipped in that solution and kept for two hours in room temperature. Later it was dried, ironed and kept ready for printing. Mordanting is used to fix the printing paste in the fabric.

2.6. EXTRACTION OF DYE

The dye is extracted from the henna leaves and leaf powder by the boiling method. The dried powder of 5gm is boiled in the 100 ml of water in the water bath at 100 degree Celsius for one hour and it was filtered and kept aside for preparation of printing paste (Md. Mahabub H et. al., 2015).

2.7 . PREPARATION OF PRINTING PASTE

The printing paste was prepared b boiling the 50ml of dye extract with 4gm of thickening agent namely tamarind seed powder for 20 minutes. The tamarind seed powder is added to get the required viscosity of the printing paste. The powder was added slowly and the liquid was stirred continuously. The prepared paste is shown in Plate 1.

Pigment Paste (Plate 1)

2.8. PRINTING

The printing is done on the cotton fabric using wooden blocks. Then the printed fabric is dried in shade and ironed. The printed fabric is shown in the Plate 2

Printed Fabric (Plate 2)

2.9. EVALUATION OF FABRIC

2.9.1 FABRIC THICKNESS

The thickness of the original and printed samples was tested by the thickness gauge according to the ASTM standard. Ten readings were taken and the mean value was calculated.

2.9.2. FABRIC WEIGHT (GSM)

The GSM of the printed fabric is calculated. In this fabric is cut in the GSM cutter and weighted in the electronic weigh machine. Ten samples were taken and mean value is calculated.

2.9.3. STIFFNESS (ASTM D1388-18)

Stiffness of the fabric is calculated by the use of fabric stiffness tester. In that the fabric sample is placed on the equipment and the measuring plane is placed over the sample. The plane is moved forward, at one point the sample begins to fall, this denotes stiffness. Ten samples were taken, stiffness was measured and mean value is calculated.

2.9.4. COLOUR FASTNESS TO WASHING

Colour fastness to washing is measured by comparing the washed sample and the printed sample in the grey scale. The washed fabric is shown on the Plate 3.

Washed Fabric (Plate 3)

2.9.5. COLOUR FASTNESS TO RUBBING

Colour fastness to rubbing is calculated by the crock meter. Here the printed sample is rubbing against the plain white fabric. The colour which is bleed in the white fabric decides the colourfastness of the printed fabric. The rubbed fabric is shown on the Plate 4.

Rubbed Fabric (Plate 4)

3. RESULTS AND DISCUSSIONS

3.1 Analysis of the physical properties of original and printed fabrics:

The original and printed fabrics sample compositions and their physical properties are shown in Table 1.

TABLE 1.PARAMETERS OF ORIGINAL FABRIC AND PRINTED FABRIC

Sample	Thickness(mm)		Weight(gm)		Stiffness(cm)	
	mean	Loss or gain over original	Mean	Loss or gain over original	mean	Loss or gain over original
Original	0.32	-	1.226	-	1.35	-
Printed	0.40	0.08	1.437	0.11	1.77	0.42

TABLE 2. PARAMETERS OF COLOUR FASTNESS TEST

Colour fastness to washing	Colour fastness to rubbing	
	Dry	Wet
¾	5	3

Results are discussed for original and printed fabrics were apparent from Table 1.Mean thickness for the original and printed fabric is found to be 0.32 mm and 0.40 respectively. It is concluded that there is a gain of thickness for the printed fabric up to 0.08 mm which shows that the printed fabric has gained thickness which might be due to the deposition of the printing paste. With reference to weight the mean values of original and printed fabric is found to be 1.226 g and 1.437 respectively and as such printed fabrics gains it weight up to 0.11.It is concluded that the fabric weight is more than the original fabric weight after printing. The printed fabric has highest absorbency than original fabrics. The Mean stiffness for original and printed fabric is 1.35 and 1.77 respectively. It is concluded that the printed fabric has gained stiffness up to 0.42 cm. from the above results it is cleared that the printed fabric has gained thickness, weight, stiffness.

3.3 Statistical Analysis of parameters tested for original and printed fabrics

The statistical analysis for the parameters for thickness, weight and stiffness for the original and printed samples is presented in Table 3 a, b, c.

TABLE 3(A)-STATISTICAL ANALYSIS OF THICKNESS TESTED FOR ORIGINAL AND PRINTED FABRICS

Variables		Mean	SD	SE	T-value	Sig
Thickness	Original	.3230	.00949	.00300	-5.330	.000*
	Printed	.4020	.04590	.01451		

***-Significant at 1% level**

The above table shows the output of the Independent T-Test analysis, that the significance value of original thickness and printed thickness is 0.000(i.e., p = .000), which is below 0.05 and, therefore, there is a statistically significant (at 1% level) difference between the original and printed fabric with reference thickness.

TABLE 3(B)- STATISTICAL ANALYSIS OF GSM TESTED FOR ORIGINAL AND PRINTED FABRIC

Variables		Mean	SD	SE	T-value	Sig
GSM	Original	1.2260	.00843	.00267	-20.377	.000*
	Printed	1.4370	.03164	.01001		

***-Significant at 1% level**

The above table shows the output of the Independent T-Test analysis, that the significance value of original thickness and printed thickness is 0.000(i.e., p = .000), which is below 0.05 and, therefore, there is a statistically significant (at 1% level) difference between the original and printed fabric with reference GSM

TABLE 3(C)- STATISTICAL ANALYSIS OF STIFFNESS TESTED FOR ORIGINAL AND PRINTED FABRIC

Variables		Mean	SD	SE	T-value	Sig
Stiffness	Original	1.3500	.15811	.05000	-4.882	.000*
	Printed	1.7700	.22136	.07000		

***-Significant at 1% level**

The above table shows the output of the Independent T-Test analysis, that the significance value of original thickness and printed thickness is 0.000(i.e., p = .000), which is below 0.05 and, therefore, there is a statistically significant (at 1% level) difference between the original and printed fabric reference stiffness.

The above table shows the output of the samples T-Test analysis for the significant values of original and printed fabrics are -5.330 for thickness,-20.377 for weight and -4.882 respectively which is below 0.05 that shows that there is significant difference between original and printed fabrics. Hence it can be concluded that there is significant difference between the original and printed fabrics with reference to weight, thickness and stiffness.

4. CONCLUSION:

This article clearly shows that the cotton fabric can be printed by henna dye and tamarind seed thickener without the use of synthetic dyes and thickeners. The colour fastness to dry rubbing is good and has poor colourfastness to wet rubbing and washing. Hence it could be concluded that this process of printing could be suitable for fabric require less washing and rubbing like curtains and draperies.

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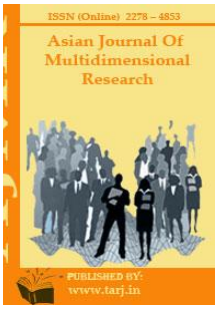

Asian Journal of Multidimensional Research (AJMR)

(Double Blind Refereed & Reviewed International Journal)

UGC APPROVED JOURNAL

DEVELOPING NONWOVEN SHEETS USING KNITTED TEXTILE WASTE AND ASSESSING THEIR PROPERTIES

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ABSTRACT

*"**Nothing is squander until and except if we realize how to utilize it.**"Growing new items from material waste by utilizing nonwoven strategies turns out to be increasingly vital wonder, in today's world. Using material waste is turning into an essential perspective for the earth. In the recent times hosiery industry has become more popular and important means of economical income generation in spite of herein effort taken by the industries to minimize the wastage while marking, cutting and sewing each garment has at least 2% of wastage. The utilization of this waste could create a new outlook and increase the economical income. Therefore, this study focuses on collecting knitting industry waste for nonwoven preparation. The result of the study proves the use of knitwear waste for production of needle punched and thermal bonding sheets.*

KEYWORDS: *Textile Waste, Needle Punching, Thermal Bonding, Nonwoven Sheets*

1. INTRODUCTION

The extent of the loss from piece of clothing industry stretches out its items to upholstery fabric, spread materials, cover, towels, shirting, quilts, clothing, cover, mechanical roller material, electric cabling, hosiery and in the assembling of asbestos yarn, paper, tile and recovered filaments. It has been accounted for that the aggregate sum of waste produced in India is around 80,000 to 85,000 tons for each annum and this needs legitimate treatment separated from transfer as landfill. This landfill has increased pollution and decomposition of these fabrics may run up to years. Therefore it is the problem of industries and academician's to find means of reducing landfill waste (Saravanan, 2011).

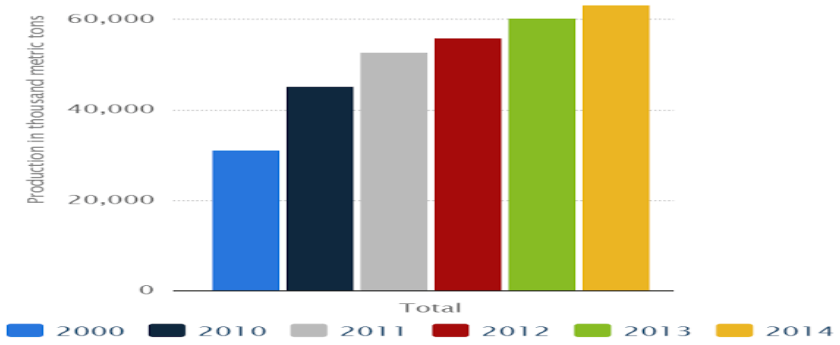


Figure 1.Statistical Analysis of Knitted Waste

As the name indicates nonwovens are not woven fabrics. These fabrics are made by different chemical, mechanical as well thermal bonded techniques which gives the fabric a new look as well as it gives strength to the fabrics. Nonwovens sector had a more significant on technical textiles where the performance and the value addition are essentially referred than its aesthetical appeal. Considering the above facts the study focuses on reusing knit waste from industries to produce nonwoven fabrics. Therefore objectives of the present research are as per the following:-

- To give a new approach of utilizing knitted textile waste
- To obtain nonwoven sheets
- To test and evaluate the various properties of developed nonwoven fabrics, and
- To analyze the best blended nonwoven fabrics.

2. EXPERIMENTAL PROCEDURE

2.1. SELECTION OF RAW MATERIALS

The worry over the earth incited substantial quantities of organizations to begin creating fabricating process utilizing elective materials for their items and looking for new markets. With the critical generation of waste stringy materials, diverse organizations are searching for applications wherein squander materials may speak to an additional esteem material. Knitwear has getting to be main stream these days for using the waste materials and forming it into nonwoven item for better utility. Considering the above conditions this knitwear textile wastes were chosen for creating nonwoven sheets.

2.2. COLLECTION OF MATERIALS

Tiruppur is a city located in the Indian state of Tamil Nadu. Tiruppur is said to have risen amid the Mahabharata period. Thiruppur is a noteworthy material and sew wear center adding to 90% of complete cotton knitwear exported from India. The material business gives work to more than six lakh individuals and added to sends out worth $200 billion out of 2014-15.Therefore the investigator visited **Tirupur "The Hub"** of knit wearand collected white coloured knitted waste fabrics from the hosiery readymade garment industries. The waste materials were collected and kept in neat containers for further uses.

2.3 BLENDING

In this process recycled PET and polypropylene fibers were blended manually in two ratios but in different techniques to prepare web for nonwoven fabrics. Blending ratios are of 20:30,20:20 i.e.in first ratio 20% PET and 30% Polypropylene then equal amount of each fiber 20% PET and 20% polypropylene and this blending fibers is then mixed with another ratio comprises of knitted fibers to make a nonwoven fabric.

2.4 CARDING

Carding process was done on marzoli c60 carding machinewhichwas utilized in the present research work. It consists of seven rollers secured with iron spikes of various length and thickness in every roller. (Sharma,2017).In carding machine the reused fibers i.e. polyester and polypropylene were mixed and made into a lap and then were passed to web feeder for further processes.

2.5 WEB FEEDING

Layers of reused PET and reused polypropylene web is then set over the woven squander material in appropriate way maintaining a strategic distance from wrinkles and after that feed them into the needle punching machine by methods for web feeder.

2.6 PRE-NEEDLING PUNCHING LOOM

The cushy layers of fiber web were then fed through a progression of needle punching machine to interweave different layers utilizing low needle thickness. It was a primer 3D intertwining to ensnare filaments. Through this procedure the cushioned mass of filaments web get marginally minimized. The more the needles penetrate the web the more thick and solid the web.

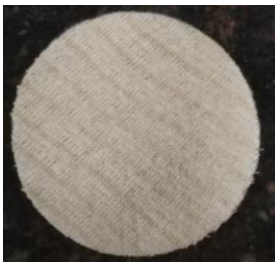
2.7 NEEDLE PUNCHING

Needle Punched nonwovens are made by precisely situating and interlocking the filaments of a spun fortified or checked web. This mechanical interlocking is accomplished with a huge number of pointed felting needles over and over going into and out of the web (ReetaGhosh, 2018).The fiber web is then laid on the needle punched machine for needle punching.

2.8 THERMAL BONDING

In order to perform thermal bonding of the fibrous web structures fibrous web must include thermoplastic strands or if nothing else then thermoplastic powders. Most commonly used thermoplastic filaments are polypropylene and polyester. The needle punched fiber web is then passed through thermal bonding at 105ºc which gives more firmness to the knitted fiber and in that capacity improves its properties.

Therefore the produced nonwoven Needle Punched and Thermal Bonded fabrics are shown below on Figure 3.



a. Thermal Bonding

b. Needle Punching

2.9. EVALUATION

The physical properties of all the developed nonwoven samples were tested according to the ASTM standard. This test were carried out to evaluate its properties like fabric weight (GSM g/m2), stiffness test (cm), fabric thickness (mm), wick ability and sinking test of the prepared nonwoven samples as per their applicability.

2.9.1 FABRIC WEIGHT (ASTM D3776-96)

Fabrics are differing in their weight some may be light weight while some others may be heavy weight so it is necessary to evaluate the weight of the fabric. To calculate the weight of the fabric GSM cutter method is used commonly. In this method place the test specimen on the rubber pad without wrinkles and then keeping the GSM cutter on top of the specimen rotate the knob of the cutter. Blades are there on the cutter which helps the fabric to cut it in a circular shape .Then removing the GSM cutter and collecting the circular specimen of $100cm^2$ and then two needle punching and thermal bonding samples were being weighed and recorded.

2.9.2 FABRIC THICKNESSES (ASTM 01777-2002)

A fabric thickness is determined according to ASTM 01777-2002.The thickness tester has 2 parts anvit and pressure foot which works under a lever spring action on top.Anvit indicates the thickness of the sample in 1000 inch. In this process the sample is placed in anvit plate and the lever of the pressure foot is released slowly which is pressed slightly on the placed sample. The dial indicates the thickness of the fabric and as such readings were taken for two needle punching and thermal bonding samples and the mean value is calculated and recorded.

2.9.3 WICKING TEST (AATC Test Method 197)

Wicking test is the test done as per the procedure to evaluate the wick ability of the fabric. This test strategy is utilized to assess the capacity of vertically adjusted texture example to transport fluid along as well as through them and is pertinent to woven, weaved or nonwoven textures. (Priyalatha,2018).In this strategy a piece of texture (30 cm *2cm) was cut and submerged vertically with an edge inside the measuring utensil of refined water. At that point the texture is being kept for some consistent time for example for 1 min to record the sponginess of the strip. To recognize the situation of the water line on that strip around few measure of color was added to the water to assimilate the water. In this manner ten readings were taken.

2.9.4 FABRIC SINKING TEST (AATC/AASTM TESTS METHOD TS-018)

Fabric sinking test technique is intended to quantify the water receptiveness of materials by estimating the time it takes a drop of water set on the texture surface to be totally ingested into the texture.(AATCC/AASTM Test Method TS-018, Procedure for Absorbency)In this method samples were cut into small square specimen which is about 1*1 and is placed inside the beaker filled with distilled water. It is then kept for one minute to evaluate the absorbency, the shorter the time greater the wet ability.

2.9.5 FABRIC STIFFNESS TEST (ASTM D1388-18)

Fabric stiffness tester is used to determine the bending height, flexural rigidity and bending modulus of a fabric by simple procedures and calculation by ASTM D1388, BS3356, DIN 53362, etc. The specimen is placed flat on the measuring plane of the instrument and then moving forward it slowly, so that one end of the specimen is gradually detached from the plane support and suspended. Affected by the gravity of the example itself, one end of the sample is bowed down to the slanted plane, and then measurement of the expansion length is taken and recorded for needle punched and thermal bonding samples.

3. RESULT AND DISCUSSION

3.1 Analysis of the Physical Properties of Blended Nonwoven Fabrics:

The needle punched and thermal bonding sample compositions and their physical properties are shown in **Table 1.**

TABLE 1 PARAMETERS OF NEEDLE PUNCHING AND THERMAL BONDING:-

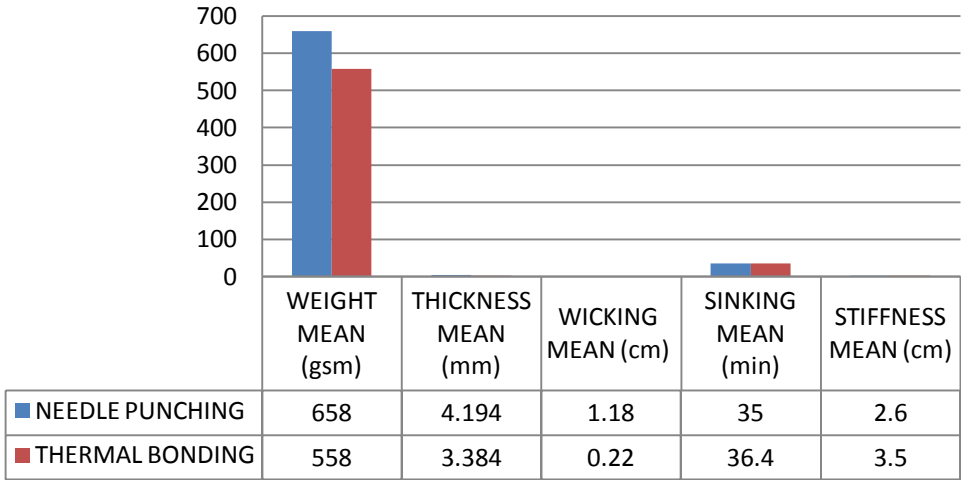
`	Weight Mean (GSM)	Thickness Mean (mm)	Wick ability Mean (cm)	Sinking Mean (sec)	Stiffness Mean (cm)
Needle punching	**658**	**4.194**	**1.18**	**35**	**2.6**
Thermal bonding	**558**	**3.384**	**0.22**	**36.4**	**3.5**

Results are discussed characteristic wise as under fabric weight of both the needle punched and thermal bonded samples were apparent from the **Table 1.** Mean weight of needle punching and thermal bonded nonwoven samples is found to be 658 GSM and 558 GSM respectively. It is concluded that the mean weight of thermal bonded sample is less as compared to needle punched sample as such thermal bonded nonwoven has more firmness than needle punched. With reference to thickness the mean values of needle punched and thermal bonding is found to be 4.194 mm and 3.384 mm respectively. It is found that the thermal bonded sample has low weight as compared to needle punched and has more compressed effect. As such then compared sample compositions and their mean wick ability values of needle punched and thermal bonded samples are found to be 1.18 cm and 0.22 cm respectively and concluded that thermal bonded nonwoven have low absorbency than that of needle punched sample.

Then **s**inking capacity of the blended nonwoven fabrics is observed from the experimental testing which is found to be 35 seconds and 36.4 seconds which shows that thermal bonded nonwoven fabrics has less sinking capacity and as such takes more time to absorb than needle punched fabrics. With reference to the fabric stiffness 3.5 cm and 2.6 cm is the stiffness of needle punching and

thermal bonding respectively. This results leads to the conclusion that the fabric stiffness of thermal bonded sample is more than needle punched as such it shows that thermal bonded samples have good stiffness and has more compressed nature.

Analysis of the physical properties of nonwoven samples



	WEIGHT MEAN (gsm)	THICKNESS MEAN (mm)	WICKING MEAN (cm)	SINKING MEAN (min)	STIFFNESS MEAN (cm)
NEEDLE PUNCHING	658	4.194	1.18	35	2.6
THERMAL BONDING	558	3.384	0.22	36.4	3.5

Figure 4. .Parameters of nonwoven samples

3.2 Statistical Analysis of Parameters Tested For Needle Punching And Thermal Bonding

TABLE 2 STATISTICAL ANALYSIS OF PARAMETERS TESTED FOR NEEDLE PUNCHING AND THERMAL BONDING

Parameters	Mean	SD	SE	F-value	Sig
Weight (gsm)	651.600	7.76316	2.45493	814.592	.000*
	550.200	8.12130	2.56818		
Thickness (mm)	4.198	.165219	.052247	226.418	.000*
	3.336	.074144	.023446		
Wick ability (cm)	1.260	.05637	.01783	2568.008	.000*
	.1730	.03773	.01193		
Sinking (sec)	32.900	2.51440	.79512	17.795	.001*
	36.570	1.11659	.35310		
Stiffness (cm)	2.490	.19692	.06227	257.753	.000*
	3.610	.09944	.03145		

***=Significant at 1% level**

The ANOVA Table shows 814.592 as F value for weight, 226.418 for thickness, 2568.008 for wick ability, 17.795 for sinking, 257.753 for stiffness respectively which is significant at 1%. Hence it can be concluded that needle punched and thermal bonded nonwoven samples have significant difference between its thickness and weight because of the compression of the samples in thermal bonding.

4. CONCLUSION:-

Pollution is becoming a major problem in today's world because of the increasing number of industries and factories. And so to reduce the impact of pollution specially in textile industries and with the development of new technologies, machineries considerable efforts are being made in developing nonwoven materials which are becoming more popular nowadays because of its eco-friendly and disposable nature which plays a significant role in reducing the environmental pollution. From the above mentioned experiment it can be concluded that blended thermal bonding nonwoven fabric is the best combination with high thickness and weight because of its compressed nature and make it more suitable eco friendly fabric for use in various applications of textiles.

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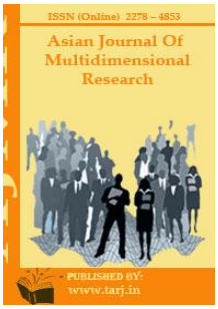

Asian Journal of Multidimensional Research (AJMR)

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SUSTAINABLE DYEING OF SILK - COTTON BLENDED FABRIC WITH SELECTED MORDANTING TECHNIQUES

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ABSTRACT

Use of chemical mordants in naturally dyed fabrics is not an eco-friendly method. Tannins and other natural extracts from plants have been investigated for mordanting natural dyes. The natural dye used was extracted from Jackfruit tree bark and pre or post mordanted with mango bark extract. Pre-mordanting and post-mordanting properties of naturally dyed fabric was compared. And it was found that post mordanting with mango bark extract gives good wash fastness performance than pre-mordanting. This research reveals the use of many untapped natural materials as mordants when dyeing silk-cotton blended fabric. The result have proved good physical and colour properties.

KEYWORDS: *Natural Dye, Natural Mordant, Fastness Property, Eco-Dyeing, Silk*

1. INTRODUCTION:

Natural dyes are considered to be eco-friendly as these are obtained from natural resources as compared to synthetic dyes which are derived from petroleum resources (Gulrajani, (2001)). Mordants are used to fix natural dyes to fabric(Siva, (2007)). Therefore, mordants form a link between the fiber and the dye, which helps certain natural dyes with no or little affinity for the fiber to be fixed on to them(Vankar, et al. (2009)). However, the use of chemical mordants during natural dyeing questions the eco-friendliness of natural dyes.

To find new natural mordants plant sources with Tannins have also been investigated for mordanting natural dyes. As per the reviews mango bark contains 16% to 20% tannins (Mahajan, et al. (2013)). In this research possibility of dyeing silk-cotton fabric using two natural dye extracts has been looked upon where one is used as dye and the other as mordant. To achieve this, yellow dye was extracted from Jackfruit tree Bark *(Artocarpusheterophyllus*) and used it as the main natural dye. The bark is golden-yellow coloured without any odour. The *Artocarpusheterophyllus* is native to Southwest India. The jackfruit bark is used for building furniture in India. Mango bark extract (*Mangiferaindica*) with a yellow colour has been used as a mordant. It is also a native to Asia where it is locally available. The wood is used for musical instruments, plywood and low-cost furniture. Considering the above facts the study focuses on dyeing and mordanting using the available natural sources. The objectives of the present research are

- Selection of Natural Dye and Mordant
- Extraction of Mordant from Mango tree bark and Dye from Jackfruit tree bark
- To dye the silk-cotton blended fabric using mango bark extract as mordant and jackfruit tree bark as dye
- To dye using pre-mordanting and post-mordanting techniques
- To compare the pre-mordanting and post-mordanting properties of fabric after dyeing

2. EXPERIMENTAL:-

The experimental process is explained under the below mentioned headings

2.1. MATERIALS AND EQUIPMENT:-

Crushed powder of mango bark and jackfruit tree bark, degummed silk-cotton blended fabric

2.2. EXTRACTION OF DYE FROM JACKFRUIT TREE BARK AND MANGO BARK POWDER:-

Crushed powder of Jackfruit tree bark and Mango tree bark was collected from lumber mills. 15 g of Jackfruit tree bark powder were extracted using 200 ml of water at 90°C for 1 hour. For mango bark extraction also same procedure was followed and the extract was directly used without any dilution

2.3. PRE-MORDANTING:-

A piece of fabric sample weighing 25 g was pre-mordanted with mango extract. The fabric sample was placed in 50 ml of respective mordant solution and heated at 60°C for one hour. After one hour the fabric was dried in open air.

2.4. DYEING USING JACKFRUIT TREE BARK:-

One sample was previously pre-mordanted and the other fabric sample only degummed but not mordanted were all dyed separately using the same conditions. Each fabric was placed in similar 100 ml jackfruit tree bark dye solution and dyed at 80°C for 2 hours. After dyeing the samples were dried.

2.5. POST MORDANTING:-

The un-mordanted dyed samples were post mordanted using mango following the same procedure as pre-mordanting.

2.6 EVALUATION:-

2.6.1 FABRIC THICKNESS (ASTM 01777-2002)

Thickness gauge is the equipment used for testing the fabric thickness. The sample is placed in anvil plate and the lever of the foot is released which press slightly on the sample placed. Ten readings were taken for dyed, pre and post mordant dyed samples and the average mean value was found and recorded.

2.6.2 FABRIC WEIGHT:-

To calculate the fabric weight the fabric sample was placed on a rubber pad and then placing the GSM cutter on top of it and rotating the knob of the GSM cutter ten samples were cut for all the three type of dyed samples. Then the weights of all these samples were calculated using the electronic balance.

2.6.3 FABRIC STIFFNESS (ASTM D1388-08):-

Stiffness tester is the equipment used to find the stiffness of the fabric. The template and the fabric sample is placed on the platform .The strip of the fabric will droop over the edge of the platform until the fabric viewed in the mirror cuts both index lines. The bending length was read from the scale on the side of the platform. Following this processes ten reading were taken for the dyed, pre and post mordant dyed samples.

2.6.4 WICKING TEST (AATCC Test Method 197):-

A strip of the fabric sample is cut out and suspended in the liquid, the rise of liquid on fabric during a speculated time period is noted. In this manner ten reading were noted for dyed, pre and post mordant dyed samples.

2.6.5 SPRAY TEST:-

The fabric sample is fastened so that it presents a smooth wrinkle free surface. Place the embroidery hoop on the tester at 45^0. Pour 250ml of distilled water into the funnel and allow it to spray onto the fabric in 25-30 seconds. After spraying the fabric is tapped to remove the surplus water. Observe the surface of the fabric with the values in the spray rating chart.

2.6.6 CROCKING:-

Crock meter is the equipment used for testing the colour fastness of dyed fabrics by rubbing. It is the transfer of colour from dyed fabric to undyed fabric under wet and dry conditions during rubbing. After rubbing for a specific number to times, the amount of colour transferred to the white

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fabric is compared to ASTM colour chart and evaluated. The test for fastness was done for the dyed, pre and post mordant dyed samples

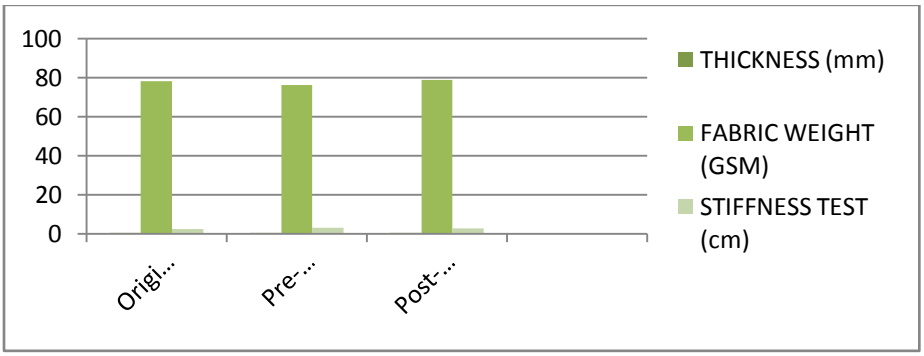
2.6.7 WASHING:-

To determine the colour fastness of the fabric while washing was carried out at home. The pre-mordanted and post mordanted samples were washed separately.

3. RESULTS AND DISCUSSION

3.1 Physical Parameters of the Dyed Samples

SAMPLE	THICKNESS TEST (mm)			FABRIC WEIGHT (GSM)			STIFFNESS TEST (cm)		
	Mean	Loss/ gain over original	Percentage loss/gain	Mean	Loss/ gain over original	Percentage loss/gain	Mean	Loss/ gain over original	Percentage loss/gain
Original fabric	0.31	-	-	78	-	-	2.38	-	-
Pre-mordanted fabric	0.306	0.004	(-) 1.30%	75.96	2.04	(-)2.68	2.8	0.42	(+)15
Post-mordanted fabric	0.31	0.0	0.0	78.8	0.8	(+)1.01	2.725	0.345	(+)12.6



To test the physical properties of the pre-mordanted and post-mordanted samples Thickness, Fabric weight and Stiffness test were carried out. By analysing the thickness test results it is understood that there is no much difference in the thickness after pre and post mordanting the fabric. In pre-mordanted fabric there is an increase of 0.004mm, which is not a significant difference.

With reference to the Fabric Weight test, there is a loss of weight in pre-mordanted fabric and an increase in weight by 0.8 can be seen in post-mordantedfabric. From Stiffness test it was found that there is an increase in the stiffness of the fabric after mordanting. The increase in stiffness shows that the mordant and dye particles are attached to the fabric.

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3.2 Analysis of Spray Test

Spray test was carried out to check the absorbency of the fabric samples and it was found that both the pre-mordanted and post-mordanted fabric sample have good absorbency. While the test specimen was analysed with the standard spray rating chart it showed a grade of '0' i.e. complete wetting of whole upper and lower surface.

TABLE -1 PHYSICAL PARAMETERS OF THE DYED SAMPLES

SAMPLE	THICKNESS TEST (mm)			FABRIC WEIGHT (GSM)			STIFFNESS TEST (cm)		
	Mean	Loss/ gain over original	Percentage loss/gain	Mean	Loss/ gain over original	Percentage loss/gain	Mean	Loss/ gain over original	Percentage loss/gain
Original fabric	0.31	-	-	78	-	-	2.38	-	-
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Post-mordanted fabric	0.31	0.0	0.0	78.8	0.8	(+)1.01	2.725	0.345	(+)12.6

3.3 Colour fastness test for Crocking

TABLE-2

SAMPLE	CROCKING		WICKING (cm)
	DRY	WET	
Pre-mordanted fabric	5	3/4	2.3
Post-mordanted fabric	5	4/5	2.1
Original Fabric			2.5

With reference to colour fastness to crocking post-mordanted sample scored a rating of 4/5 and 5 for wet and dry crocking. Proving the samples to have good and excellent colour fastness properties, whereas for pre-mordanted sample scored a rating of 3/4 and 5 for wet and dry crocking. Proving the sample to be moderate in wet and excellent when dry.

When wick ability of the original fabric sample was observed it was found that it has high absorbency when compared to pre and post mordanted samples.

Independent T-Test have done for the follwoing analysis

TABLE 3.1STATISTICAL ANALYSIS OF PARAMETERS TESTED FOR PRE-MORDANT AND POST-MORDANT

Variables		Mean	SD	SE	T-value	Sig
Thickness	Pre	.3090	.01197	.00379.	-.192	$.850^{NS}$
	Post	.3060	.01075	.00340	.405	$.691^{NS}$

NS – Not Significant

The above table shows the output of the Independent T-Test analysis, that the significance value is 0.850 and 0.691, which is above 0.05 and, therefore, there is a no statistically significant difference between the Pre-mordant and Post Mordant

TABLE 3.2 STATISTICAL ANALYSIS OF PARAMETERS TESTED FOR PRE-MORDANT AND POST-MORDANT

Variables		Mean	SD	SE	T-value	Sig
Weight	Pre	.75680	.018743	.005927	3.394	.003*
	Post	.78300	.016364	.005175	.257	.800^{NS}

***-Significant at 1% level, NS – Not Significant**

The above table shows the output of the Independent T-Test analysis, that the significance value of Pre–mordantedWeight is 0.000 (i.e., p = .000), which is below 0.05 and, therefore, there is a statistically significant (at 1% level)

TABLE 3.3 STATISTICAL ANALYSIS OF PARAMETERS TESTED FOR PRE-MORDANT AND POST-MORDANT

Variables		Mean	SD	SE	T-value	Sig
Stiffness	Pre	2.6900	.72793	.23019	-1.343	.196^{NS}
	Post	2.7500	.69162	.21871	-1.660	.114^{NS}

NS – Not Significant

The above table shows the output of the Independent T-Test analysis, that the significance value is 0.196 and 0.114, which is above 0.05 and, therefore, there is a no statistically significant difference between the variables.

TABLE 3.4 STATISTICAL ANALYSIS OF PARAMETERS TESTED FOR PRE-MORDANT AND POST-MORDANT

Variables		Mean	SD	SE	T-value	Sig
Wicking	Pre	2.1700	.11595	.03667	7.985	.000*
	Post	2.1100	.09944	.03145	9.714	.000*

***-Significant at 1% level**

The above table shows the output of the Independent T-Test analysis, that the significance value of Pre–mordantedWicking and Post-mordanted Wicking is 0.000 and 0.000 (i.e., p = .000), which is below 0.05 and, therefore, there is a statistically significant (at 1% level) difference between the variables.

Paired T-Test have done for the follwoing analysis

TABLE 3.5 STATISTICAL ANALYSIS OF PARAMETERS TESTED FOR PRE-MORDANT AND POST-MORDANT

Variables		T-value	Sig
Thickness	Pre & Post	.449	.664^{NS}
Weight	Pre & Post	-2.925	.017**
Stiffness	Pre & Post	-.144	.889^{NS}
Wicking	Pre & Post	1.616	.140^{NS}

NS – Not Significant, ** Significant at 5% level

The above table shows the output of the Paired sample T-Test analysis for the significant values of pre- mordant and post mordant of Thickness, Stiffness and Wicking is 0.664, 0.889 and 0.140, which is above 0.005 that shows there is no significant difference between pre- mordant and post mordant of the variables. Whereas the weight of pre- mordant and post mordant is 0.017 which is significant at 5 percent level. Hence it could be concluded that there is significant difference between post and pre mordanting with reference to weight.

CONCLUSION

Natural dyeing should be 100% eco-friendly hence it should not contain any hazardous chemicals like metal salts used for mordanting. Synthetic dyes and mordants are causing so much pollution so people are looking out for natural dyes but the results obtained are not satisfactory so mordanting will help in getting better shades and if using the same colour with different techniques we are able to produce different tints(Teklemedhin (2018)). Considering this the above experiment was carried out and from the experiment it is clear that the stiffness and weight have increased and post-mordanting with mango-bark extract gives better wash fastness than pre-mordanting. Hence this study can be taken as a basis for taking up many more natural materials for dying and mordanting and applied in other textile products.

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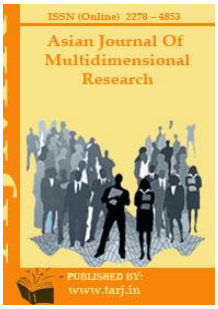

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EXTRACTION OF CORN HUSK FIBER IN DIFFERENT TYPES AND COMPARE THE PHYSICO-COMPOUNDS

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ABSTRACT

The recent demand for natural fibers could be satisfied using agro waste for fiber extraction. More are less corn husk is used only for cattle feed therefore this was being used for extraction. Cornhusk filaments were extricated with step-wise treatment utilizing soluble base, protein. There moved filaments were breaking down for different physico-compound parameters. Considering this corn husk is treated with tank water retting, acid retting and alkali retting among that tank water retting is good. The yield of extraction is better in alkali solution.

KEYWORDS: *Tank Water Retting, Alkali Extraction, Naoh and Hcl, Corn Husk Fiber, Crimp*

1. INTRODUCTION

Gathering of unmanaged agro-squander particularly from the creating areas has an expanded natural concern. Reusing of such squanders into reasonable, vitality effective material materials is a suitable answer for the issue of contamination and common asset protection for who and what is to come. Using cornhusk for material applications could turn into a noteworthy leap forward in this direction. Many different filaments have been removed from various plants like milkweed stems, water hyacinth and so forth and by results of certain plants like bagasse which are being connected in different fields of materials. Barely any investigations have been done before too to use cornhusk for extraction of strands. The present investigation additionally went for extraction of filaments from cornhusk by treating it with acid, alkali and plain water. The removed cornhusk filaments were then evaluated for different physico-substance parameters to discover their reasonableness for different material applications. (Jain, et.al.,2017)

Non-accessibility of good quality cotton has additionally upheld the move enormously. Following a sharp decrease in yield gauges for the present harvest year, costs of cotton have recorded more than five percent increase subsequent to bottoming out. Non-accessibility of good quality for over 50 years, an extreme move has been occurring in the overall wellspring of strands. During the 1960s, 80% of filaments were common, while 20% were oil-based synthetics. Today, synthetics overwhelm the market in light of the fact that petro-based strands have been shoddy and solid, while normal filaments require higher interests in land and water to develop. Overall utilization of material filaments has multiplied in the previous 15 years. It will twofold again in the following 10-15 years. Yet, our changing world is affecting the material supply (Vora, 2019,)therefore; there is considerable need to meet the various end uses of mankind. With this in view the study was framed to extract corn fiber. The major objectives of the study are:

- Extract fiber from corn husk
- Evaluate the properties of the extracted corn fiber

2. EXPERIMENTAL

2.1. EXTRACTION OF CORNHUSK STRANDS

The extraction of filaments from cornhusk was completed by step-wise treatment with tank water retting, acid and alkali methods. These steps are explained below.

2.1.1. COLLECTION OF CORN HUSK

Nowadays corn is a very favourite item in shops and it is also will available on roadsides .It is just steamed and sold out. The investigator collected the corn husk and put it in neat cover and kept it. Next day it was bought to the university.

2.1.2. RETTING

Retting is a procedure utilizing the activity of small scale life forms and dampness on plants to break down or spoil away a great part of the cell tissues and gelatines encompassing vast-fiber packs, thus encouraging partition of the fiber from the stem. It is utilized in the creation of fiber from plant materials, for example, flax and hemp stalks and coir from coconut husks. (Biagiotti,et.al., 2004)

2.1.3. TANK WATER RETTING (A)

Tank retting, an inexorably vital technique, permits more prominent control and delivers progressively uniform quality. The procedure, for the most part utilizing solid tanks, requires around four to six days and is possible in any season. In the initial six to eight hours, called the draining time frame, a great part of the soil and shading matter is evacuated by the water, which is normally changed to guarantee clean fiber. Squander retting water, which expects treatment to lessen unsafe dangerous components before its discharge, is wealthy in synthetic concoctions and is once in a while utilized as fluid compost.(Manchanda, 2007)

Fifty gms of the husk was cleaned and then weighed then it was put into water retting. As shown in the Table-1 material liquor ratio was exactly socking amount was taken and the temperature was maintained as room temperature and every day it was taken and cleaned. After 16 days only slight modification among the husk on the time the investigator was extract the fiber from the corn husk by using and the thoroughly washed and dry it in shade.

TABLE-1 PARAMETERS OF TANK WATER RETTING

MLR	**:**	**Till corn husk dipped**
Temperature	**:**	**Room temperature**
Days	**:**	**16 days**

2.1.4. ACID RETTING (B)

Retting is a procedure utilizing the activity of small scale life forms and dampness on plants to break down or spoil away a great part of the cell tissues and gelatines encompassing vast-fiber packs, thus encouraging partition of the fiber from the stem. It is utilized in the creation of fiber from plant materials sodium hydroxide (Hcl) is used.

50gms of the husk was cleaned and then weighed then it was put into alkali retting (NaoH). As shown in the Table-3 material liquor ratio 1:40 was taken in the temperature was maintained at room temperature and every day it was taken and cleaned. After 4 days only slight modification among the husk on the time the investigator was extract the fiber from the corn husk by using slight scraper and the thoroughly washed and dry it in shade.

TABLE-2 PARAMETERS OF ALKALI RETTING

Hydrochloric acid (Hcl)	**:**	**5%**
MLR	**:**	**1:40**
Temperature	**:**	**Room temperature**
Days	**:**	**4 days**

2.1.5. ALKALI RETTING(C)

For alkali retting follow the above procedure.

Fifty gms of the husk was cleaned and then weighed then it was put into acid retting (Hcl). As shown in the Table-3 material liquor ratio 1:40 was taken and the temperature was maintained as room temperature and every day it was taken and cleaned. After eight days the investigator found that there was slight modification among the husk on the time the investigator was extract the fiber from the corn husk by using slight scraper and the thoroughly washed and dry it in shade.(Peter,et.al.,2002)

TABLE-3 PARAMETERS OF ACID RETTING

Sodium hydroxide (NaOH)	**:**	**5%**
MLR	**:**	**1:40**
Temperature	**:**	**Room temperature**
Days	**:**	**8 Days**

3. EVALUATION

3.1 FIBER THICKNESS

Fiber thickness is determined according to ASTM 1777-2000 the thickness tester has two parts the anvit and pressure foot which works under a lever spring action on a top aanvit indicates the thickness of the sample in 1000 of an inch. Each dimension on the dial is in mm. The sample is placed in anvit plate and the lever of the pressure foot is released very slowly and pressure slightly on the sample. The dial showed the thickness of the sample. Ten readings were taken; mean value was calculated and recorded.

3.2 FIBER CRIMP TEST

Fiber crimp test instrument consists of a scale fixed in the bare at the end of the base and balancing head. A fixed clamp is provided and the other end of flame underlined is noted. Another clamp is provided on the scale noted in groups 0.85gms to 0. 175gsm.

The crimp %= stretched length - original length/original length×100 in this manner ten readings were taken and mean value was calculated.

3.3 FIBER LENGTH MEASUREMENT

Fiber length is measured by using the length scale. Ten neat fibers extracted from all the three procedure where taken one of the other where stretched neatly in metallic mater scale and readings were taken and the mean value was calculated

3.4. WEIGHT OF THE FIBER

After each retting the fibers where taken and dried in shade for 48 hour to ensure complete removal of moisture. The weights of the fibers were calculated to find out the yield % of the fibers extracted.

4. RESULTS AND DISCUSSION

THE EXTRACTED FILAMENT

The corn husk was treated with water, acid & alkali for extraction. The results are given below.

4.1.1. ANALYSIS OF THE FIBERS THICKNESS OF THE EXTRACTED SAMPLES

The fibre thickness result of the sample was presented in Table-4. The mean thickness of the water retting, acid retting and alkali retting samples was found 1.752mm, 1.75mm and 1.54mm from the acid retting, alkali retting thickness is reduced. Hence it could be concluded that thickness of the acid retting and alkali retting is less than water retting.

4.1.2. ANALYSIS OF THE FIBERS CRIMP OF THE EXTRACTED SAMPLES

The fibre crimp result of the sample was presented in Table-4. The mean crimp of the water retting, acid retting and alkali retting samples was found by0.26cm, 0.24cm, 0.24cm from the acid retting,

alkali retting crimp is reduced. Therefore it is clear that crimp of the acid retting and alkali retting is less than water retting.

4.1.3. ANALYSIS OF THE FIBERS LENGTH OF THE EXTRACTED SAMPLES

The fibre length result of the sample was presented in Table-4. The mean length of the water retting, acid retting and alkali retting samples was found by19.34cm,19.22cm,19.32cmfrom the acid retting, alkali retting length is reduced. Thus it could be concluded that length of the acid retting and alkali retting is less than water retting.

4.1.4. ANALYSIS OF THE FIBERS WEIGHT OF THE EXTRACTED SAMPLES

The fibre weight result of the sample was presented in Table-4. The mean weight of the water retting, acid retting and alkali retting samples was found by 4.890gms, 4.568gms, 3.756gms from the acid retting, alkali retting weight is reduced. Thus it could be concluded that length of the acid retting and alkali retting is less than water retting.

TABLE-4 PARAMETERS OF FIBRES OBTAINED

Sample	Thickness	Crimp	Length	Weight
A	1.752mm	0.26cm	19.34cm	4.890gms
B	1.75mm	0.24cm	19.22cm	4.568gms
C	1.54mm	0.24cm	19.32cm	3.756gms

TABLE-5 STATISTICAL ANALYSIS FOR PARAMETERS OF WATER, ACID AND ALKALI FIBRES

Variables		Mean	SD	SE	F-value	Sig
Thickness	Water	1.7610	.04748	.04748	92.448	.000*
	Acid	1.7440	.03273	.03273		
	Alkali	1.5540	.03098	.03098		
Crimp	Water	.2600	.05164	.05164	1.918	.660^{NS}
	Acid	.2300	.04830	.04830		
	Alkali	.2200	.04216	.04216		
Length	Water	19.2800	.94257	.94257	.082	.922^{NS}
	Acid	19.1500	.60782	.60782		
	Alkali	19.2000	.56765	.56765		
Weight	Water	4.84660	.025105	.025105	2535.859	.000*
	Acid	4.54490	.051684	.051684		
	Alkali	3.75700	.021045	.021045		

***= Significant at 1% level, NS = Not Significant**

The above Table-5 shows the output of the ANOVA analysis, that the significance value between the water, acid, and alkali treatments fiber is 0.000, 0.660, 0.922 and 0.000, there is a statistically significant (at 1% level) difference between the water, acid and alkali with Thickness and weight, but there is no statistical significance between water, acid and alkali with crimp and length.

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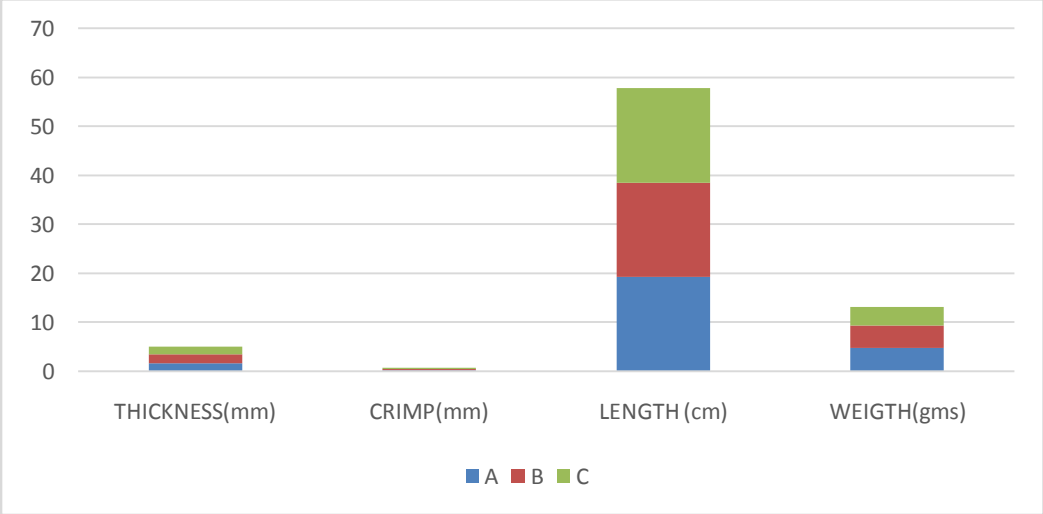
Figure-1 Analysis of Physical Properties of Water, Acid and Alkali Fibers



5. CONCLUSION

In the modern days people are looking out for biodegradable fiber in the textile industry the availability of natural fibers is not in bar with the demand of maters it hence new fiber could solve. This fiber from corn husk which is agro waste has be convert as fiber and physical properties has checked can be manufacture this which able the economy.

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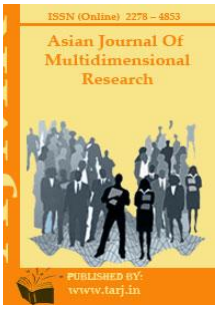

Asian Journal of Multidimensional Research (AJMR)

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MODIFICATION OF HEMP SISAL FABRIC CHARACTERISTICS FOR COMPOSITE PREPARATION

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ABSTRACT

Fibre reinforced polymer composites have acquired a dominant place in variety of applications because of higher specific strength modulus. The natural fibres are currently replacing the use of synthetic fibres as reinforcement for polymer composites. A composite is a material made of more than one substance that is used as building things. Composite materials have higher specific strength, stiffness characteristics, which enables structural design to be more versatile. Natural fibres such as hemp and sisal have been studied as a reinforcement and filler in composites. Among various natural fibres, Sisal is fairly coarse and inflexible. It possesses moderately high specific strength and stiffness, durability, ability to stretch, and resistance to deterioration in salt water. Therefore, it can be used as a reinforcing material in polymeric resin matrices to make useful structural composite materials. Composites made up of hemp fibres with thermoplastic, thermostat and biodegradable matrices have exhibited good mechanical properties. In this study, composite structures were prepared by using epoxy resin as a matrix and the reinforcement used was the hemp sisal woven fabric. Before, the composite structure preparation the surface tension of the fabric surface can be increased by the alkaline treatment of different concentrations namely, 5%, 7.5%, 10%, 15% and the fabric which exhibited the best mechanical properties was selected for resin coating. The prepared specimens were examined for tensile properties. The strength and elongation of the single layer untreated composite structure is higher compared to alkaline treated single layer composite structure and the strength and elongation of the Two-ply untreated composite structure is higher compared to alkaline treated Two-ply composite structure. Thus, the present study aims to develop the natural fibre based polymer composites with different characteristics and to analyse their mechanical behaviour.

KEYWORDS: *Biodegradable, Thermoplastic, Composites*

INTRODUCTION

Green environment for future motivated researchers to seek for an eco-friendly alternative. The interest in exploring the other available materials from agro industries has grown in recent years. Due to the increase in community interest and environmental consciousness, the new environmental regulations and unsustainable consumption of petroleum leads to thinking of the use of environmentally friendly materials such as natural fibers which have good properties compared to synthetic fibers. The growing factors such as environmental challenges, biodegradability and non-toxicity lead the researchers to focus their studies on exploring the features of natural materials[1]. Natural fibers are attractive over man-made and synthetic fibers due to their advantages low-cost, bio-degradability, light weight, High specific strength[2]Due to the constant increase in the environmental concern in the past years, the environmental issues have resulted in the development of new composite materials, such as natural fibers as an alternative for synthetic fibers[3].

Natural fibers can be classified according to their origin. The vegetable or cellulose base class includes fibers such as cotton, hemp, flax and jute etc. The animal or protein base fibers include wool and silk. The most important fiber in the mineral class is asbestos. Important factors for choosing the natural source for reinforcement are its availability, proximity, cost and the need for complementary processes[4].**Natural fiber**, any hair like raw material directly obtainable from an animal, vegetable, or mineral source and convertible into nonwoven fabrics such as felt or paper or, after spinning into yarns, into woven cloth[5]. Natural fiber reinforced polymers are gaining more attention from researches and industry due to their cost-effectiveness, lighter weight, lower abrasion of equipment and renewability, among the several benefits of natural fiber composites.

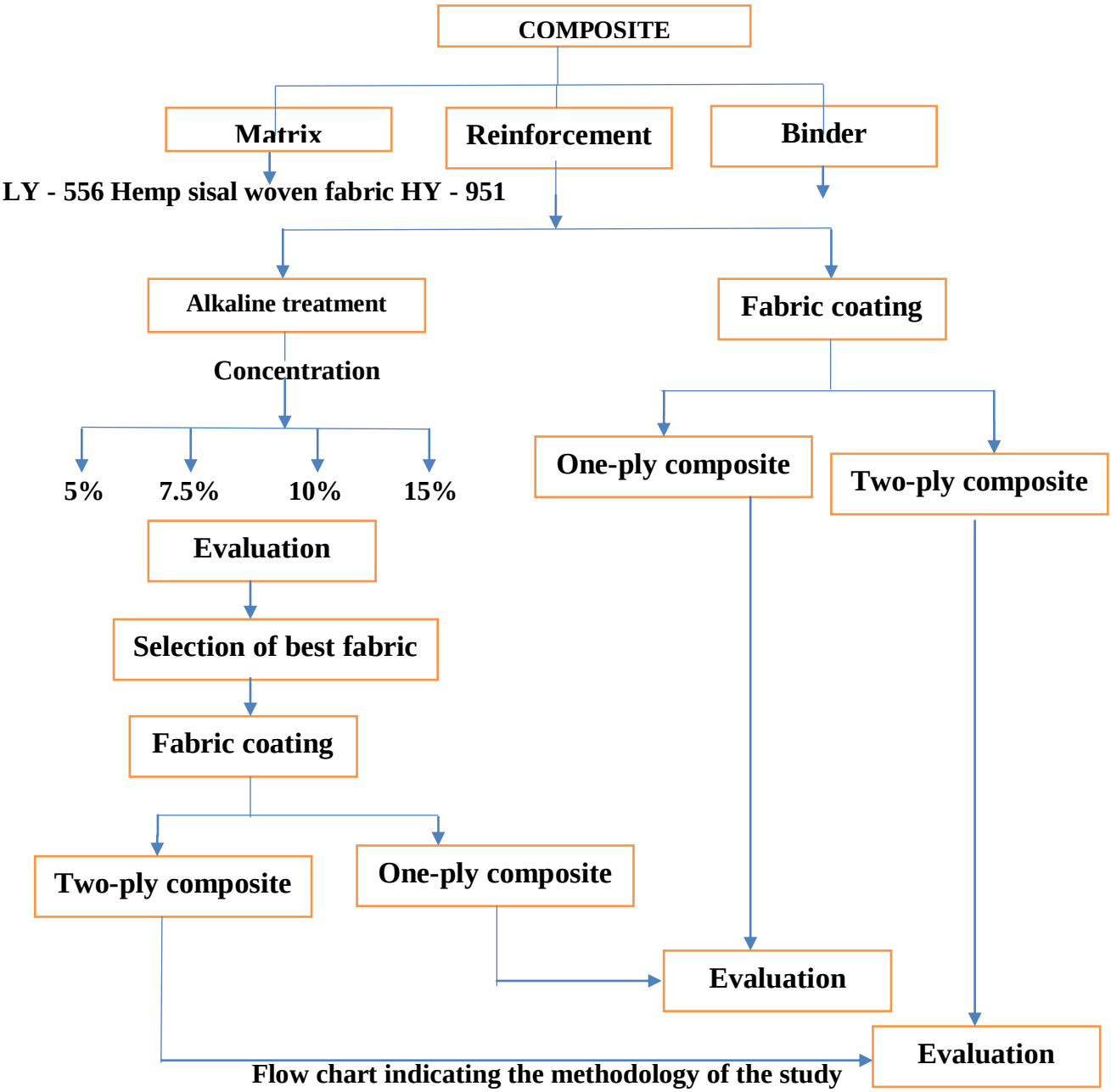
Compared to other natural fibres, Sisal is highly coarse and inflexible. It also possesses high specific strength and stiffness, durability, ability to stretch, and resistance to deterioration in salt water. Composites made up of hemp fibres with thermoplastic, thermostat and biodegradable matrices have exhibited good mechanical properties. Composites are materials based on the controlled distribution of one or more materials, termed as reinforcement, in continuous phase of second materials, called matrix. The reinforcement is added to provide strength and stiffness to a composite. The matrix is also known as 'Binder' material. Broadly, the composite material can be grouped into three categories depending upon the nature of the matrix. Thus, the classifications are a) Metal matrix composites b) Ceramic matrix composites and c) Polymer matrix composites[6]. Polymer matrix composites are commonly used in weight sensitive structures due to their high stiffness-to-weight ratios.

Epoxy resins are a class of thermo set materials used extensively in structural and specialty composite applications because they offer a unique combination of properties that are unattainable with other thermo set resins available in a wide variety of physical forms from low-viscosity liquid to high melting solids, they are amendable to wide range of processes and applications. The, first production of Epoxy resins occurred in Europe and in the United states in the late 1930s and early 1940s[7]. Epoxy resin, plays a vital role in polymer matrix materials because of their superior mechanical and adhesive properties. They have been used widely as a matrix to hold the high-performance fiber reinforcement together in composite materials, as well as structural adhesives[8]. Hardener, a substance of mixture added to a plastic composition to take part in and promote or control the curing action, also a substance added to control the degree of hardness of the cured film[9].

Among various surface treatments, Alkali treatment is a common method to clean and modify the fiber surface in order to lower the surface tension and enhance the interfacial adhesion between the natural fiber and the polymer matrix.[10]So this study was taken up to treat Hemp sisal fabric with sodium hydroxide in different concentrations, to assess the mechanical properties of the alkaline treated Hemp sisal fabrics of various concentrations and the selection of the best suited concentration, to coat the Hemp sisal woven fabrics using Epoxy resins and to evaluate the tensile properties of treated and untreated resin coated composite structures.

RESEARCH METHODOLOGY

Composite material is prepared by mixing two or more different elements in order to make a material with superior properties from its parental materials[11].



Flow chart indicating the methodology of the study

The methods followed for the study are explained under the following heads.

2.1 PROCUREMENT AND TREATMENT OF FABRIC

The fabric of plain woven construction with warp Hemp and weft as Sisal was Procured.The procured fabric was treated with Sodium hydroxide (NaOH). NaOH treated composites show better tensile strength and water absorption tendency of epoxy composite also decreased due to the chemical treatments of the fibers[6].So, the fabrics were treated with NaOH of different concentrations 5%, 7.5%, 10%, and 15%. The treated Hemp Sisal fabrics were evaluated and compared with the untreated Hemp sisal fabric.

2.2MIXING AND COATING OF CHEMICALS

To coat the fabrics, the mould releasing agent PVA was applied on the surface of the OHP sheet to facilitate easy removal of the composite from the surface after curing. The low temperature curing epoxy resin LY556 and suitable hardener HY951 are mixed in the correct of ratio 10:1[12]**(Plate 1)**.Thus, the low temperature curing resin and corresponding hardener were used for the study. These had the properties as given below.

Properties of epoxy resin: LY556 - Viscosity at 250^{o}C -10,000 -12,000 MPa, Visual aspect - clear liquid, Density - 250^{o}C- **1.15 - 1.20 gm/cm^{3},**Flash point - 1950^{0} C and the **properties of the hardener HY-951** were,Density - 0.95 g/cm^{3}, Melting point - 120^{o}C, Boiling point- 266 – 267^{o} C, Water solubility – soluble and Flash point - 143^{o}C.These were mixed thoroughly in the proportion 10:1.The untreated fabric as well as the selected, treated with NaOHand coated with the above mixed chemicals namely the resin and binder. This was left on the OHP sheet for curing.**(Plate 2)&(Plate 3)**

2.3EVALUATION OF HEMP SISAL ALKALINE TREATED FABRICS

The Hemp sisal plain woven fabrics treated with different concentrations of NaOH were evaluated for salient properties such as moisture content, moisture regain, fabric weight, thickness, strength, elongation, spray, wicking and sinking tests.

Thus, the test methods for the treated Hemp sisal fabrics were as follows:

2.3.1 MOISTURE CONTENT

Moisture content is defined as, the weight of water is expressed as a percentage of the total weight. It is expressed as Moisture content = [(100 × W) / (D – W)] %

The samples of fabrics HS,HST_1, HST_2, $HST_3$and$HST_4$to be tested were cut and weighed. The weight of the each samples was noted and then, the samples were kept in a woven at a temperature of around 45^{0} C for about one and half hour. After then, the samples were taken out of the oven and then weighed again. Thus, the percentage of the moisture content can be achieved by the substitution of both the readings (actual sample weight W and the dry sample weight D) in the above formula. Thus moisture content was analysed for all the untreated and treated samples.

2.3.2 MOISTURE REGAIN

Moisture regain refers to, the weight of water in a material is expressed as a percentage of the oven dry weight. It is expressed as Moisture regain = [(100 × W) / D] %

This was the continuous test of the moisture content. After, finding out the moisture content percentage the samples were to be conditioned in the room temperature for about 24 hours. After

then, the samples were again weighed and the weight of the each sample was noted. The, moisture regain percentage can be achieved by again substituting the values in the above given formula. Thus, moisture regain was analysed for all the untreated and treated samples.

2.3.3 FABRIC WEIGHT

Fabric weight is an important component for comparing the two similar fabrics construction[13]. The fabric weight is the relative weight of the fabric and express as the weight of a particular size of piece such as grams per square meter. It is a device to cut circular specimens of 100 square centimeters of a fabric very accurately. It has four blades that cut the fabric when the nano wheel is rotated by applying light pressure. Three samples for each of HS,HST_1, HST_2, HST_3andHST_4were carried out. Then these were weighted accurately using digital balance having 0.01sensitivity. The value obtained in grams multiplied by 100 gives grams per square meter (GSM) of the fabric. Thus, moisture content was analysed for all the untreated and treated samples. Three samples for each of the concentrations was calculated and to be tabulated.

2.3.4FABRIC THICKNESS

Fabric thickness is the distance between the upper and the lower surface of the material where measured under a standard pressure using Shirley's Thickness Tester with an accuracy of 0.01mm[14].The fabric was placed between the pressure foot and anvil the reading was noted from the dial. Five readings were taken from different places of the HS,HST_1, HST_2, HST_3andHST_4fabrics. Thus, fabric thickness was analysed for all the untreated and treated samples. Five readings for each of the concentrations was calculated and to be tabulated.

2.3.5 FABRIC STRENGTH

The strength of a fabric is defined as its ability to withstand an applied load without failure. Two rectangular specimens of size 3inches × 8inches were cut both in warp and weft direction of the fabrics HS,HST_1, HST_2, $HST_3$and$HST_4$and were placed in between the jaws of the tensile strength tester. One side of the cut end is clamped into the upper jaw and the other end into the lower jaw. When the tester was started, the jaws move apart at a constant rate until the fabric begins to tear. At that moment, the tester was stopped the readings shown in the dial of the tester are to be noted.

2.3.6 FABRIC ELONGATION

Fabric elongation is the increase in the length of the specimen from its starting length expressed in units of length. The distance that a material will extend under a given force is proportional to its original length, therefore elongation is usually quoted as strain or percentage extension. This, test is be conducted in tensile strength tester, with the same procedure that was followed for the fabric strength test. But, the readings for the samples were shown clearly on the elongation scale placed at the left side of the tensile tester. Thus, the samples of the fabrics HS,HST_1, HST_2, HST_3andHST_4were tested and the readings are to be noted.

2.3.7 SPRAY TEST

The spray rating test is one used to measure the resistance of a fabric to surface wetting but not to penetration of water. It is therefore a test which is particularly used a shower proof finishes. It is often the case that water proof coating are applied to the inner surface of a material and a water repellent finish is then applied to the outer surface to stop it absorbing water as it would otherwise become waterlogged. In such cases the test is used on the outer layer of fabrics which are otherwise considered as waterproof[15].

In the test five specimens HS,HS_1, HS_2, $HS_3$and$HS_4$are tested. Each sample is 180mm in square. Each specimen in turn is held over a 150mm diameter embroidery frame which is mounded at 45^o to the horizontal. A funnel which is fitted with a standard nozzle containing 19 holes of a specified diameter is held 150mm above the fabric square. 250 ml of distilled water is poured into funnel at 25 ± 2^0 C the shower is continued onto the fabric. After the water spraying is stopped the frame and sample is removed and it is tapped twice smartly against a solid object in an opposite point of the frame, the fabric being kept horizontal. This removes any large drops of water. The fabric is then assigned a spray rating either wing the written grading.The, spray test was analysed for all the untreated and treated samples as per the ratings[16].

2.3.8 WICKING TEST

A strip of fabric is suspended vertically with its lower edge in a reservoir of distilled water. The rate of rise of the leading edge of the water is then monitored. To detect the position of the water line a dye can be added to the water or in the case of dark colour fabrics, the conductivity of the water may be used to complete an electrical circuit. The measured height of raise in a given time is taken as a direct indication of the wick ability of test fabric.The simple form of the test does not take into account the mass of the water that is taken up. This will depend on the height. The water has risen to the thickness of the fabric and the water holding power of the fabric structure one way of allowing for this is to weight the fabric at the end of the test and hence obtain the mass of the water taken up by the fabric. The mass then can be expressed as a percentage of the mass of the length of dry fabric. This is equivalent to the measure height of water rise[17].Thus, the samples of HS,HST_1, HST_2, HST_3andHST_4 were tested for wicking and the readings were recorded.

2.3.9 SINKING TEST

A 200ml beaker was filled with distilled water. Samples of size 25mm × 25mm were cut from the HS,HS_1, HS_2, HS_3andHS_4fabrics and were dropped on the surface of the water from a standard height. The stop watch was started when the fabric stuck the surface of the water and stopped when the last corner sank below the water surface and the time required for each of the sample of HS,HST_1, HST_2, HST_3andHST_4 to sink sample was to be noted. If the sample does not sink within 1minute then, the sample is considered to as having floated[18].Thus the sinking test was analysed for all the untreated and treated samples.

2.3.10 TENSILE STRENGTH TEST FOR COMPOSITE STRUCTURES

The tensile strength was carried out for all the four samples as per standards ASTM A370:20. The load, tensile strength and elongation at peak were noted and tabulated. It was analysed for both the samples with one-ply and two-ply composite structures.**(Plate 4)**

2.4 NOMENCLATURE

The nomenclature used for the samples are presented in the following Table I.

TABLE I NOMENCLATURE

S.no	Nomenclature of Sample	Details of Samples
1	HS	Hemp sisal fabric
2	HST_1	5% NaOH treated Hemp sisal fabric
3	HST_2	7.5% NaOH treated Hemp sisal fabric
4	HST_3	10% NaOH treated Hemp sisal fabric
5	HST_4	15% NaOH treated Hemp sisal fabric

6	$HSUC_1$	Untreated 1-ply Hemp sisal composite structure
7	$HSUC_2$	Untreated 2-ply Hemp sisal composite structure
8	$HSTC_1$	Alkaline treated 1- ply Hemp sisal composite structure
9	$HSTC_2$	Alkaline treated 2-ply Hemp sisal composite structure

PLATE 1 MIXING OF CHEMICALS

PLATE 2 Untreated Composite structure

PLATE 3 Treated Composite structure

PLATE 4 Tensile tester used for composites

3 RESULTS AND DISCUSSION

The results and discussions of the study are expressed under the following heads.

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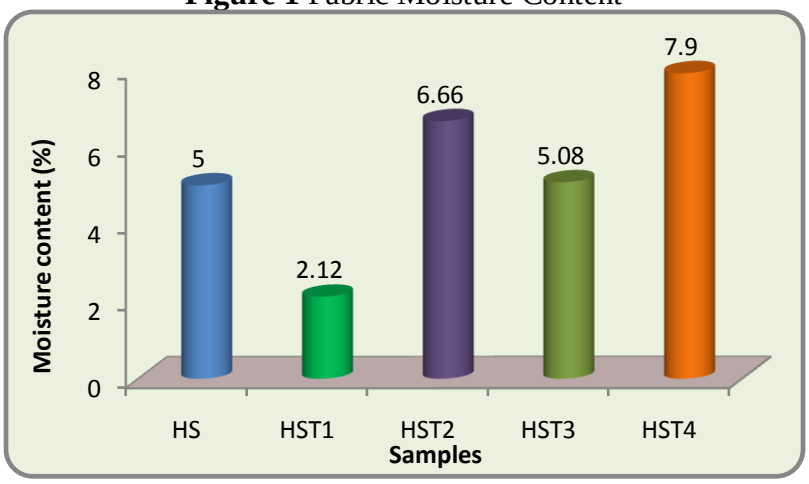
3.1 MOISTURE CONTENT

The moisture content of the fabric samples is expressed in the figure 1.

Figure 1 Fabric Moisture Content

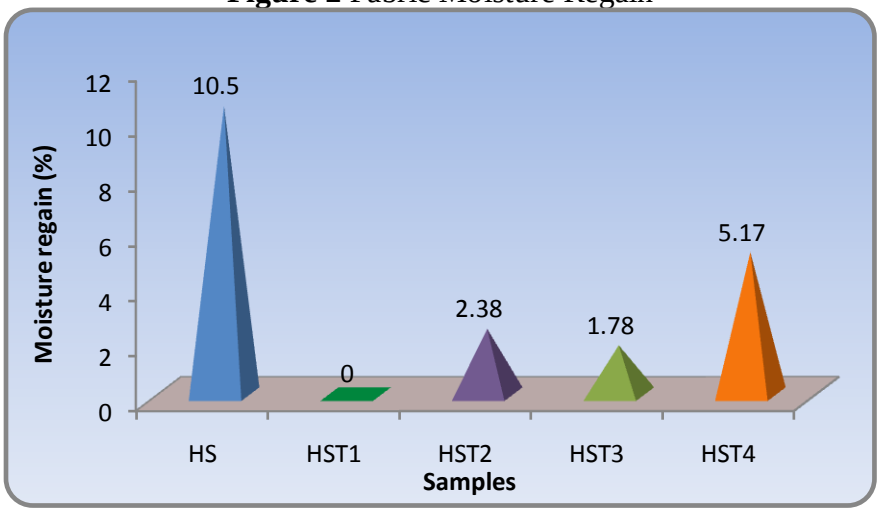


From Figure 1, it could be concluded that the sample HST_1 which was treated with 5 percentNaOH exhibited minimum moisture content among all the treated samples.The moisture content of the sample HST_1 decreased over the original sample HSwhereas, it increased in all the other treated samples.

3.2 MOISTURE REGAIN

The results of moisture regain observed are presented in the Figure 2.

Figure 2 Fabric Moisture Regain



From Figure 2, it could be concluded that the sample HST_1 did not regain moisture whereas, all the other treated samples gained moisture from the atmosphere but that was lesser than the original sample.

3.3FABRIC WEIGHT

The results obtained from the fabric weight analysis is expressed in the Table II.

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TABLE II FABRIC WEIGHT

S.no	Sample	Weight (GSM)	Gain (%)
1.	HS	408	-
2.	HST_1	443	8.57
3.	HST_2	445	9.06
4.	HST_3	494	21.07
5.	HST_4	552	35.29

From the Table II, it could be concluded that the fabric weight was increased on NaOH treatment and it was the highest exhibited highest in sample HST_4.

3.4 FABRIC THICKNESS

The results obtained in the fabric thickness test are expressed in Table III.

TABLE III FABRIC THICKNESS

S.no	Sample	Thickness (mm)	Gain (%)
1.	HS	2.43	-
2.	HST_1	2.46	1.02
3.	HST_2	2.70	11.0
4.	HST_3	2.73	12.4
5.	HST_4	2.78	14.5

From Table III, it could be concluded that the fabric thickness increased on treatment with NaOH and it was the highest in HST_4.

3.5 FABRIC STRENGTH

The fabric strength in warp and weft directions is presented in Table IV.

TABLE IV FABRIC STRENGTH

S.no	Sample	Warp		Weft	
		Strength (kgs)	Loss (%)	Strength (kgs)	Loss (%)
1.	HS	78	-	163	-
2.	HST_1	48	-38.46	64	-60.73
3.	HST_2	40	-48.71	73	-55.21
4.	HST_3	68	-12.82	60	-63.19
5.	HST_4	76	-2.56	56	-65.64

From Table IV,it could be concluded that there exists a drastic loss in strength in samples of which it was the minimum in samples $HST_4$and HST_2 in warp and weft directions respectively.

3.6 FABRIC ELONGATION

The fabric elongation is expressed in the Table V.

TABLE V FABRIC ELONGATION

S.no	Sample	Warp		Weft	
		Elongation (%)	Gain percentage (%)	Elongation (%)	Gain percentage (%)
1.	HS	17.6	-	23	-
2.	HST_1	29.4	67.04	23.5	2.17
3.	HST_2	27.0	53.4	24	4.34
4.	HST_3	29.4	67.04	35.3	53.47
5.	HST_4	23.5	33.52	41.2	79.13

From Table V, it could be concluded that there exists a drastic increase ofelongation in the treated samples in the warp direction whereas, the treated samples exhibited slighter increase in elongation in the weft direction when compared to warp treated samples.

3.7 SPRAY TEST

The observations obtained in the spray test are presented in the Table VI**.**

TABLE VI SPRAY TEST

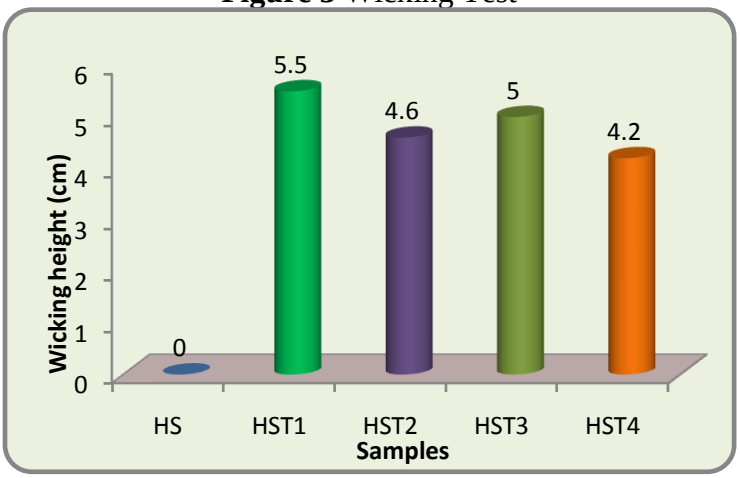
S.no	Sample	Result
1.	HS	70
2.	HST_1	0
3.	HST_2	0
4.	HST_3	0
5.	HST_4	0

From Table VI,it was obvious that the sample HS exhibited the partial wetting of the whole upper surface with the rating of 70whereas, all the treated samples showed complete wetting of the whole upper and lower surface of the fabric with the rating of 0.

3.8 FABRICWICKING

The results of wick ability of the fabric are expressed in the Figure 3.

Figure 3 Wicking Test



From theFigure 3,it could be concluded that wicking was highest in sample HST_1, showing more absorbency and it was the least in the sample HST_4.

3.9 FABRIC SINKING

The results obtained in the sinking test are presented in the Table VII.

TABLE VII SINKING TEST

S.No	Sample	Time seconds
1.	HS	86
2.	HST_1	0.04
3.	HST_2	0.23
4.	HST_3	0.14
5.	HST_4	0.08

From the Table VII,it could be concluded that the sinking of the fabric was the quick in all the treated samples and was the quickest in sample HST_1 depicting highest absorbency and the least absorbency was exhibited in the sample HST_2among all the samples.

3.10 TENSILE STRENGTH AND ELONGATION OF COMPOSITE STRUCTURES

3.10.1 TENSILE STRENGTH AND ELONGATION OF 1-PLY COMPOSITE STRUCTURES

The tensile strength and elongation of the untreated and treated 1-ply composite are presented in Table VIII.

TABLE VIII TENSILE STRENGTH AND ELONGATION OF UNTREATED AND TREATED 1-PLY COMPOSITE STRUCTURES

S.no	Sample	Load at peak (kN)	Elongation at peak (mm)	Strength at peak (N/mm^2)
1	$HSUC_1$	1.261	9.044	11.271
2	$HSTC_1$	0.298	5.528	6.690

From theTable VIII**,** the one-ply untreated composite structure exhibited higher elongation and higher strength than the one-ply alkaline treated composite structure.

3.10.2 TENSILE STRENGTH AND ELONGATION OF 2-PLY COMPOSITE STRUCTURES

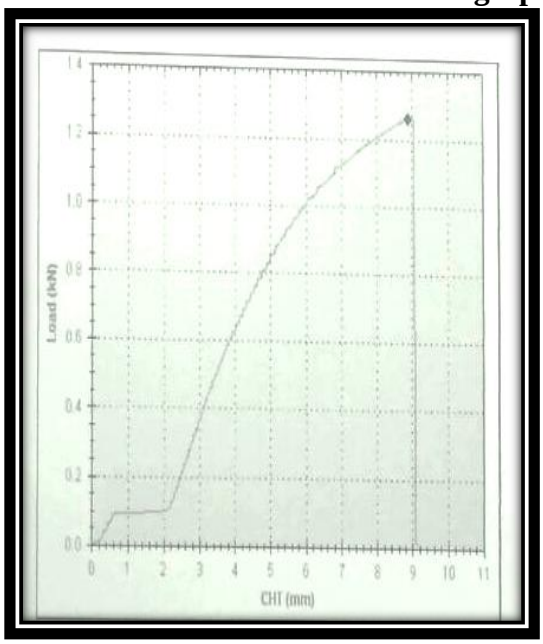
The tensile strength and elongation of the untreated and treated 2- ply composite structures are presented in Table IX.

TABLE IX TENSILE STRENGTH AND ELONGATION OF UNTREATED AND TREATED 2-PLY COMPOSITE STRUCTURES

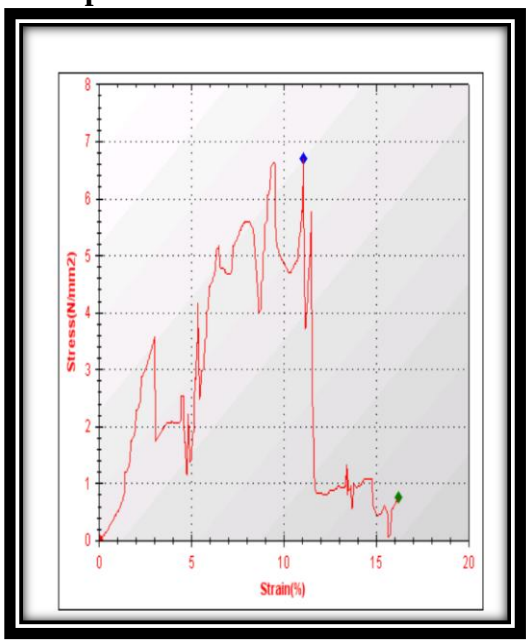
S.no	Sample	Load at peak (kN)	Elongation at peak (mm)	Strength at peak (N/mm^2)
1	$HSUC_2$	2.132	4.980	12.404
2	$HSTC_2$	0.402	2.465	4.381

From theTable IX,the two-ply untreated composite structure exhibited higher elongation and strength than the two-ply alkaline treated composite structure.

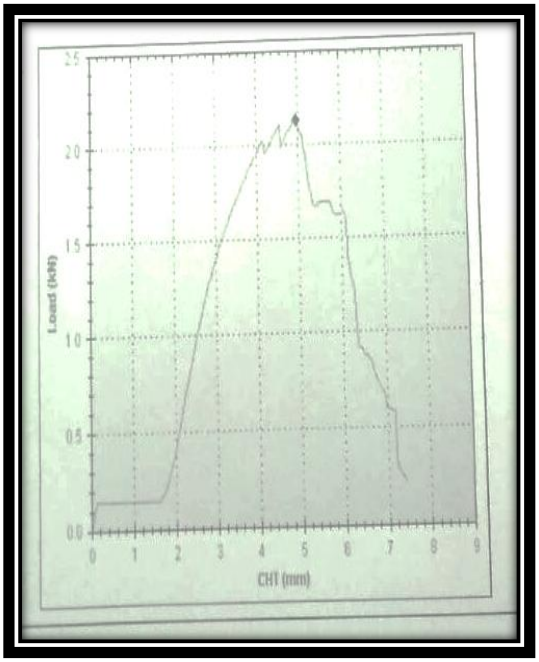
Figure 4
Stress Vs. strain graphs for composite structures



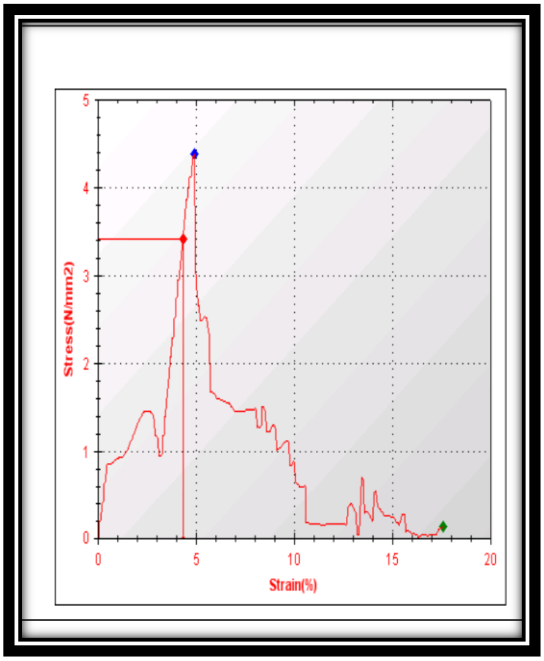
Untreated one-ply composite structure



Treated one-ply composite structure



Untreated two-ply composite structure



Treated two-ply composite structure

4 CONCLUSION

The fabric weight and thickness increased in all the samples on treatment with NaOH with more increase in sample HST_4 treated with NaOH of **15**percent concentration. There was a loss in strength in all the samples whereas the elongation was increased in all the treated samples. The moisture content and moisture regain showed favourable result in the sample treated with NaOH of **5**per cent concentration. But, water absorbency of the samples was good in all the treated samples.The strength and elongation of the single layer untreated composite structure is higher compared to alkaline treated single layer composite structure and the strength and elongation of the Two-ply untreated composite structure is higher compared to alkaline treated Two-ply composite structure. Keeping the above results in mind, the investigator has concluded that, the untreated Hemp sisal resin composite structures has high strength and elongation when compared to the alkaline treated resin treated composite structures were, treated with treated with **5** percent sodium hydroxide and hence, the untreated Hemp sisal resin composites can be used in technical applications where necessary.

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SPECIAL ISSUE

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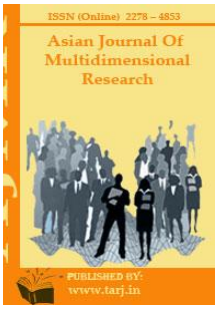

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EXTRACTION OF NATURAL DYE FROM SAW DUST OF PTEROCARPUS MARSUPIUM USING DIFFERENT SOLVENTS

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ABSTRACT

*The present study aims on the extraction of eco-colourant from Pterocarpus marsupium using different solvents such as water , alkali and acid by conventional extraction method . Cotton fabric was mordanted using premordanting technique with myrobalan mordant . The dyeing was carried out at 90°C for 60 minutes using the extract obtained from different solvents. The dyed fabrics were then assessed using spectrophotometer to analyse for color strength and CIE L*a*b*. The results show that the colour strength value of alkaline dyed fabric was the best and bright colour, and the next good result was obtained in the order of water and acid. The fastness properties of cotton fabric dyed with mordant was found to be very good whereas the fastness properties of unmordanted dyed fabric were observed to be satisfactory. The results of colour measurement and colour fastness properties of the fabric samples indicate that alkali extract is more efficient than the other two medium.*

KEYWORDS: *Alkaline Extraction, Colourfastness, Colour Strength, Natural Dye, Saw Dust.*

INTRODUCTION

Natural dyes have been known to be in use extensively for colouring of textile, handicraft, drug, food, leather, cosmetic (Siva, 2007) as well as paper, candles, shoe polish, wood from pre-historic times. Natural dye sources are difficult to obtain in huge quantity as raw material. The raw materials for natural dyes needs careful exploration of sources from plants and animals, which should be easily available at low cost and harmless on the environment when used (Verma and Gupta, 2017). Natural dyes produce graceful, soothing and artistic colours as compared to manmade dyes. Natural dyes contribute to the efficiency of measure to conserve the environment (Singh et al. 2010). From the olden days, plants are used for dyeing silk, wool and cotton material later it was replaced by synthetic dyes. There has been a growing interest for natural dye production and application on textile for sustainable and non-toxic alternative to synthetic dyes (Wanyama et al. 2010). The extraction of plant or vegetable dyes basically depends on the medium in which the dye is extracted (Samanta and Konar, 2011). Saw dust from *Pterocarpus marsupium* wood, which is available as a waste from saw mill all over world and can also used as textile eco-friendly colorant. Hence we chosen Pterocarpus marsupium commonly known as vijaysar that has been recommended for the dyeing of textiles (Nadiya and Kalaiarasi, 2018; Gokhale et al 2004). In this paper we report results on extraction of dye using different medium and application on cotton fabric.

MATERIALS AND METHODS

MATERIALS

Dye Sources: The saw dust from the bark of *Pterocarpus marsupium* was collected from Sivasamy saw mill located at Alandurai, Coimbatore, Tamil nadu, India.

Substrates:

Desized, scoured and mercerized 100% cotton fabric has been selected for the study. It was purchased from NTC, Coimbatore, Tamil Nadu.

Chemical Used:

AR grade chemicals such as acetic acid and sodium carbonate were used for extraction. Myrobalan was purchased in local market and used for mordanting.

EXPERIMENTAL METHODS

PREPARATION FOR DYE EXTRACTION

Dye was extracted using three different solvent such as water, alkali and acid (Samanta and Konar, 2011).

Aqueous Extraction: In the present study, five gram of the saw dust of *Pterocarpus marsupium* was taken and soaked overnight with 50ml of distilled water.

Alkaline Extraction: Five gram saw dust of *Pterocarpus marsupium* was taken and soaked overnight in the 1% alkaline solution (0.5 g of sodium carbonate).

Acidic Extraction: Five gram saw dust of *Pterocarpus marsupium* was taken and soaked overnight in the 1% acidic solution (0.5 ml of acetic acid).

CONVENTIONAL DYE EXTRACTION METHOD

The prepared dye mixtures were placed in the water bath at 100ºC for 60 minutes. At the end of extraction, the beaker was cooled down to room temperature and the mixtures were filtered using a muslin cloth. The filtrates were kept at 4 ºC and used for dyeing.

FABRIC DYEING

The extracted natural dye solutions were used to dye the selected cotton fabric keeping M:L ratio 1:30. Dyeing was carried out in lab dyer at 90ºC for 60 minutes.

MORDANTING

The cotton fabric samples were premordanted with 10 % myrobalan at room temperature for 1 hour.

COLOURFASTNESS TESTS

Dyed cotton fabrics were tested for light fastness, wash and rub fastness. Colourfastness to washing was tested by washing the dyed fabrics with nonionic detergent (1g per litre). Colourfastness to light was carried out by exposing the dyed fabrics to sunlight for 12 hours. Colourfastness to rubbing was determined by rubbing the dyed samples for 10 times in dry and wet conditions and checked for fading of colour (Das and Mondal, 2013).

COLOUR MEASUREMENT

Spectral reflectance techniques were used to measure the color strength of the dyed fabric using a spectrophotometer (Premier Colorscan SS 5100H). The K/S values were calculated by Kubelka-Munk equation.

$K/S = (1-R)^2 /2R$

Where K is the absorption coefficient, S is scattering coefficient and R is the decimal fraction of the reflectance of the fabric dyed samples at λmax. CIELab values were also recorded for all dyed samples.

RESULTS AND DISCUSSION

EVALUATION OF DYED FABRICS

The selected cotton fabrics were dyed with dye extract of *Pterocarpus marsupium* saw dust obtained using different medium with myrobalan as mordant and the dyed samples were observed that the absorption of dye was found to be higher.

FASTNESS PROPERTIES

The fastness properties of cotton fabrics dyed with *Pterocarpus marsupium* saw dust extract of different medium are shown in Table 1. The dyed samples were compared between mordanted and unmordanted samples.

TABLE 1 FASTNESS PROPERTIES FOR COTTON FABRIC DYED WITH PTEROCARPUS MARSUPIUM SAW DUST

Solvent	Mordant	Colourfastness test			
		Washing	Light	Rubbing	
				Dry	Wet
Water	Without	4	5	4	3/4
	With	4/5	6	4	4
Alkali	Without	4/5	6	4	4
	With	5	7	4/5	4
Acid	Without	3/4	4	3/4	3
	With	4	5	4	4

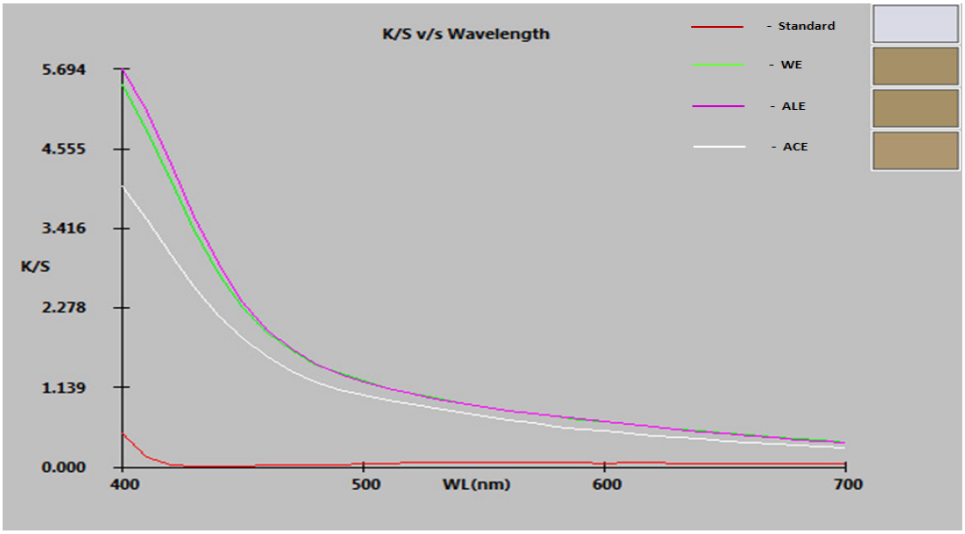
(Ratings for Washing and Rubbing fastness 1-5; where 1-poor, 2-fair, 3-good, 4-very good and 5-excellent; Ratings for light fastness - 1-8; where 1-poor, 2-fair, 3-moderate, 4-good, 5-better, 6-very good, 7-best and 8-excellent)

Colour fading by sunlight was evaluated by comparing the dyed samples and observed that all dyed samples showed good to best result. Washing fastness of all dyed samples ranged between good to excellent. Rubbing fastness of all dyed samples showed good to excellent fastness in dry condition and good to very good in wet condition. On the whole, the premordanted cotton fabric dyed with alkaline extract showed very best result and followed by water and acid extract dyed fabrics.

COLOUR STRENGTH

Colour strength curves for all dyed samples with different solvent of extract from *Pterocarpus marsupium* saw dust as presented in Figure 1. All the samples show similar shades because they were from same source but different medium used for extraction. The colour strength values were highest for cotton dyed with dye from alkaline extraction and treated with myrobalan as a mordant. In contrast, the colour strength value was lowest for cotton fabric dyed with dye from acidic extraction

Figure 1. K/S Curves of dyed samples



Standard – Undyed fabric; WE - Water extract Dyed fabric;

ALE - Alkali extract Dyed fabric; ACE - Acid extract Dyed fabric

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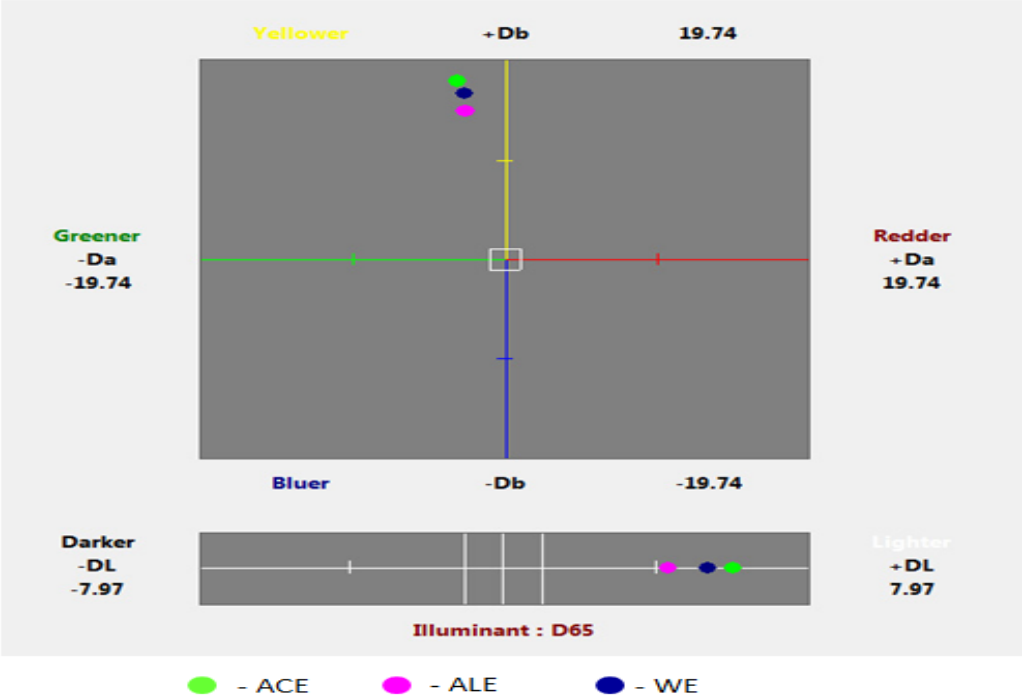
TABLE 2. CIELAB VALUES FOR PTEROCARPUS MARSUPIUM ROXB BARK EXTRACT DYED FABRICS

Parameter	K/S	Color co-ordinates				
		L*	a*	b*	C*	H*
Standard	0.930	87.224	2.142	-6.622	6.960	287.954
WE	26.149	60.635	2.487	23.699	23.829	83.975
ALE	26.907	60.651	2.290	24.469	24.576	84.619
ACE	20.801	63.265	3.533	22.567	22.842	81.070

CIE L* a* b* VALUES

The L* a* b* values for cotton fabric dyed with extract of *Pterocarpus marsupium* saw dust are tabulated in Table 2. The dyeing with myrobalan premordanting technique imparted a shade change from light yellow to dark yellowish tinge. Also, the lightness value decreased for cotton fabric dyed using alkaline extract, and retains the brightness while the highest was obtained with cotton fabric dyed with acid extract having dullness. The a* b* plot of dyed cotton samples are shown in Figure 2 show the colour range of dyed cotton samples with with *Pterocarpus marsupium* saw dust of different extraction medium. Figure 2 show that all the cotton samples dyed with *Pterocarpus marsupium* saw dust which lies in the yellow zone.

Figure 2. Represents the colorimetric values of extracted dyed cotton fabric using different extraction medium



CONCLUSION

Saw dust of *Pterocarpus marsupium* was found to be a potent natural dye source for textile coloration. It is economical and easily available source throughout the world. Different Shades can be obtained using different medium of extraction on cotton fabric. Enhancement of dye uptake was very good when compared to the unmordanted fabrics. The fastness properties of cotton fabric dyed with myrobalan premordanted were found to be quite good. Of the different medium used for extraction, alkali medium yielded the best results in colour fastness tests. Since this dye will not pollute the environment, the dye has good scope in eco-friendly industrial purposes.

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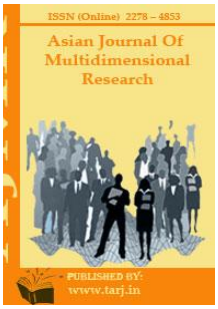

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DECOLOURISATION OF SAFRANIN BY SUGARCANE BAGASSE AND ITS TOXICITY EVALUATION

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ABSTRACT

In the present study, an agricultural waste product sugar cane bagasse was used as a eco-friendly, effective and low-cost adsorbent for the removal of cationic dye safranin from aqueous solutions. The dye adsorption was evaluated under different experimental conditions such as initial dye concentration (100-700mg/L), biosorbent dose (100-600mg/L), solution pH (1-8), temperature (25-55^{o}C) and contact time (1-7 days) respectively. The phytotoxicity studies such as germination percentage, shoot length, root length, fresh weight, vigour index, phytotoxicity percentage and relative toxicity were evaluated on 7 days old Cicerarietinum seeds to determine to toxic nature of untreated and degraded metabolites respectively. Maximum adsorption capacities for removal of dye was 100mg/L initial dye concentration, 400mg/L biosorbent dose at pH 5 with 30^{o}C in 5th day of contact time. The phytotoxicity results of control (T_1) and degraded metabolites (T_3) were showed maximum seed germination and growth whereas decreased significantly in untreated dye solution (T_2). This was evidenced by germination percentage (50), shoot length (4.67±0.41), root length (0.20±0.94), fresh weight (0.49±0.25), vigour index (244), phytotoxicity percentage (97) and relative toxicity (44%) respectively. It was concluded that the treated dye solution is non-toxic in nature and can be used as an alternative source for irrigation purposes.

KEYWORDS: *Adsorption, sugarcane bagasse, optimisation, degraded metabolites and phytotoxicity.*

INTRODUCTION

Water and soilis the wellspring of life which plays a vital role for the function of our ecosystem. Colour is one of the major pollutant to be recognized in water as well as in soil. It is fouled due to the disposal of waste water and sludge generated from the dyeing and finishing industries can be one of the biggest contributors to aquatic pollution (Firbas, 2015, El-Haddad *et al.,* 2013, Gupta *et al.,* 2012and Daneshvar*et al.,* 2004).

Over 1,00,000 different dyes have been synthesized and more than $7x10^5$tons of dyestuff produces annually. Azo dyes are the largest group of synthetic dyes which is commercially used by textile industries because of their ease and cost effectiveness in synthesis, stability, high wet fastness profiles, high stability to temperature, detergent, microbial attack and variety in colour compared with the natural dyes (Tehrani-Bagha and Holmberg, 2013 and Chequer *et al.,* 2013).

Textile dyeing industries are one of the important sources of water pollution because the 50 per cent unfixed dyes are released as waste water into aquatic bodies can cause flora and fauna (Crini 2006). The environmental problems such as the inhibition of photosynthesis due to the reduction of sunlight penetration in water bodies, increasing biochemical and chemical oxygen demand and contaminate soil and ground water resource (Boyer *et al.,* 2010 and Al-Degs*et al.,* 2008).

Dyes are inflexible to photochemical and biological degradationbecause of the degradation products may be toxic in nature which is highly harmful to living organisms including human beings. Therefore, the development of effective, inexpensive, renewable and sustainable dye removal processes is of a great importance for the removal of dyes from untreated waste water before discharge to the environment (Dakhil, 2016, Rahman, 2016.,Garg*et al.,* 2004 and Gupta *et al.,* 2013).

Several treatment techniques including coagulation, electrochemical degradation, flocculation, photocatalytic degradation, membrane filtration, adsorption, ozonation, advanced oxidation processes, radiolysis, reverse osmosis and aerobic and anaerobic treatment methods have been applied to treated textile effluents (Gupta *et al.,* 2015). Among these adsorption is extremely gaining prominence. It is the most efficient method for the removal of different types of dyes (Calvete*et al.,* 2010).

Adsorbents from renewable sources are gained more attention because they are easy to handle, able to function at low concentrations, safe and cost effective for dye removal from the aqueous solutions (Gupta and Suhas, 2009). Some of the lignocellulose materials are proven as a good dye adsorbent because of the presence of functional groups on their surface (Ferreira *et al.,* 2015,Gurgel*et al.,* 2008, Gusmao*et al.,* 2013, You *et al.,* 2016 and Martins *et al.,* 2017).

The agro- industrial waste namely sugarcane bagasse can be obtained in the sugarcane milling process which is the scum left when crushing the sugarcane stems for extraction of the sucrose-rich juice and it consists of 45 per cent cellulose, 18 per cent lignin and 28 per cent hemicellulose (Oliveira *et al.,* 2006, Soccol*et al.,* 2010 and Pehlivan*et al.,* 2013). Over the years, a large amount of bagasse has gathered due to the growth of sugarcane crops.Henceforth, sugarcane bagasse is a seemly and economically attractive alternative for the removal of dyes from the textile effluent and also can solve the agricultural waste disposal problem (Masson *et al.,* 2007).

The cationic dye, safraninis selected as a candidate dye for the present study because it is widely used as food dye in flavouring and colouring candies and cookies, textile industries, leather, paper as well as in researches related to histology, textile cytology and bacteriology (Shariatia*et al.,*

2011). Commercially used as a photosensitizer in electron and energy transfer reactions, redox indicator in analytical chemistry, analytical reagent for the determination of nitrite in acidic medium and it is reacted with nitrite to form a diazoniumcation, which caused the change of the reddish-orange colour of the dye solution to blue (El-Haddad *et al.*, 2013).

The present study describes the biosorption of safranin by using sugarcane bagasse from the aqueous solutions under optimised conditions. The effects of various factors such as biosorbent dose, initial dye concentration, pH, temperature and contact time are reported. The toxic effect of untreated and treated dye solution on the germination of *Cicerarietinum* seeds to determine the toxicity of the resulting solutions.

MATERIALS AND METHODS

COLLECTION AND PREPARATION OF SUGARCANE BAGASSE

The sugarcane bagasse was collected from road side juice hawker, Coimbatore, Tamilnadu, India. The collected bagasse were cut into fine pieces (0.5-1cm) and washed in running tap water for three times and finally washed with distilled water to remove dust and dirt and then dried at room temperature for five days. The dried bagasse were grounded into fine powder using mortar and pestle, sieved (100-120µm) and stored in air tight container for further use.

PREPARATION OF DYE SOLUTION

Safranin dye (C. I. Name –Safranin O or basic red 2; CAS.No – 477-73-6; molecular formula – $C_{20}H_{19}ClN_4$; λmax – 530 - 534nmand molecular mass - 350.85 $g \cdot mol^{-1}$) was obtained from chemical company (Hi media) Ltd. A stock solution was prepared by dissolving exactly weighed dye. Seven different dilutions of stock solutions (100, 200, 300, 400, 500, 600 and 700mg/L) were also prepared for adsorption studies.

BATCH DECOLOURIZATION EXPERIMENTS

To evaluate the decolourization efficiency of sugarcane bagasse, the batch experiments were conducted in 1000ml conical flasks containing 1L safranin dye solution with different concentrations (100-700mg/L), biosorbent dose (100-600g/L), solution pH (1-8), temperature (25-55^{o}C) and contact time (1-5days). The required pH values of the dye solution was adjusted with 1N HCL and 1N NaOH. The batch study was repeated twice to confirm the results with controls. Afterwards, the maximum absorbance of control and decolourised samples was scanned at 530-534nm in calorimeter. The percentage decolourisation was calculated using the formula

$$\text{Decolourisation (\%)} = \frac{(A_i)-(A_t)}{(A_i)} \times 100 \quad \text{---------- (1)}$$

Where A*i* was the initial absorbance and A*t* is the absorbance at contact time *t*.

PHYTOTOXICITY STUDIES

The healthy, uniform sized *Cicerarietinum* (Bengal gram) seeds were selected and the surface was sterilized with 0.1%$HgCl_2$ for 1min and then washed with tap water. 10 seeds were placed with equal distance in plastic cups filled with soil. The seeds were irritated with different treatment solutions such as tap water (T_1) served as a control, untreated dye solution (T_2) and degraded

metabolites (T_3) respectively for 7 days. Three replicates were maintained for each treatment. The germination percentage, shoot length, root length and fresh weight (Sajani and Muthukkaruppan, 2011) were recorded on 7th day and the vigour index, phytotoxicity percentage and relative toxicity (%) were also calculated.

GERMINATION PERCENTAGE

After 7 days of seeding, germination percentage of the seedlings were calculated using the formula

$$\text{Germination percentage} = \frac{\text{Number of seeds germinated}}{\text{Total numbers of seeds sown}} \times 100 \quad \text{---------- (2)}$$

SHOOT LENGTH AND ROOT LENGTH (cm/seedling)

The maximum length of each shoot and root was measured in each treatment (T_1, T_2 and T_3) using cm scale from the ground level to the tip. The plants were uprooted during the 7thday after sowing and washed in running water to remove soil particles and pressed between filter paper folds to remove water droplets before the shoot length was measured.

FRESH WEIGHT (g/seedling)

The seedlings were taken from each treatment and their fresh weights were recorded using electrical balancer.

VIGOUR INDEX

Vigour index was calculated as the product of germination percentage and plant height. The vigour index of each seedling was calculated using the formula

Vigour index = germination percentage X (root length + shoot length) ---------- (3)

(Abdul-Baki and Anderson, 1973)

PHYTOTOXICITY PERCENTAGE

Phytotoxicity percentage was calculated using the formula of Chou and Lin (1976).

$$\text{Phytotoxicity (\%)} = \frac{R_C - Rt}{R_c} \times 100 \quad \text{---------- (4)}$$

RELATIVE TOXICITY (% R_T)

Relative toxicity of each treatment exposed seedlings were evaluated using the formula (Chapagain 1991).

$$R_T = \frac{x-y}{x} \times 100 \quad \text{---------- (5)}$$

where, R_T = Relative toxicity (%), x= germination percentage in control on 7th day and y= germination percentage in the presence of treatment solutions at the same time.

RESULTS AND DISCUSSION

EFFECT OF VARIOUS ENVIRONMENTAL FACTORS ON DYE DECOLOURISATION

The dye concentration is one of the important parameter in adsorption process which overcomes the mass transfer resistance of adsorbate between the aqueous and solid phases (Murugan,*et al.*, 2010). The effect of initial dye concentration of safranin onto sugarcane bagasse was studies and shown in figure 1. The experiments were carried out at 400mg/L biosorbent dose, temperature 30^{o}C, pH 5 and different initial dye concentration (100-700mg/L) at 5th day of contact time.The results showed that the maximum dye removal was attained at initial dye concentration (94%). Beyond 100mg/L dye concentration, gradual decrease in the decolourisation was observed probably due to by the fact that the binding sites of the adsorbent surface would be saturated (Saratale*et al.*, 2010a).

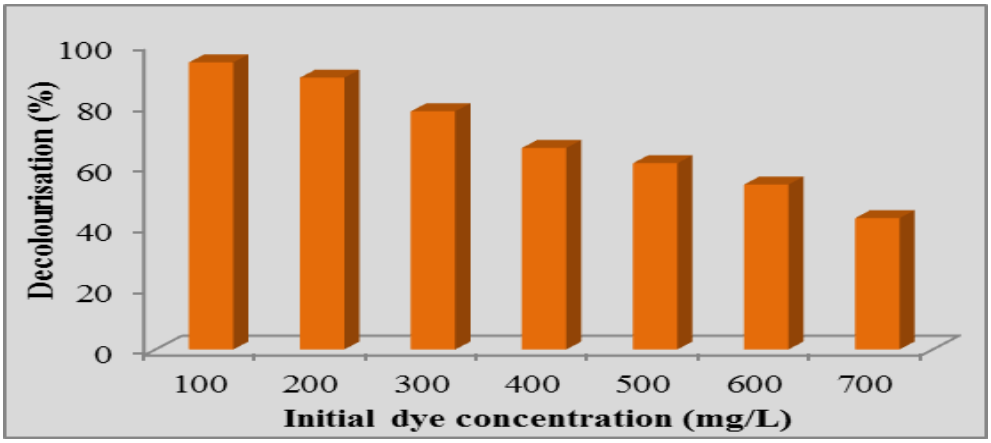

Figure 1 Effect of initial dye concentration on the percentage colour removal of safranin by sugarcane bagasse

The results discovered that the dye removal was decreased with an increase in initial dye concentration which might be due to the saturation of adsorption sites on the adsorbent surface (Salleh*et al.*, 2011). The percentage removal was decreased from 94% to 43% as the initial dye concentration increased from 100-700mg/L. Hazzaa and Hussein (2012) stated that a large number of surface active sites are available during initial dye adsorption and after a period of time, the residual surface active sites are occupied and when the dye concentration increases, the surface active sites required for adsorption will not be available.

EFFECT OF BIOSORBENT DOSE ON DYE DECOLOURISATION

Adsorbent dose is also an important parameter in adsorption studies because it determines the capacity of adsorbent for a given initial concentration of dye solution (Fatiha and Belkacem 2016).In order to evaluate the effect of biosorbent dose on the removal efficiency was studies by varying the quantity of biosorbent dose (100-600mg/L) while keeping the initial dye concentration of 100mg/L. Figure 2 depicts the amount of dye adsorbed by biosorbent from 65% to 95% with an increasing biosorbent dose 100-400mg/L. the dye uptake was decreased with increasing biosorbent dose is might be due to the concentration gradient between solute concentrations in the solution and on the biosorbent surface (El-Haddad *et al.*, 2013). The optimum biosorbent dose was found to be 400mg/L of sugarcane bagasse per 100mg/L of safranin dye solution.

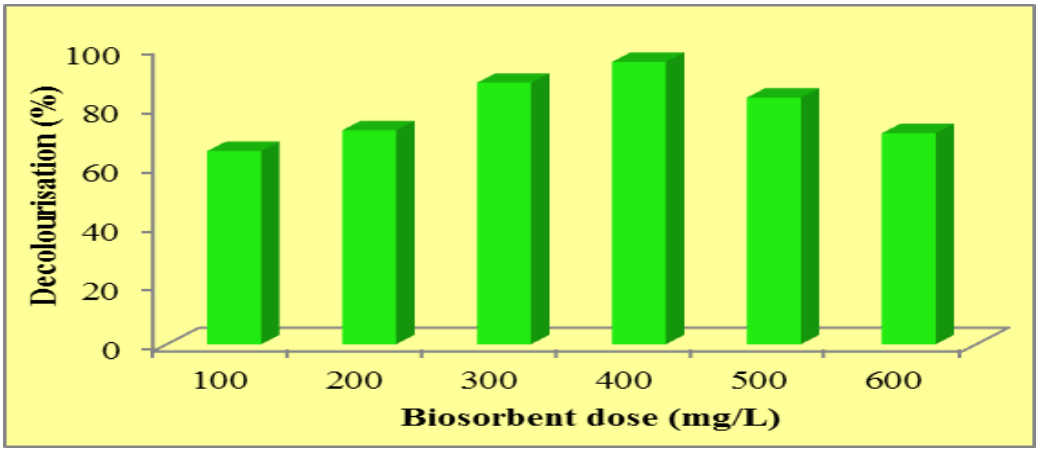

Figure 2 Effect of biosorbent dose on the percentage colour removal of safranin by sugarcane bagasse

From this study, the decrease in the adsorption capacity at higher dosage is probably due to the decrease of surface area of the biosorbent by the overlapping during sorption (Kovacevic*et al.*, 2000).

EFFECT OF pH ON DYE DECOLOURISATION

The solution pH is one of the important factor in adsorption process, particularly for dye biosorptionas it may be affects the surface active sties of the adsorbent and the ionization degree of the dye (Ahmad *et al.*, 2018). Figure 3showed the percentage of dye removal at different pH.The dye removal was maximum (94%) with increasing the solution pH up to 5 followed by reached equilibrium.

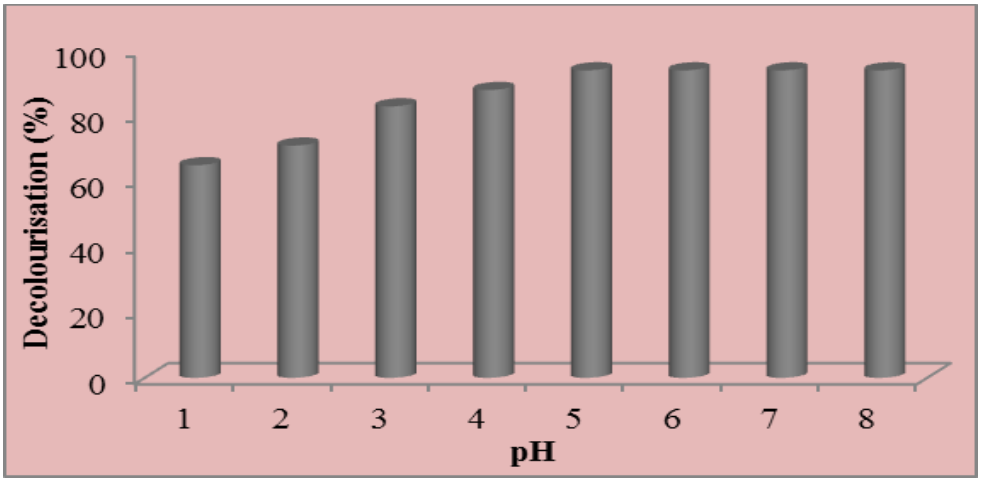

Figure 3 Effect of pH on the percentage colour removal of safranin by sugarcane bagasse

At lower pH, the percentage dye removal was decreased in cationic dyes and increased in anionic dyes. This is probably dye to the presence of excess H+ ions opposite with the cation groups on the dye for adsorption sites. In contrast, at higher pH, the percentage dye removal was increased in cationic dye adsorption and decreased in anionic dye adsorption. This could be explained by the

electrostatic attraction between the positively charged dye and the surface of the adsorbent is lowered, which results in an increase of adsorption (Shallehet *al.*, 2011 and Wang *et al.*, 2012).

EFFECT OF TEMPERATURE ON DYE DECOLOURISATION

Effect of changes in temperature on dye adsorption is an indicator of the nature of thebiosorption process that is whether an endothermic or exothermic process (Demirbaş and Alkan 2013) is. The effect of temperature on dye removal was investigated at different temperatures (25-55^{o}C) and keeping all other parameters constant (initial dye concentration: 100mg/L, biosorbent dose: 400mg/L, pH 5 and contact time: 5 days). From the figure 4, it was observed that the rapid enhancement in the dye adsorption was observed with increase in temperature from 25-30^{o}C which suggest that the adsorption is an endothermic in nature.

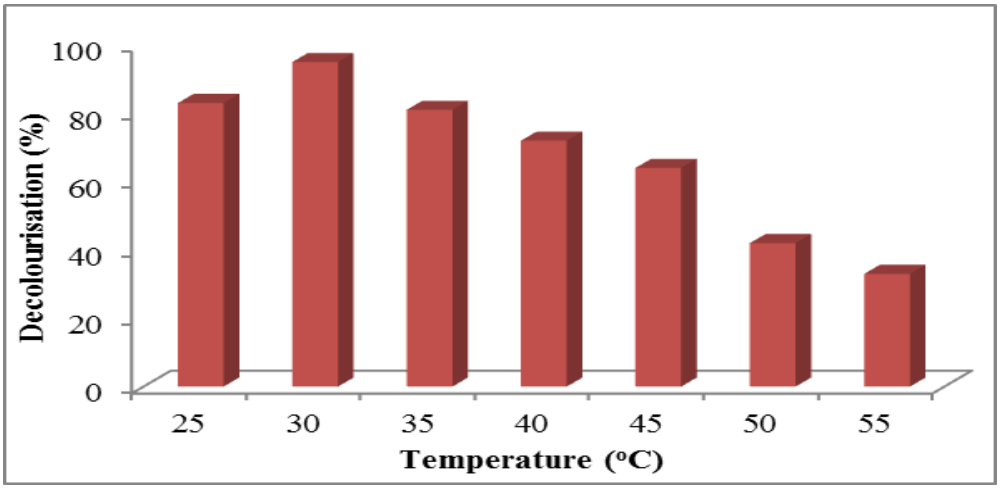

Figure 3 Effect of temperature on the percentage colour removal of safranin by sugarcane bagasse

Beyond 30^{o}C, the dye removal efficiency was significantly reduced; this is because of the weakening of the physical interactions between dyes and active adsorbent sites. Increasing temperature may decrease the adsorptive forces between dyes and the active sites on the adsorbent surface as a result of decreasing adsorption capacity (Chowdhury and Saha 2010 and Bharathi and Ramesh, 2013).

EFFECT OF CONTACT TIME ON DYE DECOLOURISATION

The influence of contact time on dye removal by sugarcane bagasse from aqueous solution was investigated at different contact times (1-7days). It was evident from the figure 5, the rate of dye removal was rapid initially (54%-97%) and then there is no significant raise in dye removal. This could be considered as an equilibrium state for dye uptake.

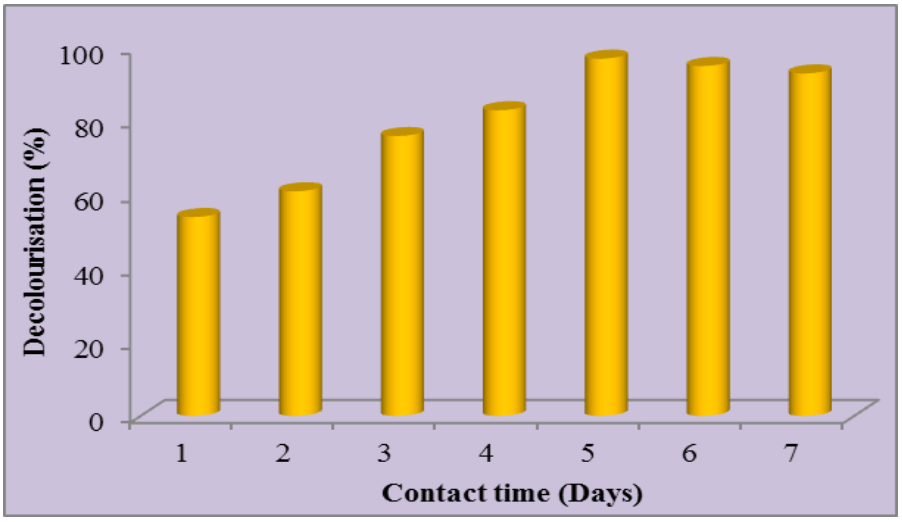

Figure 5 Effect of contact time on the percentage colour removal of safranin by sugarcane bagasse

A large fraction of dye was removed upto 5days of contact time (97%). Beyond which there was no significant increase in the rate of dye removal. Therefore, it was concluded that 5th day as an optimum time for maximum decolourisation (Figure 5). These results indicate that the contact time improves the diffusion of dye molecules toward the surface of the biosorbent. The overall adsorption is seen to consist of high adsorption rate at the early period which may be due to the electrostatic attraction on the adsorbent surface (Uddin*et al.*, 2007).

OPTIMAL CONDITIONS FOR SAFRANIN DECOLOURISATION USING SUGARCANE BAGASSE

The optimisation of multiple interacting factors seems useful in improving the biosorption process. The maximum colour was removed by sugarcane bagasse found to be 95%. The higher decolourisation was achieved due to the effect of coordinated metabolic interactions under optimal environmental conditions with initial dye concentration (100mg/L), biosorbent dose (400mg/L), pH (5), temperature (30^{o}C)at 5th day of contact time.

PHYTOTOXICITY STUDY

Use of untreated and treated textile effluent for agriculture purpose has direct impact on the fertility of soil. Therefore, it is of concern to assess the phytotoxicity of the textile dye effluent before and after degradation by any mode of treatment. Seed germination and plant growth bioassays are the most common techniques used to evaluate the phytotoxicity (Jadhav*et al.*, 2010).

The biometric parameters such as germination percentage, shoot length, root length, fresh weight, vigour index, phytotoxicity percentage and relative toxicity (%) were recorded on 7 days old *Cicerarietinum*exposed to tap water (T_1), untreated dye solution (T_2) and degraded metabolites (T_3) and the results were showed in table 1.

Treatments	Germination Percentage	Shoot length (cm)	Root Length(cm)	Fresh weight (g)	Vigour index	Phytotoxicity percentage	Relative toxicity
T_1	90	15.35±0.34	6.53±0.54	1.52±0.2	1969	-	-
T_2	50	4.67±0.41	0.20±0.94	0.49±0.25	244	97	44
T_3	80	10.83±0.75	6.10±0.46	1.10±0.14	1354	7	11

T_1 - Control (Tap water), T_2 - Untreated dye solution, T_3 – degraded metabolites

Table 1 Biometric parameters of 7 days old seedlings of *Cicerarietinum* grown with different treatments

The biometric parameters of*Cicerarietinum*seeds exposed to T_1 and T_3showed maximum germination and growth whereas minimum growth and germination was observed in T_2treatment as shown in table 1. Decrease in the germination and seed vigour irrigated with untreated dye solution (T_2) might be due to the interaction of different pollutants with the developing radical. From the results it was observed that the reduction in shoot and root length of seedlings grown using T_2 might be due to the presence of higher dye concentration of dye which exhibited the uptake of micro and macro elements by plant system.

From the table, it is concluded that the untreated dye solution is more toxic as compared to degraded metabolites. This result finally proves that the present study is successful in reducing the toxicity level of safranin by using sugarcane bagasse and its degraded metabolites can be used for irrigation purposes. Jolly *et al.* (2012) studied the impact of dyeing industry effluent on wheat cultivation. Who revealed that wheat irrigated with treated effluent shown better performance in growth and yield compared to untreated irrigated wheat which supports the present investigation..

CONCLUSION

Water scarcity has a great impact on human life as it becomes one of the most pressing problems. The global challenges to meet future demand are constrained by sustainable fresh water availability. Therefore new and novel methods are required for efficient and ecofiendly treatment of existing polluted resources of water. Promising results obtained from this study. On the basis of results it is concluded that the sugarcane bagasse successfully reduced the toxicity level of safranin and can be used for irrigation.

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SPECIAL ISSUE

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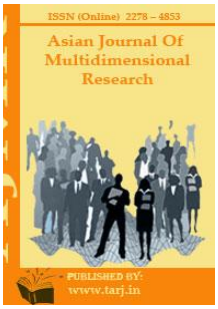

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STUDY ON TODDLERS BEDDING

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ABSTRACT

In the present world most of us are very conscious about our hygiene and cleanliness. This study is done to enhance the qualities in toddlers bedding. Toddlers are the children from the age between 1- 3years . They must be taken care by their mothers to improve their good habits and thoughts. At this stage the mothers should pamper toddler's brain. Bedding is a part of enjoyment for kids. Toddlers and babies are the important stage where they get attracted to the colours and designs. In addition to the decoration, the bedding requires comfort, soft, safe, good texture and shapes. Mothers are focused for this study to collect information about their toddlers bedding. It is proved that majority of the mothers prefer Organic cotton for the fabric, natural dyes for the colour, and special finishes like antimicrobial finish for their toddlers bedding.

KEYWORDS: *Bedding, Organic cotton, Natural dye, antimicrobial finish.*

1. INTRODUCTION

Bedding is a part of enjoyment for kids. Toddlers and babies are the important stage where they get attracted to the colours and designs. In addition to the decoration, the bedding requires comfort, soft, safe, good texture and shapes. These are the characters of bed results with a restful sleep to the toddlers. Mothers are the first person who took lot of care on their children. Special care must be taken on children because **"Today's Children are Tomorrows Future World"**. Therefore the mothers are selected to take the survey based on Toddlers Bedding. From this mothers gained knowledge about the theme based bedding to their children's taste.

Main Objectives of the study is to collect information regarding toddlers bedding

2. EXPERIMENTAL PROCEDURE:

Interview schedule is done by face to face which will be in good results to get correct data (Groves,Fowler, et.al, 2009). The interview was schedule is conducted among 50 mothers with toddlers (Fowler, 1995). This interview was done when the mothers are free to spend their time in deciding their toddlers bedding. They preferred theme based toddlers bedding (Leon, 2003). It was collected in a systematic manner and consolidated.

3. RESULTS AND DISSCUSSION

The Results and discussion of the topic entitled "Toddlers Bedding preferred by their Mothers" is given below:

3.1 Results of the title to elect information about Bedding preferred by young mothers for their Toddlers:

3.1.1 AGE DETAILS OF THE MOTHERS PREFERRING BEDDINGS FOR THEIR TODDLERS:

The age details of mothers who prefer bedding for their toddlers is presented by conducting Interview Schedule and results are given below in Table-I and Figure: 1

TABLE I- AGE OF THE MOTHERS PREFERRING BEDDINGS FOR THEIR TODDLERS

AGE(yrs.)	No. of mothers	Percentage
20-23	4	8
24-27	35	70
28-30	5	10
31-33	6	12
TOTAL	**50**	**100**

Figure-1: Age of the Mothers Preferring Beddings for Their Toddlers

From the above Table-I and Figure-1, most of the mothers are from the age group 24-27 is noticed as higher percentage. That is, the age group 20-23 is basically considered as the studying period. And the most important factor is the age period 31-33; at this stage the mothers have least chance of getting pregnancy. Hence it is concluded that age period 24-27 is considered that most of the women get married and have children.

3.1.2 EDUCATIONAL DETAILS OF THE MOTHERS PREFERRING BEDDINGS FOR THEIR TODDLERS:

The Educational details of mothers who prefer beddings for their Toddlers is shown below by Interview schedule and the results are given in Table II and Figure-2.

TABLE II- EDUCATIONAL OF THE MOTHERS PREFERRING BEDDINGS FOR THEIR TODDLERS

Education	No. of mothers	Percentage
10^{th}Std	2	4
12^{th}Std	2	4
UG	29	58
PG	17	34
TOTAL	**50**	**100**

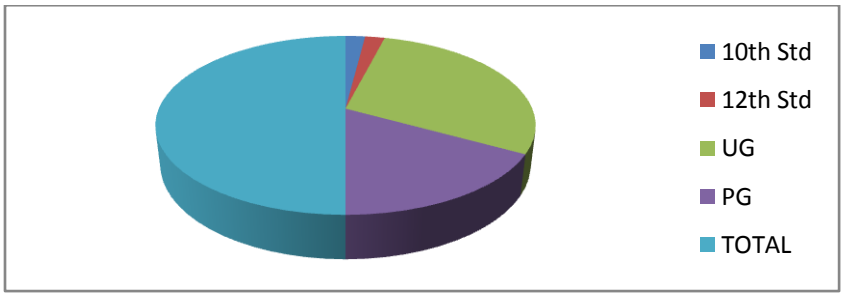

Figure-2: Educational of the Mothers Preferring Beddings for Their Toddlers

From the above Table-II and Figure-2 it is noted, that all the mothers are littered in which some of them are credited by UG degree and a few by obtaining PG degrees. Therefore, all the mothers have the content of literature, studying and writing ability as by the interview schedule. Hence it is concluded that majority of the mothers have studied up to UG.

3.1.3 Age details of the Toddlers:

Age details of toddlers are shown below by Interviewing with their mothers and the results are given below in Table III and Figure-3.

TABLE III- AGE OF THE TODDLERS

AGE(months)	No. of toddlers	Percentage
Birth-6	4	8
7-12	8	16
13-18	3	6
19-24	11	22
25-30	15	30
31-36	9	18
TOTAL	**50**	**100**

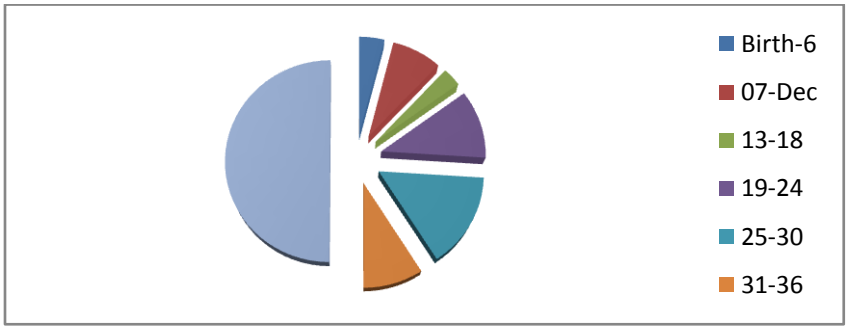

Figure-3: Age of the Toddlers

From the above Table-III and Figure-3, most of the toddlers are ageing from the range 25-30 months, which is then followed by 19-24. And the least range is from 13-18. Hence it is concluded that the maximum range is from 25-30 months.

3.1.4 Gender of the Toddlers:

Gender details of toddlers are shown below by Interviewing with their mothers and the results are given below in Table IV and Figure-4.

TABLE IV- GENDER OF THE TODDLERS

GENDER	No. of toddlers	Percentage
Male	30	60
Female	20	40
TOTAL	**50**	**100**

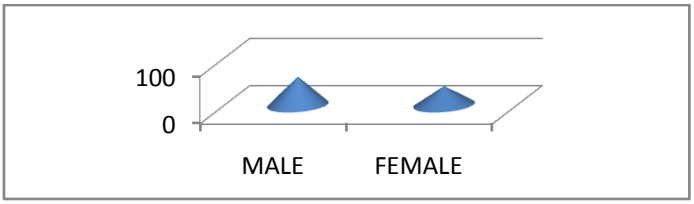

Figure-4: Gender of the Toddlers

From the above Table-IV and Figure-4, the male gender is higher than the female by the total count. That is due to the biological factor of the "Y" chromosome in the sperm. The presence of "Y" chromosome results the baby in male gender when there is an absence of "Y" and presence of "X" chromosome results the baby in female gender. Hence it is concluded that male toddlers is large in amount.

3.1.5 PRODUCTS PREFERRED BY THE MOTHERS FOR THEIR TODDLERS BEDDINGS:

Products preferred by the mothers for their Toddlers Beddings are shown below by Interviewing with their mothers and the results are presented below in Table V and Figure-5.

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TABLE V- PRODUCTS PREFERRED BY THE MOTHERS FOR THEIR TODDLERS BEDDINGS

	No. of products preferred by mothers	**Percentage**
Bed	50	100
Pillow	41	82
Bed covers	50	100
Pillow covers	41	82
Bolster	19	38
Cushion	21	42
Soft toy	39	78
Hanging	16	32
others	-	-
TOTAL	**277**	**554***

*Multiple responses

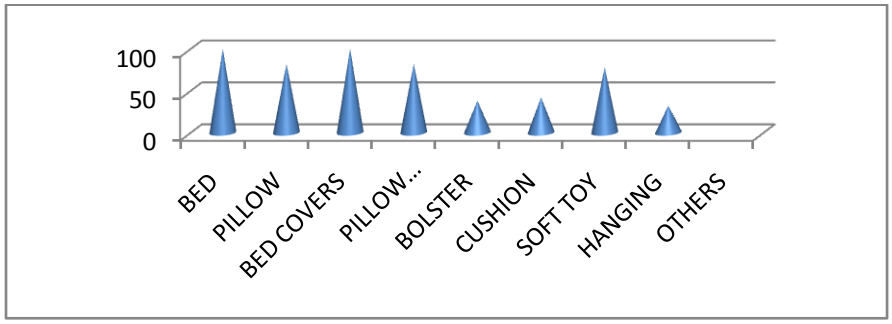

Figure-5: Products Preferred by the Mothers for Their Toddlers Beddings

From the above Table-I and Figure-2, it is clear that all the mothers prefer the bed and bedcovers as the basic need in their toddlers bedding. And majority of the mothers include pillow and pillow covers in their toddlers bedding as neck rest and also for protection to avoid baby falls from the bed. Hence it is concluded that bed and bed covers are preferred by all the mothers for their toddlers.

3.1.6 TYPE OF BED USED BY THE MOTHERS FOR THEIR TODDLERS:

Types of bed used by the mothers for their Toddlers are presented below by Interviewing with their mothers and the results are shown below in Table VI and Figure-6.

TABLE VI-TYPE OF BED USED BY THE MOTHERS FOR THEIR TODDLERS

TYPE OF BED	**No. of beds**	**Percentage**
Mosses basket	7	14
Mattress	32	64
Sleeping bag	4	8
Bunker cot	7	14
others	-	-
TOTAL	**50**	**100**

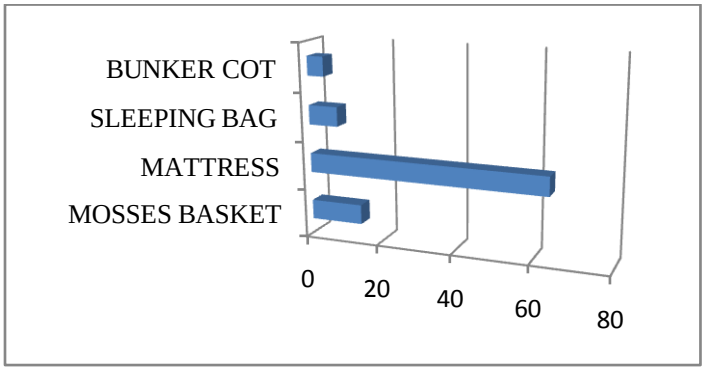

Figure-6: Type of Bed Used by the Mothers for Their Toddlers

From the above Table-VI and Figure-6, the least selection is done on the sleeping bag, where it is mainly used in the cold countries. And the higher selection is on mattress that is commonly used in our country, where it can be easily shifted and also it can kept aside of the mother while sleeping. Hence it is concluded that mattress is preferred by most of the mothers.

3.1.7 THEME BASED BEDDING PREFERRED BY THE MOTHERS FOR THEIR TODDLERS:

Mothers who are interested and not interested to have theme based beddings for their toddlers are counted by conducting interview to the mothers. The below Table-VII and the Figure-7 represents the preference of theme based bedding by the mothers.

TABLE VII- THEME BASED BEDDING PREFERRED BY THE MOTHERS FOR THEIR TODDLERS

THEME	No. of mothers	Percentage
Yes	33	66
No	17	34
TOTAL	**50**	**100**

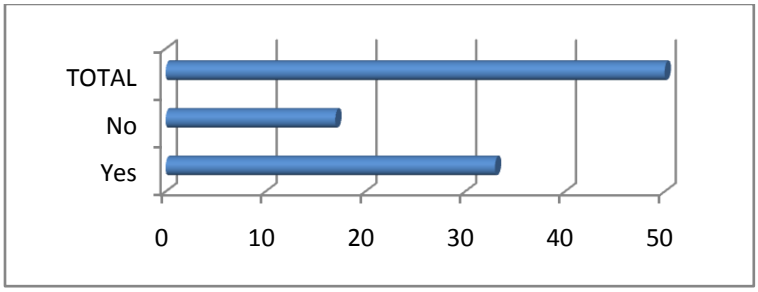

Figure-7: Theme Based Bedding Preferred by the Mothers for Their Toddlers

From the above Table-VII and Figure-7 it is noted that majority of the mothers are wished to have theme based bedding for their toddlers based on their own interest on selection. It can be either depends on colour or texture and so on. Hence it is concluded that theme based bedding is preferred by most of the mothers for their toddlers.

3.1.8 COLOURS PREFERRED BY THE MOTHERS FOR THEIR TODDLERS BEDDING:

Colours preferred by the mothers for their toddlers bedding is shown by interviewing with their mothers and so the results are mentioned below in Table VIII and Figure-8.

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TABLE VIII- COLOURS PREFERRED BY THE MOTHERS FOR THEIR TODDLERS BEDDING

COLOUR	No. of mothers	Percentage
Primary	9	18
Secondary	8	16
Monochromatic	10	20
Analogous	3	6
Warm	1	2
Cool	18	36
Others	1	2
TOTAL	**50**	**100**

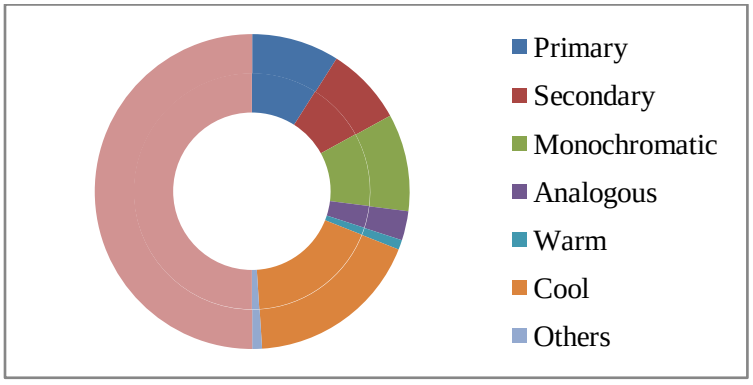

Figure-8: Colours Preferred by the Mothers for Their Toddlers Bedding

From the above Table-VIII and Figure-8, the least preference is on warm colours (red, yellow, orange), where it gives a variety of emotions ranging from comfort and warmth to hostility and anger. And the highest preference is on cool colours (blue, green, violet), where it gives a variety of emotions like health, royalty, power, nature, respect and wisdom. Secondly, the monochromatic colours which means the tints and shades of a single colour. This gives a pleasant and rhythmic sense to the viewer. Hence it is concluded that cool colours and monochromatic colours is preferred mostly by the mothers.

3.1.9 MATERIAL PREFERRED BY THE MOTHERS FOR THEIR TODDLERS BEDDING:

Materials preferred by the mothers for their toddlers bedding are collected by interviewing with their mothers and so the results are shown below in Table IX and Figure-9.

TABLE IX- MATERIAL PREFERRED BY THE MOTHERS FOR THEIR TODDLERS BEDDING

MATERIAL	No. of material	Percentage
Organic cotton	41	82
Cotton	8	16
Linen	-	-
Silk	1	2
Polyester	-	-
Poly- cotton	-	-

Others	-	-
TOTAL	**50**	**100**

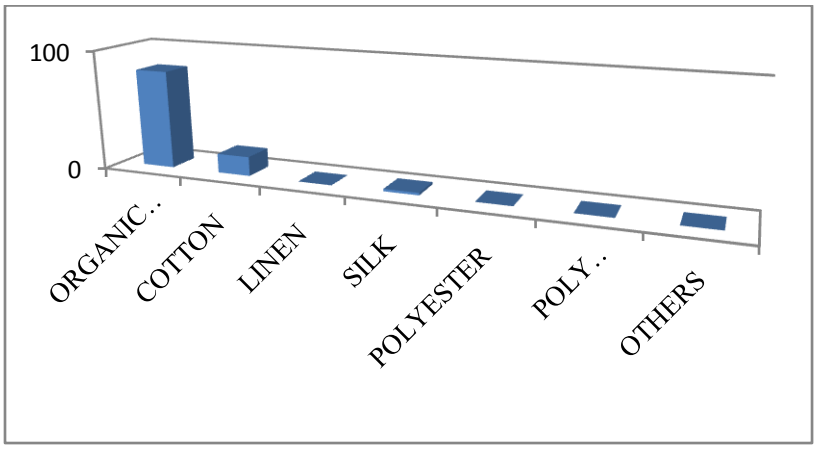

Figure-9: Material Preferred by the Mothers for Their Toddlers Bedding

From the above Table-IX and Figure-9, the Organic cotton is preferred by most of the mothers for their toddlers bedding than the other fabrics. It is selected due to the advantages of no chemical usage and so it doesn't affect the toddlers in way. Hence it is considered that the organic cotton is majorly preferred by the mothers for their toddlers.

3.1.10 Stuffing material preferred by the mothers for their Toddlers bedding:

Stuffing materials preferred by the mothers for their toddlers bedding are collected by interviewing with their mothers and so the results are mentioned below in Table X and Figure-10.

TABLE X- STUFFING MATERIAL PREFERRED BY THE MOTHERS FOR THEIR TODDLERS BEDDING

FIBER	**No. of fibres for stuffing**	**Percentage**
Acrylic	1	2
Coir	1	2
Organic cotton	41	82
Recron	-	-
Cotton	7	14
Feathers	-	-
Foam	-	-
Polyester	-	-
Fur	-	-
Others	-	-
TOTAL	**50**	**100**

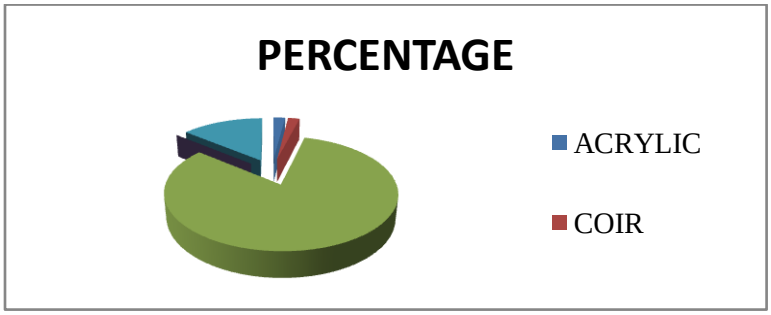

Figure-10: Stuffing Material Preferred by the Mothers for Their Toddlers Bedding

From the above Table X and Figure-10, the Organic cotton is preferred by most of the mothers as stuffing material for their toddlers bedding than the other fibres. It is selected due to the advantages of no chemical usage and so it doesn't affect the toddlers in way. Hence it is considered that the organic cotton is majorly preferred by the mothers as stuffing material for their toddlers.

3.1.11 PROBLEMS MENTIONED BY MOTHERS DUE TO SYNTHETIC DYES USED IN TODDLERS BEDDING:

These are some problems noted by the mothers due to the usage of synthetic dyes in toddlers bedding and the common problems are shown in the below table-XI and figure-11.

TABLE XI- PROBLEMS MENTIONED BY MOTHERS DUE TO SYNTHETIC DYES USED IN TODDLERS BEDDING

PROBLEM	No. of problems	Percentage
Rashes	21	42
Thickening of skin	17	34
Bleeding of colour	9	18
Others	3	6
TOTAL	**50**	**100**

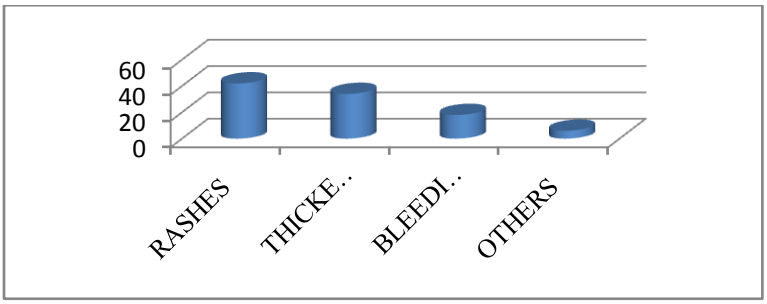

Figure-11: Problems Mentioned by Mothers Due to Synthetic Dyes Used in Toddlers Bedding

From the above Table-XI and Figure-11, it is clearly noted that rashes is the mostly obtaining problems which is mentioned by the mothers by using synthetic dyes in their toddler bedding. Therefore, they prefer natural dyes for their toddlers bedding. Hence it is concluded that most of the toddlers are suffered by rashes which is observed by their mothers.

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3.1.12 ADVANTAGES OF THE NATURAL DYES IN TODDLERS BEDDING:

The advantages of natural dyes are selected and given to mothers for their preference in toddlers bedding. The collected information is mentioned below in table-XII and figure-12.

TABLE XII- ADVANTAGES OF THE NATURAL DYES IN TODDLERS BEDDING

ADVANTAGES	No. of advantages	Percentage
Friendly to skin	24	48
Environmental friendly	20	40
Pale colours	3	6
Pollution free	3	6
Others	-	-
TOTAL	**50**	**100**

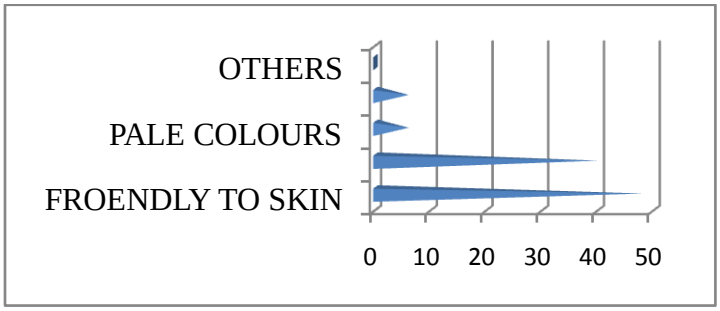

Figure-12: Advantages of the Natural Dyes in Toddlers Bedding

From the above Table XII and Figure-12, it is clearly noted that rashes is the mostly obtaining problems which is mentioned by the mothers by using synthetic dyes in their toddler bedding. Therefore, they prefer natural dyes for their toddlers bedding. Hence it is concluded that the usage of natural dyes is friendly to skin.

3.1.13 TIE AND DYE TECHNIQUE PREFERRED BY THE MOTHERS FOR THEIR TODDLERS BEDDING:

Tie and dye technique used by the mothers for their toddlers bedding preference in toddlers bedding. The collected information is shown below in table-XIII and figure-13.

TABLE XIII- TIE AND DYE TECHNIQUE PREFERRED BY THE MOTHERS FOR THEIR TODDLERS BEDDING

TIE & DYE	No. of tie & dye	Percentage
Spiral	19	38
Knots	21	42
Line	1	2
Diamond	1	2
Floral	1	2
Omber	7	14
Others	-	-
TOTAL	**50**	**100**

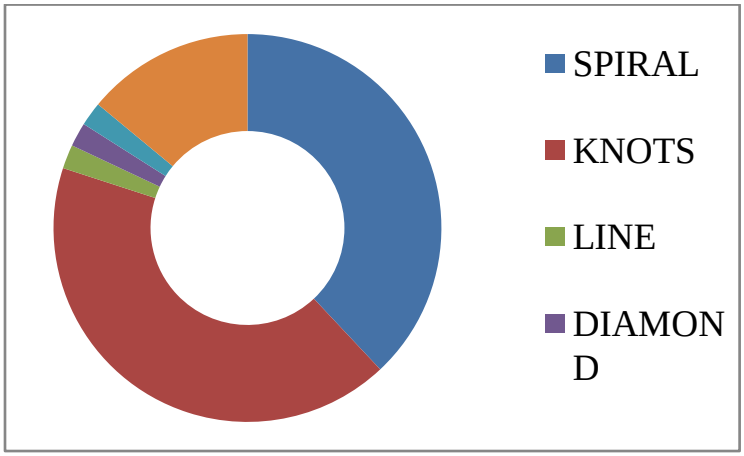

Figure-13: Tie and Dye Technique Preferred by the Mothers for Their Toddlers Bedding

From the above Table XIII and Figure-13, the spiral and knots technique are maximum preferred by the mothers for their toddlers bedding, which is evergreen and mostly suits for both the girl and boy. Hence it is concluded that the spiral and knot technique is preferred by most of the mothers for their toddlers bedding.

3.1.14 SPECIAL FINISHES PREFERRED BY THE MOTHERS FOR THEIR TODDLERS BEDDING:

The interview conducted to know whether special finishes are preferred by the mothers or not for their toddlers bedding. The preferences are shown below in table-XIV and figure-14.

TABLE XIV- SPECIAL FINISHES PREFERRED BY THE MOTHERS FOR THEIR TODDLERS BEDDING

Special Finish	No. of special finishes	Percentage
Yes	44	88
No	6	12
TOTAL	**50**	**100**

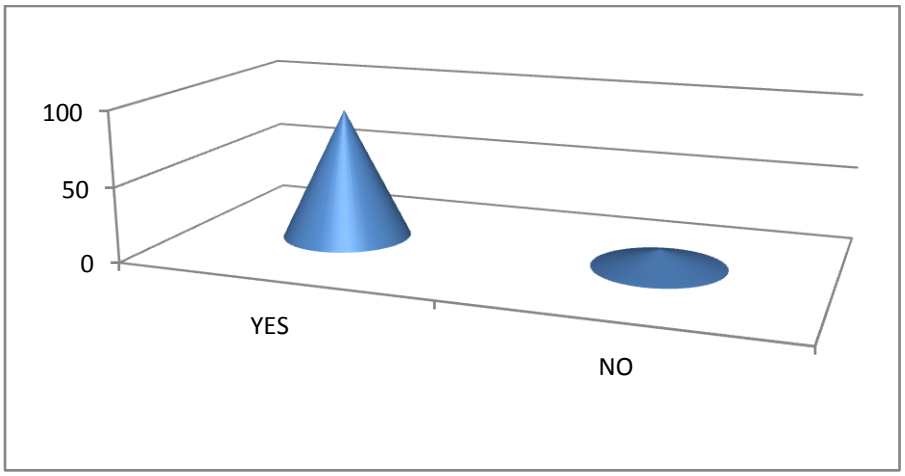

Figure-14: Special Finishes Preferred by the Mothers for Their Toddlers Bedding

From the above Table XIV and Figure-14, it is clearly noted that majority of the mothers prefer special finishes for their toddlers bedding. Therefore, they have aware on the health issues on their toddlers who are easily get affected due to less immune power. Hence it is concluded that majority of the mothers prefer Special Finishes for their toddlers bedding.

3.1.15 SPECIAL FINISHES PREFERRED BY THE MOTHERS FOR THEIR TODDLERS BEDDING:

Here are some special finishes which are preferred by the mothers for their toddlers bedding based on their needs. The preferences are collected by conducting interview with the mothers and are listed below in table-XV and figure-15.

TABLE XV- SPECIAL FINISHES PREFERRED BY THE MOTHERS FOR THEIR TODDLERS BEDDING

SPECIAL FINISHES	No. of special finishes	Percentage
Antimicrobial	43	86
Oil Repellent	-	-
Stain Guard	5	10
Blood Replant	-	-
Soil Release	2	4
Anti-grease	-	-
Wrinkle Free	4	8
Thermal Resistance	-	-
De- Odorant	9	18
Mosquito Repellent	13	26
Odour	22	44
Water Repellent	17	34
Flame Retardant	1	2
Others	-	-
TOTAL	**116**	**232**

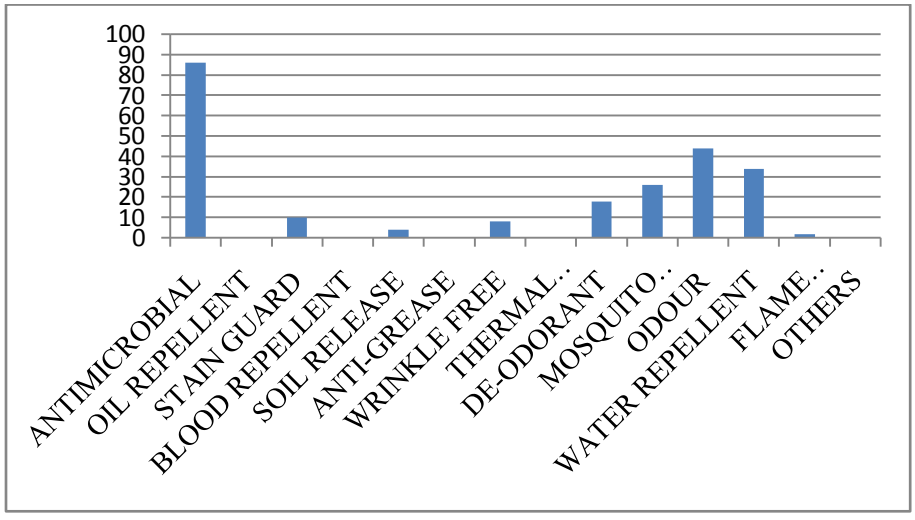

Figure-15: Special Finishes Preferred by the Mothers for Their Toddlers Bedding

From the above Table XV and Figure-15, the Antimicrobial finish is the most wanted and preferred by all, which can be used in any garments and fabric where it is needed to kill the microbes. Secondly, odour finish is nothing but adding an additional odour based our need. Other finishes are used only where it is required. Hence it is concluded that majority of the mothers prefer Antimicrobial finish and adding Odour to their toddlers bedding.

3.1.16 PRICE RANGE PREFERRED BY THE MOTHERS FOR THEIR TODDLERS BEDDING:

Pricing range preferred by the mothers for their toddlers bedding which include all the basic bedding products. The approximate amount value which is preferred by the mothers are shown below in table-XVI and figure-16.

TABLE XVI- PRICE RANGE PREFERRED BY THE MOTHERS FOR THEIR TODDLERS BEDDING

PRICE(Rs)	No. of mothers	Percentage
2500-4999	22	44
5000-7499	16	32
7500-9999	10	20
Above 10,000	2	4
TOTAL	**50**	**100**

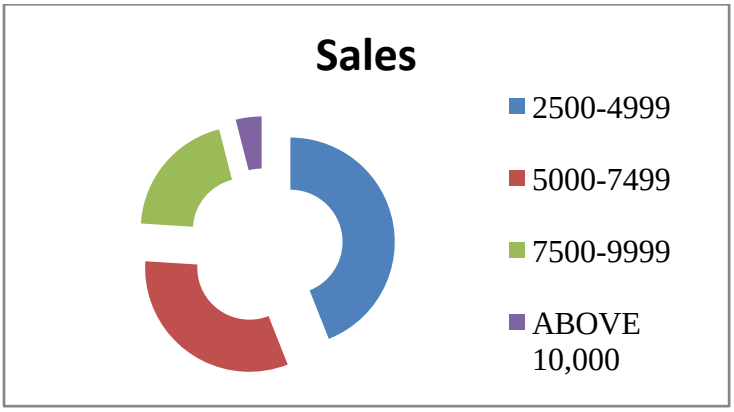

Figure-18: Price Range Preferred by the Mothers for Their Toddlers Bedding

From the above Table XVIII and Figure-18, it is highly noted that the amount range 2500-4999 is preferred by most of the mothers for their toddlers bedding. And above 10,000 is preferred by least number of mothers. This preference is done based their family financial status. Hence it is concluded that the price range 2500-4999 is preferred by the mothers for their toddlers bedding.

CONCLUSION:

Hereby it is concluded that mothers are the best person in taking care of their children and so to decide what is necessary for the children in day to day life. Toddler's stage is the important stage in which they come to learn many things such as colours, shapes, toys and get admired soon. In present days the mothers prefer theme based bedding for their toddlers according to their taste which encourages the toddlers mind and activities. And now a day, the mothers are more conscious about the toddler's health and hygiene because in this stage they easily come in contact with the microorganisms and get affected to it. In a nut shell the research will help industrialist to develop beddings suitable for toddlers.

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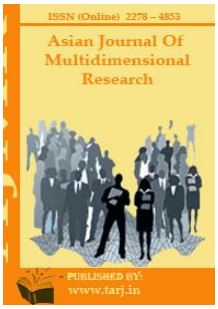

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IDENTIFICATION OF VARIETIES OF BANANA PSEUDO STEM FIBER IN TAMILNADU FOR TEXTILE APPLICATION

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ABSTRACT

In the present scenario, renewable sources of raw materials are what mankind is looking as an alternate. Recycling of the waste can be one of the methods to solve environmental issues.The use of waste bio-mass from the banana after harvesting is a good valuable source of textile fiber. Statistics from National Horticultural Board, data Base, have shown that India ranks No. 1, in the world in the production of Bananas. Tamilnadu produces nine million tons, out of 29.7 million tons of overall production in the year 2014 in India.The information from National Research Centre for Banana, Trichy, and the interaction with the senior scientists from the Research Centre was an encouragement for the study. Useful information on the current scenario of the banana cultivation was collected for the proceedings of the study.Surveys on the geographical area, cultivation, and utilization, of the banana plant were conducted. The weavers' preferences of variety of Banana Psuedo stem fiber were also investigated. Based on the survey, the varieties of Banana Psuedo stem fiber for textile purposes was identified.In the findings, the production of Red Banana, Nendran and Robusta in Tamilnadu was promising. The study also revealed, the preference, of the weavers for Red Banana, Nendran and Robusta Psuedo-stem fibers in comparison with other textile fibers. Thus the above varieties were identified for their potential. This resource can therefore be tapped by the textile industry to produce "Green Fabric".

KEYWORDS: *Nendran, robusta, red banana – varieties of banana Psuedo stem- fiber extracted from the banana plant.*

INTRODUCTION

Eco-textiles can be produced by keeping in mind the environmental and social compatibility in the production of textile process from fiber to fabric. Waste disposable Disposable waste must has to be given importance to deal with environmental issues. Creating awareness and exploring techniques to use the disposed material will solve many problems. Innovative thinking in handling the agricultural bio-mass waste to convert into value added products will be appreciated. Products created in such a manner will not only be eco-friendly, but also have an aesthetic performance characteristics and least possible environmental impact.

India is the largest producer of Banana in the world with an annual production of 16.81 million tons from an area of 4.90 lakh hectares. The average productivity of the country is 34.30 tons per hectare. Among the different states, Tamilnadu ranks first in area and production with 92000 hectares and 4.856 million tons respectively. The productivity is highest in Maharashtra with an average of 60 tons per hectare.

Banana fiber needle punched non-woven can used as thermal insulation medium effectively. Thick and porous banana fiber needle punched non-woven contains evenly disbursed void which are responsible for thermal insulation. Needle punched non-woven technology is the most suitable for banana fibers. Composite fabrics to be used in geo textiles, automobile textiles, can be produced with the recyclable and bio-degradable banana fiber.(N.Shanmugam, P.G.Patel, Indian Journal for Applied Research, April,2015.)

Properties of banana fiber are superior among the natural fibers. Combination of two different materials along with low manufacturing cost, makes them useful in various fields of engineering and sports goods. The future of banana seems to be bright with the low- cost and environmentally superior to other synthetic fibers. (Ravi Batnagar, GauravGuptha et.al. Indian Journal of Scientific Research, May 2015).

Considering the statistics and the literature of Banana plant cultivation, the study was taken up. It aims at identifying the geographical areas, and varieties of Banana plant that can be used for extraction for textile fiber. Survey research was taken up and many facts have been identified. Weavers preferences in the usage of natural fibers were also studied. The study reveals about three potential varieties of Banana plant that can be used for textile fiber extraction. The varieties identified were Red Banana, Nendran and Robusta. These varieties were located in plenty at various districts of Tamilnadu.

OBJECTIVES

- Identify the potential varieties of Banana Pseudo stem plant in Tamilnadu to be used for the construction of a mixture fabric with cotton.
- To collect preliminary technical information about the banana fibers, to create value-added products for textiles.
- To find out the preferences of the weavers among the natural fibers.

REVIEW OF LITERATURE

VARIETIES OF BANANA

More than 20 varieties are commercially grown in different parts of India. However, Indian banana trade mainly depends on “Cavendish Clones “of banana, which are called by different names in different areas. The important Cavendish clones are: are: Basrai (Dwarf Cavendish), Robusta,

Harichal, Grand Naine, Shrimanthi, Bhusaval and PeddaPachiAranti. There are other locations specific varieties are grown in large quantity in different regions of throughout the country. The important varieties are: are: Rasthali (Silk), Poovan (Mysore), Karpuravalli (PisangAwak), Nendran (French Plantain), Hill Banana and Monthan (cooking). (C.K. Narayana., M.M. Musthafa., Tech.Bulletin 15. NRCB.Trichy).

Red Banana: Red Bananas, also known as Red Dacca bananas in Australia. Red Banana is a famous variety with a reddish-purple skin. They and are bigger, when compared to with other varieties and similar to Nendran or Plantain types. Due to its color, it is often called by different names like Chenkadali, RakthaKadali, Kappa Vazhai., etc. Uupon ripening, the fruit attains sweet taste with an orange-yellow color and a

Pleasant aroma. They are best eaten in it's their soft and unbruised state. It contains more beta carotene and Vit.C vitamin C than the usual yellow bananas. Red bananas get ripe in a few days at room temperature, best suited for storage outside refrigeration. (http://healthyliving.natureloc.com/common-banana-types-available-kerala).

Nendran: This belongs to Plantain AAB. This variety is also known as French plantain and Rajeli. It is a popular variety of Kerala where it is used as fresh fruit as well as for making chips. Nendranplant is a slender, medium statured plant reaching a height of 2.5 meters. The bunches have 4-6 hands each with 8-10 fruits weighing 10-14 kgs. The Ffruits have a distinct neck with thick green skin turning, buff yellow on ripening. Skin turns yellow upon full ripening. It is starchy, pink fleshed and highly suitable for making chips and powder. (NRCB.,Trichy)

Robusta: This belongs to AAA Cavendish sub-group and is also known as Bombay green, Harichal and PeddaPachiAranti. It is mostly grown in Karnataka, Andhra Pradesh, Maharashtra and Tamilnadu. The plant is medium-tall with a strong pseudo stem. It has uneven black blotches all along its length. The bunch weighs about 25-30 kgs with 10 hands, and each hand has about 16 – 20 fruits. The fruits are dark- green color and turn to bright yellow if ripened between 22-25 deg.C. The fruit is very sweet with a good aroma.(NRCB. Trichy).

It is a semi-tall variety, grown mostly in Tamil Nadu and some parts of Karnataka for table purpose. It is a high yielding and produces a bunch of large size with well developed fruits. Dark green fruits turn bright yellow upon ripening depending on ripening conditions. Fruit is very sweet with a good aroma. Bunch weighs about 25-30 kg. and it requires propping. Fruit has a poor keeping quality leading to a quick breakdown of pulp after ripening, hence not suited for long distance transportation. Robusta is highly susceptible to Sigatoka leaf spot disease in humid tropics. (National Horticultural Board.) nhb.gov.in/pdf/fruits/banana/ban013.pdf

RESEARCH METHODOLOGY

TABLE 1 - PROFILE OF THE BANANA CULTIVATION IN TAMILNADU

Districts	Type of cultivation			Area of cultivation in hectares	Yield in metric tonnes
Thoothukudi	S	M	L	9586	6,21,672
Trichy	S	M	L	8767	4,83,495
Theni	S	M	L	5817	4,53,756
Coimbatore	S	M	-	8634	3,39,894
Thirunelveli	S	M	-	7645	2,99,123
Kanyakumari	S	-	-	5982	1,63,039

S: 1 to 2 acres M: 2 to 3 acres L: 3 acres and above.

TYPES OF CULTIVATION:

In Thoothukudi, Trichy and Theni small, medium, large type of banana cultivation is done. In Coimbatore and Thirunelveli small and medium-scale cultivation is being done. In Kanyakumari, Calicut, Thrissur and Palakkad only small scale cultivation of banana is being done.

AREA OF CULTIVATION:

The maximum banana cultivation is done in Thoothukudi, Trichy and Theni districts. then comes Coimbatore, Thirunelveli and Kanyakumari followed by Calicut, Thrissur and Palakkad districts.

YIELD OF BANANA:

Theni shows the maximum yield eventhough the area of cultivation is less .The above table shows the quantity potential of Banana plantation in Tamilnadu and Kerala. The maximum yield is shown in Thoothukudi and Trichy Districts. In Theni district, the average is less, but productivity is very high. Coimbatore shows a good quantity of production followed by Tirunelveli and Kanyakumari districts. In Kerala, Palakkad district, the yield is very good compared with the acreage.

Data from the Survey among Farmers – Primary Data

TABLE 2 – CULTIVATION OF VARIETIES OF BANANA IN VARIOUS DISTRICTS IN TAMILNADU

Districts	Red banana			Nendran			Robusta			Others
	Small	Medium	Large	Small	Medium	Large	Small	Medium	Large	
Theni	5%	-	-	5%	10%	15%	5%	35%	5%	20%
Trichy	5%	5%	5%	3%	10%	2%	10%	20%	30%	10%
Thoothukudi	5%	10%	10%	5%	20%	10%	5%	10%	5%	20%
Thirunelveli	2%	5%	3%	10%	10%	10%	10%	10%	20%	10%
Coimbatore	5%	5%	5%	10%	20%	10%	5%	30%	5%	5%
Kanyakumari	10%	10%	30%	5%	15%	5%	5%	5%	-	15%

Small Scale: 1 to 2 acres Medium Scale: 2 to 3 acres Large Scale: 3 acres and above

RED BANANA: In Kanyakumari district, a maximum of 50% cultivation is done and followed by Thoothukudi where it is 25%. In the other districts, an average of 15% is being cultivated.

NENDRAN: In Coimbatore district, a maximum of 40% cultivation is done and followed by Thoothukudi where it is 35%. In other districts, an average of 25% is being produced.

ROBUSTA: It seems to be very popular in all the districts of Tamilnadu. Highest production of around 60% is recorded in Trichy district followed by all other districts of around 40%.

THENI DISTRICT: among Banana cultivatiors 50% are cultivating Robusta, 30% of them cultivate Nendran, and 5% them cultivate Robusta and the rest20% constitute other varieties.

TRICHY DISTRICT: 60% are cultivating Robusta, 15% Red Banana, and 15% Nendranandother varieties about 10%.

THOOTHUKUDI DISTRICT: Nendran accounts for 35%, Red Banana 25%, Robusta 20%, Andothers varieties are about 20%.

THIRUNELVELI DISTRICT: 40% are Robusta, 30% constitute Nendran, and around 10% are Red Banana. Others constitute 10%.

COIMBATORE DISTRICT: 40% are cultivating Nendran, another 40% are Robusta, 15% accounts for Red Banana and others are 5%.

KANYAKUMARI DISTRICT: 50% are cultivating Red Banana (highest percentage in the state), 20% accounts for Nendran, 15% for Robusta and other varieties constitute 15%.

There are around twenty varieties of Banana cultivated in Tamilnadu. Among them, the more versatile varieties are Red Banana, Nendran, and Robusta are widely cultivated. The productions of these varieties are being ranked high in most of the districts. The utilization of the various parts of the plant is been given below.

TABLE 3 - PROFILE OF VARIOUS VARIETIES OF BANANA PLANTATION

Variety	Period of the crop (in months)	Approx weight of each plant in (kgs)	Plant/acre	Height of plant (in feet)	Fertilizers Used	
					Organic	Inorganic
Red Banana	10- 12	80 – 120	850 – 910	8 – 10	20%	80%
Nendran	8 – 10	60 – 100	1000 – 1250	8 - 10	20%	80%
Robusta	6 – 8	40-80	1000 – 1250	6 - 8	20%	80%
Rasthali	8 – 9	50 – 70	800 – 900	6 – 8	20%	80%
Monthan	8 – 9	50 – 70	800 – 900	6 – 8	20%	80%
Poovan	8 – 9	50 – 70	800 – 900	6 – 8	20%	80%

The above table shows that the period of the crop for the Red Banana was a maximum of 12 months and other varieties Nendran and Robusta is on an average 9 months. The maximum weight of the Red Banana plant with fruit is 120 kgs and the maximum weight shown for Nendran and Robusta variety are on an average was 70 kgs. The number of plants for Nendran and Robusta variety were 1250 plants/ acre. Whereas, the Red Banana and other varieties like Monthan, Poovan and Rasthali was only 900 plants/acre. The height of the plant is maximum for Red Banana and Nendran, while the minimum is recorded for Robusta. 80% of the cultivators have used inorganic fertilizers, and only 20% have used organic fertilizers.

TABLE 4 – PROFILE OF UTILIZATION OF THE BANANA PLANT

Criteria	Local market	Export market	Own consumption	Others Wastage
Fruit	80%	10%	5%	5%
Leaves	90%	-	5%	5%
Inner stem	90%	-	2%	8%
Outer pseudo stem	-	-	10%	90%

FRUIT: Every part of the banana plant is useful to mankind. In the above table, 80% of the fruits is being utilized by the local market. This shows that marketing of the fruit separately is not a problem, because it is being consumed by the local market. 5% are lost as wastage during transportation and storage. Researchers are exploring into the practice of better storage to bring down the wastage to 0%.

LEAVES AND INNER STEM: The table indicates that the leaves, the inner stem and the fruit are all sent to the local market.

PSUEDOSTEM: From Table-4 it can be seen that, 90% of the pseudo stem goes as waste and only 10% is utilized for making products like ropes, etc. This factor of wastage can be re-cycled to create value added products in the textile industry.

Figure – 1

DATA OF THE SURVEY AMONG WEAVERS- PRIMARY DATA

After identifying the – Three Varieties- Red Banana- Nendran- Robusta. The feasibility of creating the fabric with the three varieties along with cotton was studied through the survey. The following tables show the data for the selection of the mixture fabric.

TABLE 5 – PROFILE OF THE HANDLOOM WEAVERS- ANAKAPUTHUR (CHENNAI DISTRICT) AND PERUNDURAI (ERODE DISTRICT)

Experience in years	No. of weavers-25	Loom type	Fiber preference for weaving				
			C	B	P	BA	Others
30 years	4	Pit loom	80%	2.5%	2.5%	10%	5%
20 years	5	Pit loom	70%	10%	5%	10%	5%
15 years	4	Pit loom	75%	5%	5%	10%	5%
10years	5	Pit loom	80%	2.5%	2.5%	10%	5%
5 years	1	Pit loom	75%	5%	5%	10%	5%
3 years	3	Pit loom	80%	5%	5%	5%	5%
2 years	3	Pit loom	80%	5%	5%	5%	5%

C: Cotton B: Bamboo P: Pineapple BA: Banana O: others

TABLE 6 – RATING OF THE BANANA FIBER BY THE WEAVERS

No. of weavers	Banana variety	Fair	Good	Very good	Excellent
25	Red Banana	-	2	2	21
25	Nendran	-	2	2	21
25	Robusta	-	3	3	19
25	Poovan	-	20	5	-
25	Monthan	-	20	5	-

RESULTS AND DISCUSSION

On the basis of the pilot study, the geographical area and the varieties of banana psuedostemfiber was identified. Based on the data collected from the statistics of bulletin, survey among weavers the following data has been analyzed and the findings were used in the selection of the study sample.

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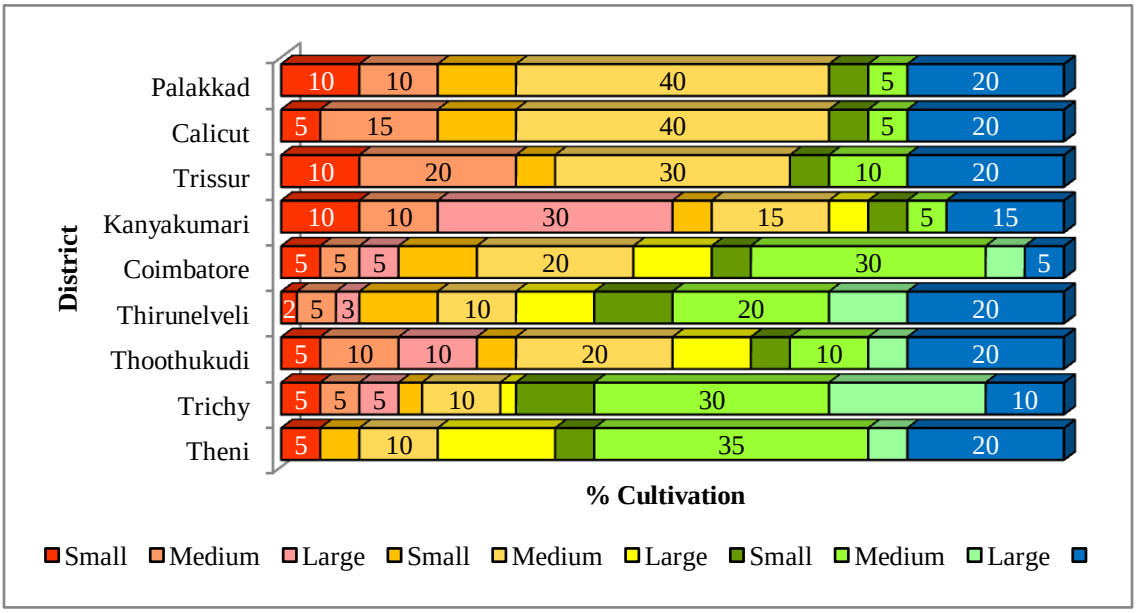
TABLE 7 – CULTIVATION OF VARIETIES OF BANANA IN VARIOUS DISTRICTS IN TAMILNADU

Districts	Red banana (%)			Nendran (%)			Robusta (%)			Others (%)
	Small	Medium	Large	Small	Medium	Large	Small	Medium	Large	
Theni	5			5	10	15	5	35	5	20
Trichy	5	5	5	3	10	2	10	30	20	10
Thoothukudi	5	10	10	5	20	10	5	10	5	20
Thirunelveli	2	5	3	10	10	10	10	20	10	20
Coimbatore	5	5	5	10	20	10	5	30	5	5
Kanyakumari	10	10	30	5	15	5	5	5	-	15
Trissur	10	20		5	30		5	10	-	20
Calicut	5	15		10	40		5	5	-	20
Palakkad	10	10		10	40		5	5	-	20

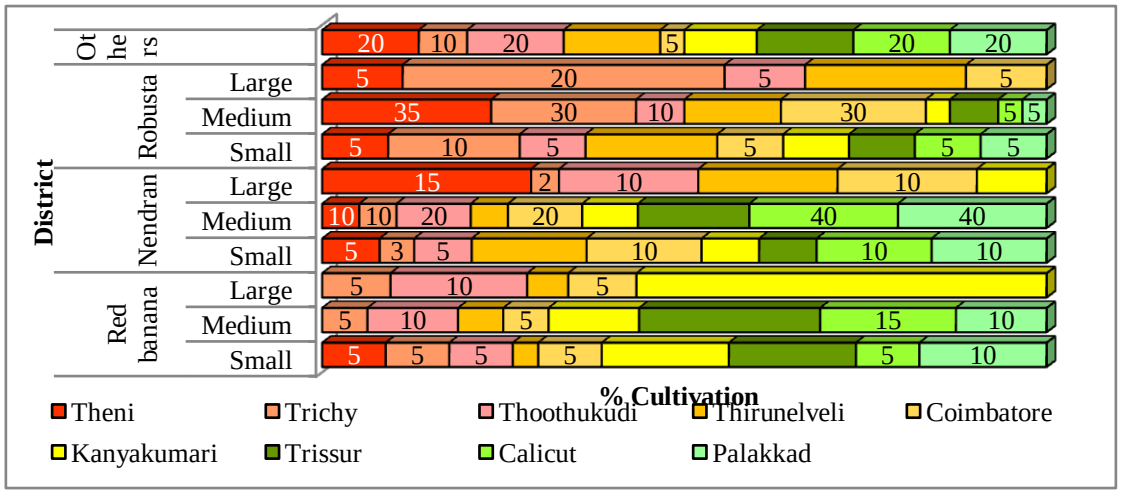
SOURCES – from the survey conducted

Cultivation of varieties of banana in various districts in Tamilnadu and Kerala – Figure 2



The above figure shows the potential area of banana cultivation productivity. Large scale of 20% production is done in Kanyakumari, Thoothukudi, Tirunelveli, and Theni Districts of Tamilnadu, and Palakkad, Calicut, and Thrissur in Kerala. Medium Scale of production of 30% to 35% is done at Coimbatore, Trichy, Theni and Tirunelveli District of Tamilnadu. The Small Scale cultivation of 20% to 40% were prevalent at Palakkad , Calicut, Thrissur, Coimbatore and Thoothukudi. This shows that the maximum production of Banana is done in Small Scale followed by Medium Scale and Large Scale.

Varieties of banana in various districts - Figure3

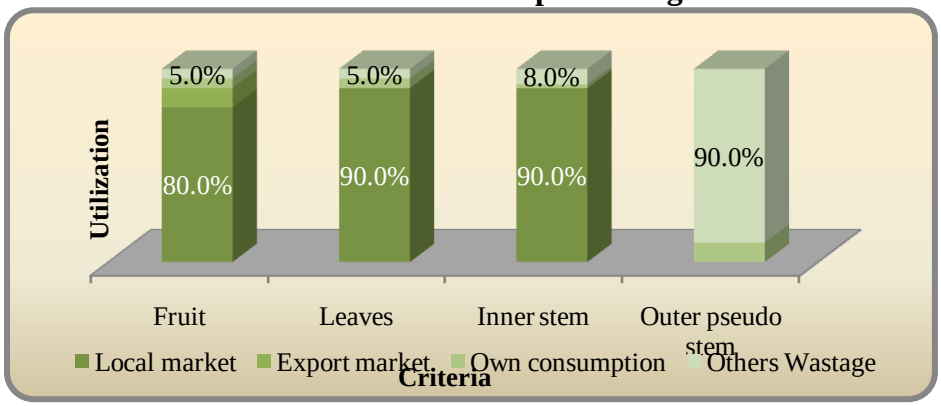


VARIETIES OF BANANA FIBER: The above figure shows among the various districts in Tamilnadu, in which the survey was conducted, Kanyakumari produced the maximum quantity of Red Banana followed by Kerala. Nendran varieties were produced in large quantities at Palakkad and Trishur districts of Kerala. The maximum production of Robusta is from Tirunelveli ,Trichy and Thoothukudi districts.

POST HARVEST UTILITY:

In the survey conducted among the farmers, the data on the utilization of the banana plant for their revenue was collected. The following data reflects the various places, to which the farmers sold their products.

Utilization of the Banana plant – Figure 4



In the pilot study, the survey from the farmers showed the above pattern in the figure- the utilization of the banana plant. Among the various parts of the plant, the fruits, leaves, and the inner stem, were sold to the local market. This shows that 80% to 90% of the products were sent to the local market. It was interesting to note that the pseudo stem was not sold but discarded as waste. . Though it is the potential part that can be used to create value added products, it has been discarded. Therefore an attempt to utilize the pseudo stem to produce fibers for textiles was made. The above figure shows the potential of the pseudo stem fiber that can be used for extraction of fibers to be utilized for textile purposes.

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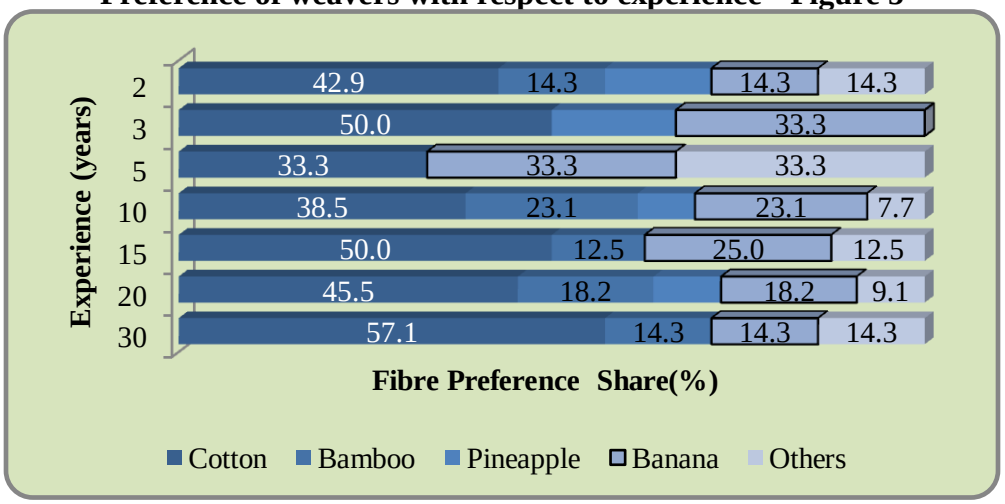
PREFERENCE OF WEAVERS:

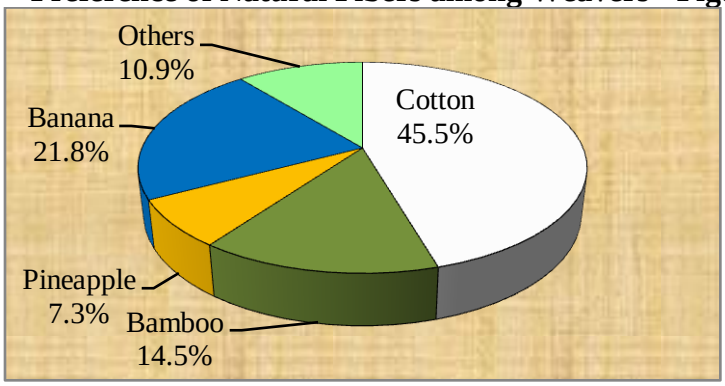
The fabric formation was done by handloom. The information from the weavers who handled these fibers was considered, in the selection of the study material. The following data shows the preference of the natural fibers by the special weavers, with respect to their experience.

Preference of weavers with respect to experience- Figure 5



Majority of the weavers with an experience of 30 years, have showed their preference for cotton fiber, followed by banana fibers. Weavers with less experience between 2 and 5 years and also between 10 and 15 years, showed their preferences for cotton, followed by banana fibers. Therefore the banana fiber was considered for the study.

Preference of Natural Fibers among Weavers- Figure 6



The above figure shows that most of the weavers have preferred cotton fiber for weaving. However, the next most preferred fiber is the banana pseudo stem fiber, followed by Bamboo, Pineapple and others respectively.This shows that most of the weavers have been weaving cotton fibers for many years.

Among the varieties of banana fiber, preference for the varieties of natural fibers were found out. The figure 6 below shows the rating of the natural fibers by the weavers.

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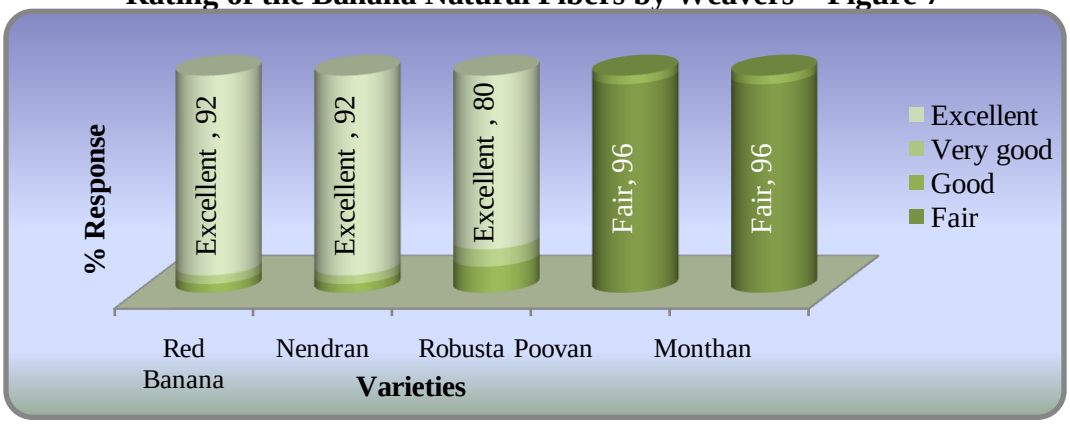
Rating of the Banana Natural Fibers by Weavers – Figure 7



In the survey conducted among the weavers at Anakaputhur and Perundurai, showed the above rating of the banana fibers woven by them. The Red Banana, Nendran, and Robusta have been rated as excellent with 92% and Monthan and Poovan, were rated as fair with 96%, and followed by the other varieties. This factor was the guidance for the selection of the varieties of Banana/Cotton blend for the study.

SUMMARY AND CONCLUSION

The findings and outcome are stated below:

- The information collected from the existing data showed that Tamilnadu and Kerala have the potential places for the banana fiber production. Researchers, business enterprises, and agriculturists need to tap the potential of the Banana plant and contribute to the economy of the country by increasing the individual revenue.

- The utilization of various parts of Banana plant by the farmers is a source of revenue. An additional revenue can be created, if the pseudo stem and the "Peduncle" is utilized to extract fibers., which in turn will solve environmental and economical issues.
- Among the varieties of the Banana fiber productions in India, it can be concluded that Red Banana, Nendran, and Robusta, are produced in large scale in Tamil Nadu have favourable qualities. The Resource can therefore be tapped by the textile industry to produce "Green Fabric".

Recommendations for further Study

- Explore potential of creating value added products from banana pseudo stem waste.
- To create non-woven's by needle punching to be used in filtrations and geo textiles etc. using banana fiber.
- Explore the possible ways to reduce the economical viability in the extraction of the banana fiber.
- To produce, Modal/Banana Mixture fabrics.
- Application of resins on banana fiber fabrics.
- To create banana fabrics, with herbal and functional finishes improving their applications.
- Create coarse fabrics for technical applications, using double warp banana fiber with other synthetic or natural fibers.

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PRELIMINARY PHYTOCHEMICAL SCREENING OF LEAF AND FLOWER EXTRACTS OF THE SPATHODEA CAMPANULATA

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ABSTRACT

Phytochemicals are naturally occurring biochemicals that provide plants their colour, flavour, smell, and texture. Phytochemicals are fetching more importance due to their various reported biological performances. They are found in an ample group of plants. The indigenous groups have used therapeutic plants for their personal phytomedical remedies and also for spiritual reasons. The herbal medicines are a readily available resource for primary health care. S. campanulata is knownas the African tulip tree which possess ornamental worth to it. It is introduced pan-tropically. It is evident from the study that Spathodea campanulata leaf and flower extracts recorded good therapeutic efficacy, possessing majority of phytochemical classes of compounds presence of majority of phytoconstituents.

KEYWORDS: *Phytochemical, Screening, Flower extracts, Leaf extracts*

INTRODUCTION

Phytochemicals may protect human from a host of diseases. Phytochemicals are non-nutritive plant chemicals that have protective or disease preventive properties (Ahmed and Urooj, 2010). Phytochemicals (from the Greek word phyto, meaning plant) are biologically active, naturally occurring chemical compounds found in plants, which provide health benefits for humans further than those attributed to macronutrients and micronutrients (Mamta et al,. 2013).

REVIEW OF LITERATURE

The phytochemicals can be categorized to two main divisions (Krishnaiah et al., 2009) which are primary constituents that has proteins, common sugars, amino acids and chlorophyll etc., and secondary constituents consisting of alkaloids, essential oils, flavonoids, tannins, terpenoids, saponins, phenolic compounds etc. (Krishnaiah et al., 2007; Edeoga et al., 2005).

Taxonomical Classification of *Spathodea campanulata*

Kingdom: Plantae

Order: Lamiales

Family: Bignoniaceae

Genus: *Spathodea*

Species: *S. campanulata*

Common name: Fountain Tree, African Tulip Tree, Syringe Tree, Flame of the Forest or Nandi Flame

This plant has many uses in folk medicine such as the leaves being employed against kidney diseases urethra inflammations and as antidote against animal poisons (Akharaiyi, 2012).

The research conducted on flowers of the S. campanulata plant in terms of phyto-chemical investigations, revealed that the plant flowers for its anti-solar potential and pharmacological/medicinal use (Vinayak et al., 2009). Alternative system of medicine like ayurveda, siddha and Unani are comprehensively practiced in the prevention, diagnosis and treatment of various life threatening or incurable diseases and disorders (Dorai, 2012).

OBJECTIVES

To select suitable plant source with antimicrobial potential

To select suitable medium for extraction

To carry out phytochemical screening in the selected sources

To evaluate the best medium with high potential of antimicrobial activity

METHODOLOGY

1. PLANT MATERIAL

The fresh leaves and flowers of *S. campanulata* were collected from Coimbatore situated in the state of Tamil Nadu, India. The freshly collected leaves and flowers were dried under shade, cut in small pieces and made into coarse powder using mechanical grinder and preserved in air tight container until further use.

PREPARATION OF PLANT EXTRACT

Fresh leaves and flowers of *S. campanulata* was washed thoroughly, shade dried and powdered. The plant powder was then kept in contact with petroleum ether, methanol and distilled water separately in a stoppered container for a defined period with continuous agitation. The extract is then filtered, condensed and stored for further use of phytochemical studies.

2. PHYTOCHEMICAL SCREENING OF *S. CAMPANULATA* LEAF AND FLOWER EXTRACT

Preliminary screening of phytochemicals is a valuable step in the detection of bioactive principles present in medicinal plants and may lead to novel environmentally friendly bioherbicides and drug discovery (Ndam et al., 2014).

2.1. TEST FOR ALKALOIDS

Dragendroff's test - *S. campanulata* leaf and flower extract were take care of separately along with Dragendroff's reagent a red precipitate was formed which indicates the alkaloids presence.

Mayer's test - *S. campanulata* leaf and flower extract take care of separately along with 2ml of Mayer's reagent seperately and yellow coloured precipitate was the resultant which indicates alkaloids presence.

2.2. TEST FOR PHENOLS

The *S. campanulata* leaf and flower extract were individually added to 2ml of 2% ferric chloride solution which resulted in a blue green or purple change in colour. It indicates the phenols presence.

2.3. TEST FOR FLAVONOIDS

Alkaline reagent test - With 2ml of 2% NaOH solution *S. campanulata* leaf and flower extract was mixed separatelyand the result showed an intense yellow colour that changes colourless when adding few drops on dilute acid. This shows the flavonoids presence.

2.4. TEST FOR SAPONINS

Foam test – Both the *S. campanulata* leaf and flower extract was added to 5ml of distilled water seperately. Then the conical flasks containing the extracts were shaken vigorously. When there is stable foam formed it shows the saponins presence.

Froth test - With 20ml of distilled water Both the *S. campanulata* leaf and flower extract were added in a conical flask separately and shaken for 15 minutes. When there is one centi meter layer of foam formed it shows the saponins presence.

2.5. TEST FOR STEROIDS

2ml of chloroform and concentrated sulphuric acid is added to the leaf and flower extracts and a red colour is formation in the chloroform layer indicates steroids presence.

2.6. TEST FOR TERPENOIDS

2ml of chloroform was added to extracts and 3 ml of concentrated sulphuric acid was added to each tube. When a reddish brown colour is formed it indicates terpenoids presence.

2.7. TEST FOR TANNINS

Gelatin test - *S. campanulata* leaf and flower extract along with 1% gelatine containing sodium chloride was added individually. White precipitate formation indicates tannins presence.

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TABLE 1. PRELIMINARY PHYTOCHEMICAL SCREENING OF FLOWERS OF S. CAMPANULATA

Solvents / Phytochemicals	***S. campanulata* Flower extract**		
	Petroleum ether	Methanol	Aqueous
Alkaloids	+	+	-
Tannins	+	+	+
Saponins	-	+	-
Steroids	-	+	+
Terpenoids	-	+	+
Flavonoids	+	+	+
Phenolics	+	-	+
Anthroquinones	-	+	-

+=Presence , - = Absence

Fig. 1 Presence of Phytochemical constituents in *S. campanulata* flower extracts

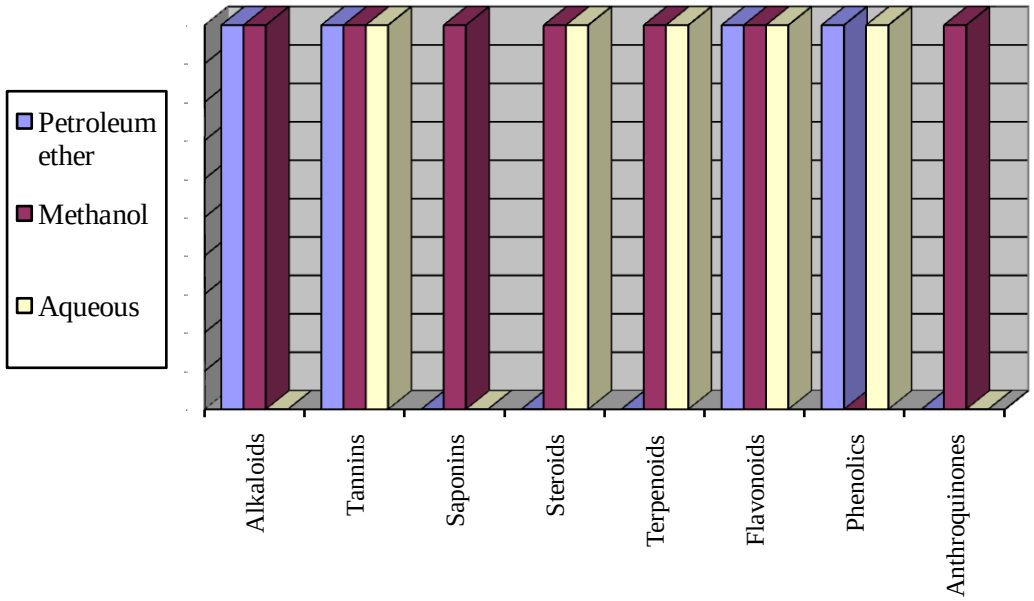
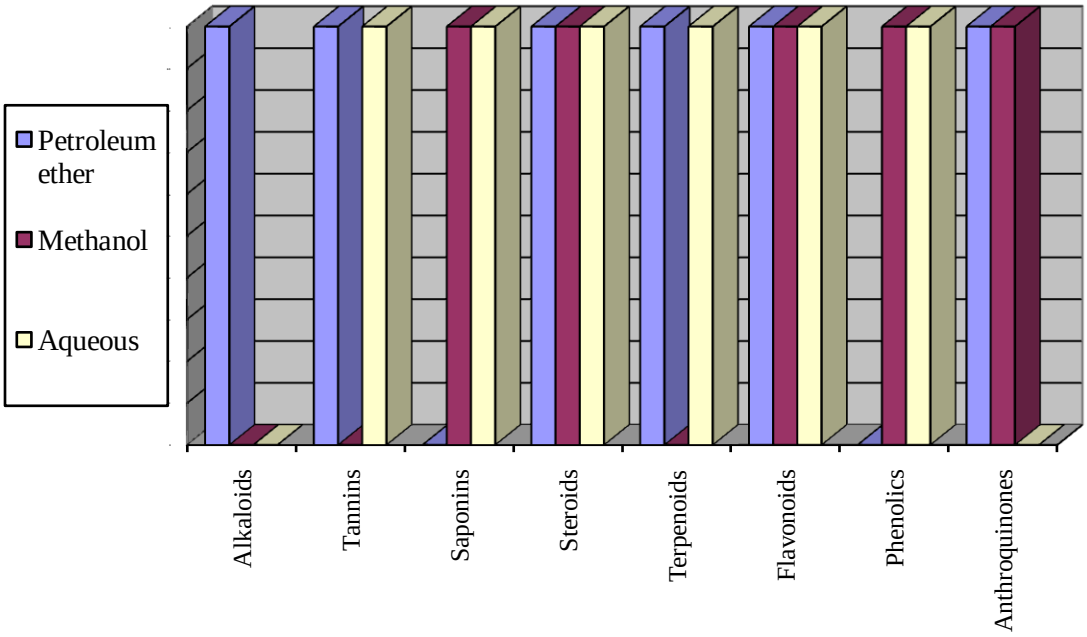


TABLE 2. PRELIMINARY PHYTOCHEMICAL SCREENING OF LEAVES OF S. CAMPANULATA

Solvents / Phytochemicals	*S. campanulata* Leaf extract		
	Petroleum ether	Methanol	Aqueous
Alkaloids	+	-	-
Tannins	+	-	+
Saponins	-	+	+
Steroids	+	+	+
Terpenoids	+		+
Flavonoids	+	+	+
Phenolics	-	+	+
Anthroquinones	+	+	-

+=Presence , - = Absence

Fig. 2 Presence of Phytochemical constituents in *S. campanulata* leaf extracts



RESULTS & DISCUSSION

From the Table 1 , Table 2, Fig 1 and Fig 2, the results of the phytochemical screening revealed that Alkaloids, Tannins, Steroids, Terpenoids, Flavonoids and Anthroquinones presence in the Petroleum ether extracts of *Spathodea campanulata* leaf extract and Alkaloids, Tannins, Flavonoids and Phenolics presence in the Petroleum ether extracts of *Spathodea campanulata* flower extract .

The methanolic extracts of *Spathodea campanulata* leaf extract displayed the presence of Saponins, Steroids, Flavonoids, Phenolics and Anthroquinones and *Spathodea campanulata* flower extract

displayed the presence of Alkaloids, Tannins, Saponins, Steroids, Terpenoids, Flavonoids and Anthroquinones.

Tannins, Saponins, Steroids, Terpenoids, Flavonoids and Phenolics were present in the Aqueous extracts of *Spathodea campanulata* leaf extract and Tannins, Steroids, Terpenoids, Flavonoids and Phenolics were present in the Aqueous extracts of *Spathodea campanulata* flower extract.

CONCLUSION

Components used in the ethnomedical remedies offer smart templates for the development of new-fangled pharmaceutical products. At the present time, there is a massive natural product pool containing substances of well acknowledged bioactivities and scientists have the opening to investigate structure-activity relationships and mechanisms of action. Preliminary Phytochemical screening revealed that the presence of Alkaloids, Tannins, Saponins, Steroids, Terpenoids, Flavonoids, Phenolics and Anthroquinones by positive reaction with the respective test reagent. Further studies can explore the potential of *Spathodea campanulata* in remarkable scope of medicinal utilization.

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REGENERATIVE CUSHIONS AND FOOTPADS FOR INDUSTRIAL TAILORS

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ABSTRACT

Textile industry is one of the largest industries which provide more employment opportunities. There are around 70,000 units in the country providing employment to more than three million people. Occupational diseases have been recognized as a growing problem in the developing countries. The workers in these units face health problem arising out of abysmal working conditions. Work environment must be provided with adequate comfort to enable them to function at optimum levels without exposure to unnecessary risk. Increasing industrial concerns for workers comfort are driving the researches in developing various measures for better performing on a continuous basis. Textile materials and products should be engineered to meet particular needs of the workers in the industry. Designing and manufacturing of suitable textile products made of fibers or fabric for industrial environments has been another line of focus that has a tremendous market in recent years. Hence the study was carried out on the topic "Regenerative Cushions and Foot Pads for Industrial Tailors". The natural fibreLoofah and marine seaweeds were selected for the study which naturally has the massaging effect and medicinal properties. The selected fibers were processed and utilized as stuffing material. Cushion and foot pads were custom designed based on preliminary survey. Cotton fabric was used as outer covering. The cushions and footpads were constructed and fixed to the stools and pedal respectively. The tailors were asked to use the same and it was found that the tailors were very happy and felt comfortable while sewing.

KEYWORDS: *Cushions and Footpads, Industrial Tailors, Loofah, Seaweed*

INTRODUCTION

The textile industry in India has also a strong multi fibre raw material production base, a vast pool of skilled personnel have been involved in the production. It covers all types of industries producing wearing apparels, bedding materials, screens, and so on. Within its fold may be included handloom, khadi, power loom factory units or mills. Around 35 million people are directly employed in the textile manufacturing activities. Occupational diseases have been recognized as a growing problem in the developing countries. The workers in these units face a health problem arising out of abysmal working conditions. Work in the garment unit, requires prolonged hours of standing or sitting in a forward bending posture of the workers. The work in these units is highly repetitive in nature, requiring a combining of both static and rhythmic muscular activity. When such tasks are repeated several times in a day without sufficient rest break, these lead to several disorders of neck and shoulders among the garment workers [1].

Work environment must be provided with adequate comfort to enable them to function at optimum levels without exposure to unnecessary risk. Increasing industrial concerns for workers comfort are driving the researches in developing various measures for better performing on a continuous basis.Designing and manufacturing of comfort textiles for industrial environment has been another line of textile products that has a tremendous market in recent years. The advent of technological advancement in industrial set-ups has altered the working conditions and requirements on the part of employees and employers [2].

Natural Fibre have shown significant contribution in variety of applications which was previously dominated by synthetic fibres. Loofah helps blood circulation and gives a sensation of lightness to tired, heavy legs. It tones the skin, preventing stretch marks and efficiently attacks cellulite because it prevents the accumulation of fatty tissues [3, 5]. Marine seaweed is used in the multitude of cosmetics and therapeutic applications [4]. Considering the occupational health of the tailors, a study on ***"Regenerative Cushions and Foot Pads for Industrial Tailors"***was conducted with the following objectives;

- To collect base line information about work environment from the industrial tailors
- To design cushions and foot pads
- To select natural sources for stuffing cushions and foot pads
- To construct cushions and foot pads
- To conduct wear study

METHODOLOGY

CONDUCT OF SURVEY

A survey was conducted among 100 tailors to elicit information about their work related problems.

COLLECTION OF RAW MATERIALS

Loofah, the vegetable fibre was collected from Kozhiparai village of Kerala district, and Marine seaweed was collected from EnayamPuthenthurai village of Kanyakumari district.theseNatural sources were selected owing to their regenerative healing effect.

Processing of Loofah Fiber and Seaweed

LOOFAH FIBER EXTRACTION

The methods such as stagnant retting, boiling method, and decortications have been followed to extract the fiber from theLoofah. Laterthe loofah sponge was taken after removing the outer skin. The sponges were soaked in stagnant water for 30 days. Care was taken to refill the water once in three days. The fibres were then removed by manual decortication method.

PRE PREPARATION OF SEAWEED

Seaweed was collected from EnayamPutthanthurai village of Kanyakumari District. The collected seaweed was washed in seawater once and twice in fresh water thoroughly to remove the unpleasant odour and stickiness. The washed seaweed was dried in shade in order to avoid direct sunlight as it may deteriorate the properties. The duration of drying under shade was kept as 12, 24, and 48 hours. Then the dried seaweed was crushed and made into powder.

DESIGNING AND CONSTRUCTING CUSHIONS AND FOOT PADS

Selection of fabric

Cotton is an ideal fabric for wearing qualities, high tensile strength, good absorption, low cost, excellent abrasion resistance and stability to repeated blending. Owing to the above factors, 100 percent cotton fabric made of twill weave structure was selected to make cushions and foot pads. The selected fabric was purchased in KhadiBavan, Coimbatore.

CONSTRUCTION OF CUSHIONS AND FOOTPAD

Since the cushions and foot pads were meant for a stool and pedal, box type cushion was selected. Though, there were number of designs available; care was taken to fix the cushions and foot pads exactly on the stool and pedal because the production should not get affected and should be convenient too. Therefore, the size and shape of the cushion footpad were made exactly to the shape of the stool and foot pedal. Five cushions were made by stuffing Loofahfibre and seaweed fillings mixed in different proportions. Along one side of the cushion and foot pad foam was attached to get firmness.

A pilot study was carried out in order to select the proportion of filling to be stuffed inside the cushions and foot pads. Initially Five workers were chosen to use the cushions and foot pads for five days. All the five workers were given a chance to work with each cushion and footpad since each of them has been stuffed with selected sources in different proportions. Criteria's such as sturdiness, pricking or itching, decreased speed of sewing, impressions, slippage and over all comfort were put forth to collect the overall comfortness of the workers and also to optimize the variable proportion of the selected sources, Loofah and seaweed.

Based on the opinion of the wearers and considering their comfort, filling proportion of Loofah and seaweed were taken as 80:20. Loofah and seaweed filling was stuffed into a cushion and footpad in the cushion cover made of twill weave cotton fabric. Number of cushions and footpads prepared was 40 each. Among 100 tailors surveyed, 20 males and 20 females were selected for wear study. The willingness of the tailors and time taken for processing of raw materials made the investigator to choose 20 males and 20 females. The cushion and footpads fixed well on the stool and pedal with a tiecord firmly. The tailors were requested to use the same for a period of 90 days. Therefore, the cushions and foot pads underwent 900 hours of use.

FINDINGS:

HEALTH PROBLEMS FACED BY THE TAILORS

TABLE I

Opinion	Male		Female	
	Yes %	No %	Yes %	No %
Health problems faced	83	17	82	18
Comfort of seat and foot pedal	72	28	90	10
Preference for change in seat and foot pad	80	20	90	10

Eighty three and 82 per cent of male and female tailors have faced health problem. Body pain, low back pain, joint pain, foot pain, rashes and swelling of legs were the problems faced by the tailors.72 and 90 per cent of male and female expressed that they are not comfortable with their seat and foot pedal. This discomfort may be due to the hard surface of the stool and operation of foot pedal with bare foot which is in constant touch with metal surface sitting on hard stool without support for longer hours would also result in lower back pain.80 percent of male and 90 percent of female tailors were of the opinion that they prefer change in their seat and foot pedals. Moreover, they expressed that they would like to have revolving wire chairs or cushion for comfort, so as to ease them from health problems.

HEALTH PROBLEMS AFTER USING CUSHIONS AND FOOT PADS - MALE

Health problems of male tailors before and after the using the cushions and foot padsare given in Table II.

TABLEII HEALTH PROBLEMS BEFORE AND AFTER USING CUSHIONS AND FOOT PADS - MALE

S.No.	Problems Faced	Before		After	
		No.	%	No.	%
1	Body pain	17	85	12	60
2	Joint pain	13	65	10	50
3	Low back pain	18	90	18	90
4	Foot pain	15	75	13	65
5	Rashes	12	60	9	45
6	Swelling of legs	17	85	13	65

Table II reveal that the health problems of the male tailors before and after the usage of cushions and foot pads. As per the data, in general, they were all relieved from health problem to a considerable extent. The percentage of tailors faced health problems varied from 60-90 per cent before using cushions and foot pads. Majority of male tailors, 92 and 90 per cent, were suffering from low back pain and body pain respectively but these problems seemed to be reduced after using cushion and foot pad for a period of 90 days, as expressed by 60 and 90 percent of tailors for low back pain and body pain.Therefore if the tailors are given permanent cushions and foot pad stuffed with natural sources it would be beneficial.

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HEALTH PROBLEMS AFTER USING CUSHIONS AND FOOT PADS – FEMALE

The Table IIIshow the health problems of female tailors before and after usage of cushion and foot pad.

TABLE III HEALTH PROBLEMS BEFORE AND AFTER USING CUSHIONS AND FOOT PADS - FEMALE

S.No.	Problems Faced	Before		After	
		No.	%	No.	%
1	Body pain	16	80	9	45
2	Joint pain	15	75	12	60
3	Low back pain	17	85	15	75
4	Foot pain	14	70	12	60
5	Rashes	14	70	9	45
6	Swelling of legs	18	90	14	70

Table IIIrefer that 80 and 85 percent of the female tailors were suffering from body pain and low back pain respectively. Ninety and seventy five per cent of female tailors have expressed that they have problems like swelling of legs and joint pain. Seventy percent of female tailors have suffered from foot pain and rashes. After using cushions and foot pads for 90 days, body pain and low back pain were seemed to be reduced to 60 per cent against 75 percent before use as expressed by female tailors. Seventy and forty five percent were relieved from swelling of legs and rashes after using the cushion and foot pads.

WORK EFFICIENCYOF TAILORS

The Table IVrefers the work efficiency of tailors before and after using the cushions and foot pads.

TABLE IV WORK EFFICIENCY OF TAILORS

Tailors	Improved %	Normal %
Male	60	40
Female	70	30

The improved efficiency of male tailors 60 percent is seen against 40 percent of tailors with normal work efficiency. As high as 70 per cent of female tailors expressed that their work efficiency has improved against 30 per cent with normal work efficiency. It is clear that per cent health problems of female tailors are higher than male tailors when read from Table IV. Therefore, these facts could be very well associated with the improved efficiency of female tailors. Some sort of additional cushions and footpads and soothing effect through them would be helpful to the female tailors on a long run.

CONCLUSION

It could be concluded from the study that the physical health problems like body pain, joint pain, low back pain, foot pain, rashes and swelling of legs have been reduced after using the regenerative cushions and foot pads which was stuffed by natural source such as Loofah and seaweed. Continuous use of these cushions and foot pads would be beneficial to the industrial tailors as they provide good comfort as well as soothing and massaging effect.

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ANTIBACTERIAL ACTIVITY OF SYNTHESIZED SILVER NANOPARTICLES FROM LEAVES OF TERMINALIA BELLIRICA

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ABSTRACT

Medicinal plants besides therapeutic agents are also a big source of information for a wide variety of chemical constituents which could be developed as drugs with precise selectivity. These are the reservoirs of potentially useful chemical compounds which could serve as newer leads and clues for modern drug design. Synthesis of metal nanop articles is solely dependent on knowledge of microorganisms and their behavior which play a crucial role. Against this background, researchers have been working extensively on extracellular and intracellular synthesis of metal nanoparticles using bacteria, fungi, yeasts and many other biological sources. Silver nanoparticles have been synthesized from the ethanolic extract of leaves Terminaliabelliri causing green synthesis method. The antibacterial activity of synthesized silver nanoparticles of Terminaliabellirica was assessed against various bacterial organisms such as Klebsiellapnueumoniae, Staphylococcus aureus, Pseudomonas aeruginosa, Escherichia coli and Bacillus subtilis. Among all these Bacillus sub tilis was found to exhibit highest antibacterial activity.

KEYWORDS: *Medicinal plants, Nanoparticles, Antibacterial activity, Terminalia bellirica*

INTRODUCTION

Nanotechnology is an important field of modern research dealing with design, characterization, production and application of structures, devices and systems by controlling shape and size at the nanometre scale. Nanoparticles are sub-nano sized colloidal structures composed of natural, synthetic or semi synthetic polymers (Deepa*et al.*, 2016). Green chemistry synthesis of nanoparticles (NPs) has recently received wide spread attention among physical and chemical synthesis processes for its emergence as a simple, speedy synthesis, inexpensive, eco-friendly and size-controlling approach in the synthesis of metal nanoparticles (MNPs). As a result of its growing popularity, there is an increased need to produce MNPs using biological systems such as bacteria, fungi, yeast and plant extracts as reducing and stabilizing agents (Pak *et al.*, 2016). Medicinal plants play an important role in the treatment of diabetes and hypertension, particularly in developing countries where most people have limited resources and access to modern treatments (Shori and Baba, 2011). *Terminaliabellirica* has been shown to possess multifarious medicinal properties viz laxative, regenerative, beneficial for hair, throat, eyes, skin disease, cough, cold, asthma, to arrest the bleeding and induce deep sleep. It also has antifertility, antihypertensive, antifungal, antimicrobial, anti-inflammatory, antioxidant, antibio film, anticancer, antidepressant, antidiabetic, antidiarrhoeal, anti-ulcer and immunomodulatory activities (Das and Devi, 2015; Kadian*et al.*, 2014).

MATERIALS AND METHOD

The leaves of the *Terminaliabellirica* were collected from Velliangiri hills, Coimbatore. The collected samples were authenticated by Botanical Survey of India, TNAU, Coimbatore. The authentication number is BSI/SRC/5/23/2014-15/Tech510. The collected sample was washed thoroughly and shade dried at room temperature. The dried sample was powdered. Ten gram of the powdered sample was added into100ml of ethanol, which was kept in the mild shaker for 7 days at dark. It was then filtered by What mann no.1 filter paper and the filtrate obtained was used for further studies.

SYNTHESIS OF SILVER NANOPARTICLES

Silver nanoparticles were synthesized by the method explained by Harbone, (1998). Ninety ml of 1mM aqueous silver nitrate solution was added to 10ml of ethanolic extract. The mixture was incubated by different methods followed below.

ROOM TEMPERATURE

The ethanolic extract of leaves of *Terminaliabellirica* and silver nitrate mixture was incubated at the room temperature for 72 hours (Paulkumar*et al.*, 2014)

HEATING IN WATER BATH

The ethanolic extract of leaves of *Terminaliabellirica* and silver nitrate solution were kept in water bath at a temperature of 60^0C for various duration of 5, 10, 15 and 20 minutes (Gulcin*et al.*, 2011; Mubarakali*et al.*, 2011).

HEATING BY MICROWAVE OVEN

Silver nitrate (1mM) and ethanolic extract of the sample was heated in microwave oven for different durations of 10, 20, 30 and 40 seconds (Nooroozi*et al.*, 2012).

EXPOSURE TO SUNLIGHT

The mixture of ethanolic extract of *Terminaliabellirica* and silver nitrate was exposed to sunlight for the durations of 5, 10,15 and 20 minutes (Sulaiman*et al.*, 2013).

SEPARATION OF SILVER NANOPARTICLES

The synthesized silver nanoparticles of the ethanolic extract of leaves of *Terminaliabellirica*sample was centrifuged for 20 min under refrigeratedcentrifugation at 13000 rpm and washed 3 times with distilled water. The residue of silver nanoparticles was obtained by freeze drying.

MICROORGANISM

Antibacterial activity of ethanolic extract of silver nanoparticles of *Terminaliabellirica*was determined using bacterial cultures namely*Klebsiellapnueumoniae, Staphylococcus aureus, Pseudomonas aeruginosa, Escherichia coli* and *Bacillus subtilis.* The strains of the bacterial culture were bought from Microlab, Coimbatore,which was stored at 4^0C and used for the experiments.

AGAR WELL DIFFUSION METHOD

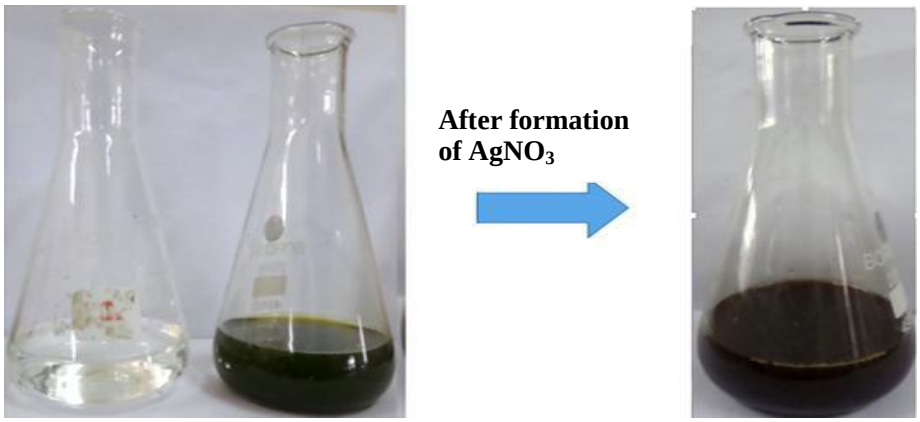
Muller Hinton agar was used as a nutrient source for bacteria. The silver nanoparticles synthesized from leaves of *Terminaliabellirica*was dissolved in known amount of dimethyl sulphoxide. 20ml ofMuller- Hinton agar was poured into the petriplates which was allowed to solidify and the well was cut by gel puncture in the size of 6mm diameter. Then 20µl of sample and chloramphenicol was impregnated in the well. The plates were exposed at 37^0C for 24 hrs. The obtained zone of inhibition around the well was measured (NCCLS, 1997).

MINIMUM INHIBITORY CONCENTRATION (MIC)

Dilution methods used to investigate minimum concentration of antimicrobial to kill or inhibit the microbial growth. Microtitre plate was added with 100µl of nutrient broth and diluent which makes the well to two fold dilution. From the first well 100µl of the dilution was taken and transferred into the second row wells to make a 4:1 dilution. This proceeds sequentially to making the each wells to 2 fold dilution. After the dilution of sample over, an aliquot of test organism was added to all wells and the plate was kept under incubation to overnight. Followed by incubation MIC was calculated as the lowest concentration of sample extract which inhibits the growth of bacteria. If the sample concentration is insufficient the bacterial growth will be seen in the wells (Eloff, 1998).

RESULTS AND DISCUSSION

The maximum yield of silver nanoparticles was obtained when the ethanolic extract of leaves of *Terminaliabellirica* was subjected to sunlight for 20 minutes. This method acts as the stabilizing agent for the reduction of Ag^+ to Ag^0. When the AgNPs formed, the colour of the solution will changes from fluorescent green to dark brown. Similar results were observed by Bahararaet *al*. (2014) when the *Achilleabiebersteinii*of plant extract was added to $AgNO_3$solution, the colour of thesolution became dark brown, which is indicating the formation of AgNPs. The colour formation occurs due to excitation of the surface plasmon resonance effect and the reduction of $AgNO_3$.



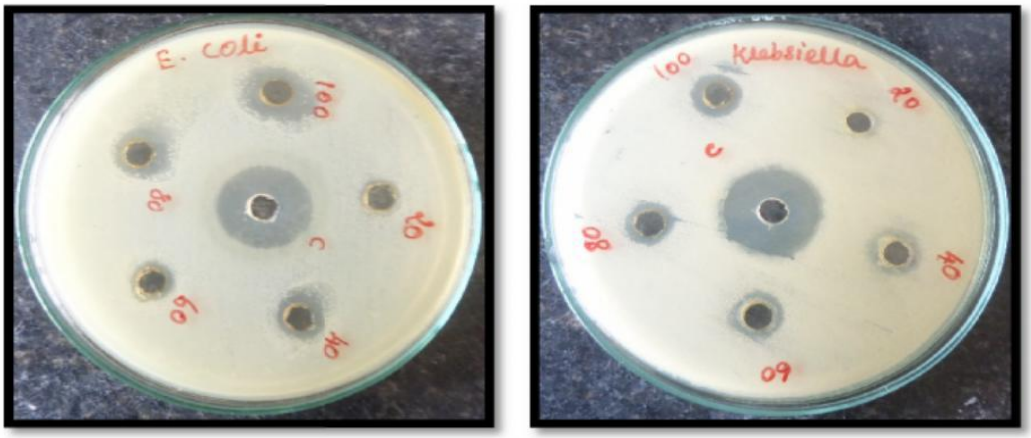
Antibacterial activity of synthesized silver nanoparticles of ethanolic extract of leaves of *Terminaliabellirica* by Well Diffusion method

Antibacterial activity of synthesized silver nanoparticles of leaves of *Terminaliabellirica*was done by well diffusion method and the diameter of zone ofinhibition is presented in Table 1 and Plate 3.

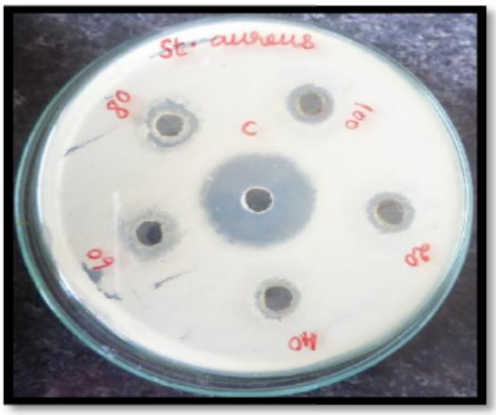
TABLE 1 ZONE OF INHIBITION (MM) OF SYNTHESIZED SILVER NANOPARTICLES OF ETHANOLIC EXTRACT OF LEAVES OF TERMINALIA BELLIRICA AGAINST

Microorganism	Zone of Inhibition (mm)					
	20µl	40µl	60µl	80µl	100µl	Control Gentamycin
Bacillus subtilis	15	20	20	22	23	25
Staphylococcus aureus	9	11	12	12	14	22
Escherichia coli	8	10	10	13	17	20
Pseudomonas aerugina	7	9	10	13	15	17
Klebsiellapneumonia	8	11	12	13	13	20

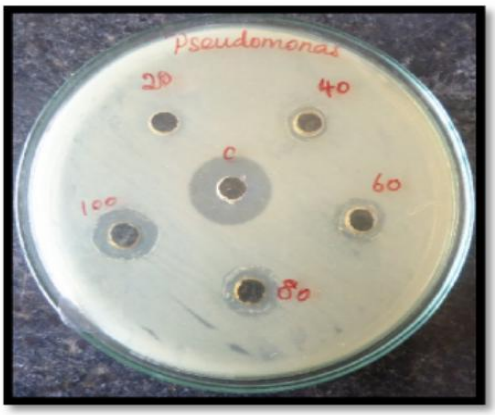
Plate 3
Antibacterial Activity of Synthesized Silver Nanoparticles of Ethanolic Extract of Leaves of Terminalia belliricaby Well Diffusion Method



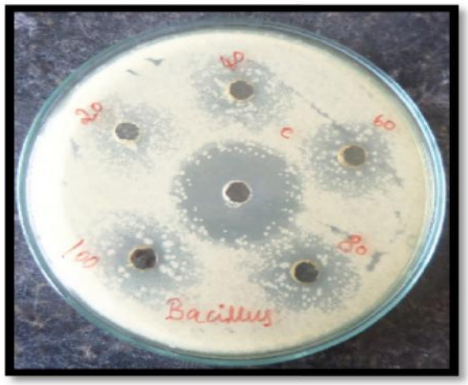
Escherichia coli ***Klebsiellapneumoniae***



Staphylococcus aureus



Pseudomonas aeruginosa



Bacillus subtilis

20- 20 µg/ml

40- 40 µg/ml

60-60 µg/ml

80- 80 µg/ml

100- 100 µg/ml

C- Control (Gentamycin)

Table 1 and Plate 1 confirms that the various concentrations of silver nanoparticles synthesized from *Terminaliabellirica* leaves extract have effective antibacterial activity against gram positive and gram negative bacteria. From the results, it can be concluded that the zone of inhibition was increased when the concentration of silver nanoparticles of ethanolic extract of leaves of *Terminaliabellirica*increased. However the highest zone of inhibition was foundagainst *B.subtilis* (23mm) while compared with other bacterial strains at 100µg/ml concentration followed by *E.coli* (17mm), *P.aeruginosa* (15 mm), *S.aureus* (14 mm) and *K.pneumoniae* (13mm).

Minimum Inhibitory Concentration (MIC) of synthesized silver nanoparticles of ethanolic extract of leaves of *Terminaliabellirica*

The AgNPs synthesized from the leaves of *Terminaliabellirica* showed maximum zone of inhibition for all the organisms studied. Therefore it was used for minimum inhibitory concentration (MIC) assay. The MIC was determined as the lowest concentration that inhibited the visible growth of the used bacterium. The result of MIC was depicted in Table 2

TABLE 2 NANOPARTICLES OF ETHANOLIC EXTRACT OF LEAVES OF TERMINALIA BELLIRICABY MINIMUM INHIBITORY CONCENTRATION (MIC) METHOD

Microorganism	Concentration of organism (µg/ml)						
	0	8	4	2	1	0.5	0.25
Bacillus subtilis	-	+	+	+	+	+	-
Staphylococcus aureus	-	+	+	+	+	-	-
Escherichia coli	-	+	+	+	-	-	-
Pseudomonas aeruginosa	-	+	+	+	+	-	-
Klebsiella pneumonia	-	+	+	+	+	-	-

(+) Inhibition of microorganism growth (-) Growth of microorganism

The synthesized silver nanoparticles of ethanolic extract of leaves of*Terminaliabellirica*was inoculated against*K.pneumoniae*,*P.aeruginosa*,*S.aureus, E.coli*and*B.subtilis*in the concentration of 8-0.25 mg/100µl. The growth of*S.aureus, P.aeruginosa, K.pneumoniae, E.coli*and*B.subtilis*were inhibited by synthesizedsilver nanoparticles of *Terminaliabellirica* of 8-1.0 mg/100µl concentration. *S.aureus* and *P.aeruginosa* was found to have significant killing effect at 8-1.0 mg/100µl whereas *K.pneumoniae* and *E.coli* have the killing effect at 8-2 mg/100µl concentration. *B.subtilis* found to have killing effect at 8-0.5 mg/100µl.

At the end of this antimicrobial screening test, it is confirmed that the biologically synthesized silver nanoparticles of ethanolic extracts of leaves of *Terminaliabellirica*possess effective antibacterial property. Therefore, applicationsof it can cover a large domain of medical, leather and food technologies.

CONCLUSION

To conclude, the results of the present study demonstrated that the silver nanoparticles synthesized from the ethanolic extract of leaves of *Terminaliabellirica* via green route had a potent antibacterial activities.

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UGC APPROVED JOURNAL

ANTIMICROBIAL ACTIVITY OF THE METHANOLIC EXTRACT OF LEAVES OF RHUSCHINENSIS MILL

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ABSTRACT

An antimicrobial treatment is performed on a textile to help human to withstand against microorganisms that causes allergy, irritation and sensitization. The main importance of the study is evaluation of antibacterial activity of the methanolic extracts of leaves of Rhuschinensis mill on Aspergillusniger and Staphylococcus aureus. The methanolic extract of the leaves of Rhuschinensismill. Soxhletmethos was used foe extraction. Disc diffusion method for antimicrobial test is very common, therefore this was followed. The plant extractwas placed onto the Mueller Hinton agar plateswith bacterial cultures of 0.5 McFarland standards, an incubated for 24 hrs at 37◦c [1].T he result proved positive by showing high zone of incubation.. The plant extract of Rhuschinensis mill showed significant antibacterial activity against Aspergillusniger and Staphylococcus aureus.

KEYWORDS: *Rhuschinensis Mill, Aspergillusniger, Staphylococcus Aureus, Antimicrobial*

INTRODUCTION

Humandaily woredifferent types of clothing on everyday basis on everyday life, which is also known as dress, garment that covered up the body in order to protect it against from the adverse climate conditions. Finishing of Textiles plays an important role in increasing global demand in textile and apparel industry in the field of both fashion and medical. And the use of herbal natural product has been increasing day by day. Some of the finishing process in textiles includes wrinkle resistance, soil resistance, and water repellency, flame retardant. Among them, antimicrobial activity is being considered to be very important due to its properties of prevented human against skin problems, rashes etc [4] Textiles are known as being conducive to microorganisms growth, such as bacteria and fungi. This micorganisim depending on the moisture and temperature level etc are able to quickly multiply. The microorganism growth on textiles also further cause a unpleasant odor, reduction in mechanical strength, stains and discoloration and an increased likelihood of user contamination[5].

The plants *Rhuschinensis mill* is commonly known as Khongma or Heimang in local dialect of Manipur. It belong to Anacardiaceae family is a taproot and perennial shrub. It is a native to Asia but there are some species found in Hawaii and Australia as well. In India it is found in Jammu and Kashmir and north -eastern part of India, Manipur being one of the place where hilly areas are abundant contains a humpty numbers herbs, medicinal plants where various new project on studying of plants can be taken up.The plant*Rhuschinensismill* is found commonly on the hilly region in the wild form in the forest area or in the uncultivated areas without any maintenance as underutilized minor fruit crops. However, In Manipur this underutilized minor fruit crops are used as medicine from time immemorial either in raw or in the form of cooked or boiled and used as a traditional treatment of allergy and skin problems over a decades by the forefathers. In this study, an attempt has been made to evaluate the antibacterial activity of the leaves of *Rhuschinensis mill* against*Aspergillusniger*and *Staphylococcus aureus* [6].

MATERIALS AND METHODS

The leaves of *Rhuschinensis mill*was obtained by plucking if off from the bark and branches. The leaves were dried and powdered. Extracts of the seed powder were obtained to assess Antimicrobial activity properties of selected plant*Rhuschinensis mill.* Firstly, the solvent 250 ml of methanol is added to a round bottom flask which is attached to a Soxhlet extraction and condenser on an isomental. The plant 20g each are loaded into the thimble which is placed inside thrSoxhlet extractor. The solvent is heated using the isomental and will begin to evaporate moving through the apparatus to the condenser. The condenser then drips into the reserviour containing the thimble. Once the level of the solvent reaches the siphon it pours back into yhr flask and the cycle begins again. The process is run for a total of 24 hours. After 24 hrs the yield% is calculated where *Rhuschinensis mill* is 10.43%.

MICROORGANISMS

As per gillusniger and *Staphylococcus aureus*were obtained from the Dept. of Microbiology.

PREPARATION OF THE CULTURE MEDIA

The media used in Kirby Bauer testing must be Mueller Hinton agar at only 4 mm deep, poured into either 100 mm or 150 mm Petri dishes. The pH level of the agar must be between 7.2 and 7.

ANTIMICROBIAL SUSCEPTIBILITY TEST

METHOD PROTOCOL:

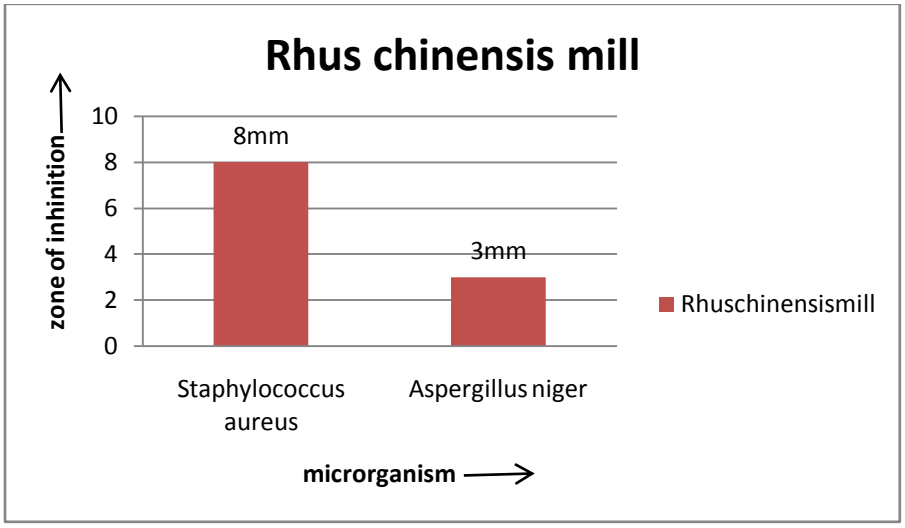
Twenty four hrs grown culture *(staphylococcus aureus,* and *Aspergillusniger*) was taken and diluted to 108 CFU / ml using McFarland standard. Muller hinton agar plates were prepared. The diluted cultures were swabbed over the surface of the medium. The plates were dried for few minutes and using a sterile cork borer (6 mm in dia) wells were punctured. 100 µl of the samples were loaded in thewell (Duplicates). All the plates were incubated (For bacteria 37°C for 24 h and for fungus 25°Cfor 7 days). After incubation period the zone of inhibiton was measured using antibiotic zonescale and reported.

RESULTS

In the study, the zone of inhibition was shown by methanolic extracts against the selected individual microrganismi,e. *staphylococcus aureus,* and *Aspergillusniger*and it is shown in table1 and graph 1 given below:

TABLE 1: ZONE OF INHIBITION GROWTH OF BACTERIA OF RHUSCHINENSIS MILL

ORGANISMS	*Rhuschinensismill*
Staphylococcus aureus	8mm
Aspergillusniger	3mm



Graph 1: Antibacterial activity of methanolic plant extract against *Staphylococcus aureus* and *Aspergillusniger*

From the above table it is clear that zone of inhibition growth of methanol extract of Rhuschinensis mill for Staphylococcus is 8mm and Aspergillusniger is 3mm respectively. Therefore it could be concluded that the selected herbal extract namely Rhuschinensis mill has Antimicrobial activity against *Staphylococcus aureus*and *Aspergillusniger*.

CONCLUSION

The study reveals the antibacterial activity of the methanolic extract of *Rhuschinensis mill* leaves against *staphylococcus aureus,* and *Aspergillusniger*. The present study can pave a way for further

research to determine the lead compounds in the leaves to develop newer antimicrobial agent in this era of antimicrobial resistance.

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APPLICATION OF ANTIMICROBIAL FINISH USING IXORA COCCINEA ON COTTON FABRIC

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ABSTRACT

The Antimicrobial finish is used to prevent the textile material and clothing from pathogenic microorganism. Ixora coccinea leaf selected as the source due to its antimicrobial property. Active compounds present inflavonoids, coumarins, alkaloids and phenolic group of compounds. Methanol is used as solvent extraction. The Antimicrobial finish is done on the cotton fabric. Tocontrol the skin diseases, infection of microbes, wound healing. The antimicrobial property of Ixora coccinea leaf extract was tested by the well diffusion method. The well diffusion results showed the Ixora coccinea extract have potential of antimicrobial activity against gram positive& gram negative bacteria. After the conformation of the activity this extract applied on the cotton fabric. The antimicrobial activity was assessed quantitatively by AATCC test method against the test organism staphylococcus aureus and pseudomonas aeruginosa. The zone of inhibition was seen clear. While accessing the sample that is finished with Ixora coccinea.

KEYWORDS: *Ixora coccinea, well diffusion, cotton, antimicrobial*

INTRODUCTION:

Ixora coccinea (Rubiaceae) is known as the wilder uses of Geranium or fire of the forested areas or vetchi in ayurvedia. Usually blossoming shrub is local to Asia. Its name is gotten from an Indian dirinity. Inspite of the fact that there somewhere in the range of the 400 species in the genus *Ixora*, just an only some are cultivated. *I. coccinea* is usually called as *Ixora*; it is a broad, multibranched evergreen bush grows 4-6 feet (1.2-2m) tallness however once in a while capable of coming up to 12 feet (3.6m) height. It is generally utilized as hepatoprotective, chemo protective, antimicrobial, anti-inflammatory agents. Existence of photochemical such as alkaloids, phenols, steroids, saponins, and flavonoids are observed in the plant extract which contain antibacterial activity and can be used for healing use. Hence the plant is prosperous in bioactive constituent and possible therapeutic activities, (Annapurna and raghavan, 2003).

MATERIALS AND METHODS:

Preparation of plant extract:

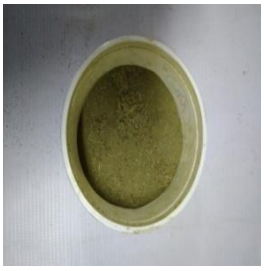
The fresh plant of *Ixora coccinea* is collected and it is cleaned. The leaves were then removed from the stem, with consciously washed with the running tap water, rinse with the distilled water, and dry it with 1 hour. The dried *Ixora coccinea* leaves were dried in room temperature for until the leaves were dried. Then the dried leaves were grounded into a powder. Stored in a dry container. 6 gm. of powder is measured and it is taken in a conical flask, with a ratio of 1:20 methanol and water added. The beaker is made airtight by covering the mouth of the conical flask using a sheet of paper. Then kept 24 hours in room temperature and then filtered the solvent.

ANTIBACTERIAL TESTING:

The Nutrient agar be ready and pour in the Petri plate. After 24 hours growing cultures (*Escherichia coli and staphylococcus aureus*) were swabbed on it. The wells (10mm diameter) were made using cork borer and altered concentrations of the crude extract were fill into the wells. Then the plates were incubated at 37 C for 24 hours. The inhibition of Zone diameter was measured. The extracted source shows that the bacteria around the well where the extracted solution is inoculated. Thus the bacteria are sensitive to the methanol extract of *Ixora coccinea.*

EVALUATION METHOD:

The test to evaluate the efficiency of this fabric is done according to the standard method. Here, disc diffusion method is used to evaluate the antibacterial activity of the treated sample. It is a method of testing of microbial growth, it is also known as the antimicrobial sensitivity test. This sensitivity test is performed on agar plates. A small disc of treated sample and controlled sample is placed on to the agar plate using puncher which is known as disk. A small amount of antibiotic absorbed by the treated sample diffuses out into the agar plate, along a concentration gradient , as the plate are incubated for 24 hrs. Disk Diffusion method against *staphylococcus aureus and Escherichia coli*. The treated sample is effective against the selected bacteria and hence the selected source has the antibacterial activity.


Ixora coccinea leaf Extraction powder Methanol solvent


Untreated sample Treated sample

RESULTS AND DISSCUSION:

Well diffusion

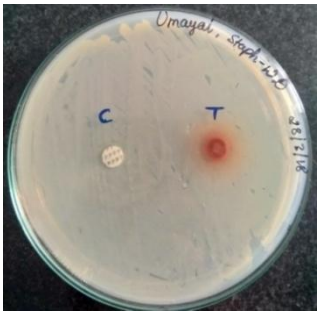
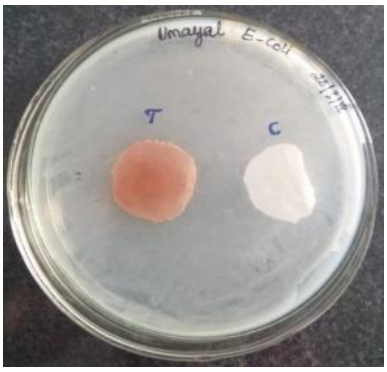


TABLE 1 WELL DIFFUSION AGAINST STAPHYLOCOCCUS AUREUS AND ESCHERICHIA COLI

Sample	Antibacterial	
	Staphylococcus aureus	*Escherichia coli*
Controlled fabric	Growth surrounding the well	
Finished fabric	No growth surrounding the well	

The above table shows that the extracted source shows that the bacteria around the well where the extracted solution is inoculated. Thus the bacteria are sensitive to the methanolic extract of *Ixora coccinea*.

Disc diffusion



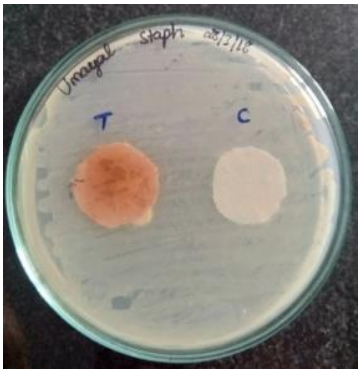


TABLE 2 DISK DIFFUSION METHOD AGAINST STAPHYLOCOCCUS AUREUS AND ESCHERICHIA COLI

Sample	Antibacterial	
	Staphylococcus aureus	*Escherichia coli*
Controlled fabric	growth beneath the fabrics	
Finished fabric	No growth beneath the fabrics	

The above table shows that the treated sample is effective against the selected bacteria and hence the selected source has the antibacterial activity.

Fabric weight:

The fabric weight of the original and finished fabric is given in Table 3.

S.No	Original sample	Finishing samle
1	1.310	1.350
2	1.316	1.370
3	1.320	1.360
4	1.326	1.380
5	1.310	1.350
Average	1.3164	1.362

The weight is increased in FS than the OS. This is due to because of imparting finishing.

Fabric Thickness:

The fabric thickness of the original and finishing fabrics are given in Table 4.

S.No	Original sample	Finishing sample
1.	0.65	0.43
2.	0.50	0.45
3.	0.51	0.46
4.	0.67	0.45
5.	0.53	0.47
Average	0.572	0.452

The Thickness is increased in FS than the OS. This is due to the processes of finishing.

Sinking Test:

The fabric sinking characteristics of the original and finishing sample are evaluated and present in the Table 5.

S.No	Time constant	Desizing sample	Finishing sample
1.	1 min	1.5 cm	4 cm
2.	1 min	2.5 cm	3.9 cm
3.	1 min	1.5 cm	3 cm
4.	1 min	2.4 cm	3.8 cm
5.	1 min	2.5 cm	3.9 cm
Average		2.08	3.72

The wet ability of FS was decreased when compare to OS. This may be due to the application of finishing.

The sample of both desized fabric and finishing sample is taken and the time noted sink completely. Thus the finishing sample takes less time to sink completely compared to desized sample

Wicking Test:

The fabric wicking characteristics of the original and finishing fabric evaluated and presented in the Table 6.

S.No	Time	Original sample	Finishing sample
1.	1 min	1 cm	2 cm
2.	1 min	1 cm	2.5 cm
3.	1 min	1 cm	2.3 cm
4.	1 min	1 cm	2 cm
5.	1 min	1 cm	2.4 cm
Average		1	2.24

FS absorb more water than the OS. This may be due to the application of finishing.

The antibacterial activity is evaluated by using the well diffusion and disc diffusion methods. It is analysed by measuring the zone of inhibition of growth of bacteria and the growth of bacteria beneath the treated fabric according to the standard of AATCC90. The above results show that the *Ixora coccinea* leaf extract has the efficiency of antibacterial activity against the selected bacteria i.e., *Staphylococcus aureus* and *Escherichia coli*. The application of finishing sample improved the physical properties of the fabric like, Fabric thickness, Fabric weight etc.

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EXTRACTION OF NATURAL DYE FROM PAPAYA LEAF AND ITS APPLICATION ON COTTON

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ABSTRACT

Natural dyes have emerged as an alternative to synthetic dyes. In this study natural dye was extracted from papaya leaves using conventional extraction method. Factors influencing extraction of natural ye such as extraction time, temperature, dye source concentration and solvent were studied. The natural dye extracted under optimized conditions was used to dye the selected cotton fabric. There sults indicated that the dye source concentration of 5% at 90^{o}C and extraction time of 60 misusing water as solvent resulted in maximum dye yield. Color fastness properties of dyed fabric to washing, rubbing and exposure to sunlight have also been determined. The results of color fastness properties of the dyed fabrics were found to be good to excellent. The results indicate that natural dye could be extracted from papaya leaves.

KEYWORDS: *Natural Dye; Papaya Leaf; Conventional Extraction; Optimization;*

INTRODUCTION

Colors have played a significant role in man's individual, family and social life. Dye is an organic molecule that is responsible for dyeing and printing of textile fibre material. Dyes which are extracted from natural sources like plants, animals and minerals are called as natural dyes. Natural dyes are eco-friendly, biodegradable and non carcinogenic (Mongkholrattanasitet al., 2010).They are new at all times and never age. Natural dyes are used forcoloring of food, natural fibres like cotton, wool, silk and leather since pre historic times (Mongkholrattanasit et al., 2011).Natural dyes produce elegant colors and provide antimicrobial, anti-odor and UV protective functions to the dyed fabrics (Grifonietal., 2011; Habbaletal., 2011; Leeetal., 2010; Reddyetal.,2012).

The use of natural dyes has declined with the invention of synthetic dyes, which is widely available, inexpensive and have excellent color fastness properties. Nowadays the use of natural dyes increased due to strict environmental regulations and to avoid the toxic effect caused by the synthetic dyes. Natural dyes are used only by small scale and cottage level dyers. The possibilities of natural dye extraction at a larger scale need to be explored.

Hence the objective of the study is to extract natural dye from papaya leaves and to determine the influence of different process parameters on dye extraction and investigate the fastness properties of dyed cotton fabric.

METHODOLOGY

EXTRACTION OF DYE

Fresh papaya leaves (5g) were collected and ground to paste using 100 ml of water.The content was kept at$100°C$ for 60 mins. The dye extract was filtered using Whatman No.1 filter paper. The color intensity of the dye extract was measured using UV-VIS spectrophotometer at 365 nm.

OPTIMIZATION OF VARIOUS PARAMETERS FOR DYE EXTRACTION

Various process parameters such as pH, dye source concentration, extraction time, temperature and solvent were optimized for dye extraction.

Suitable extraction medium was determined by extracting papaya leaves with different solvent medium such as aqueous, alcohol, acidic and alkaline medium. Optimum dye source concentration was determined by taking different concentrations of papaya leaves (1-10%). The optimum time for the extraction of natural dye was determined by extracting the dye at various time intervals (30-270min).To select the suitable pH for dye extraction, the pH of the medium was adjusted to 4-12 using dilute hydrochloric acid or sodium carbonate. Dye extraction was done at different temperatures such as 30-$100°C$ to select the optimum temperature.The dye extract was filtered and the color yield was determined using UV-Vis spectrophotometer at 365 nm.

EXTRACTION OF DYE UNDER OPTIMIZED CONDITIONS

Extraction of natural dye was carried out using appropriate solvent medium, dye source concentration, pH, extraction time and temperature. The extracted dye was used for dyeing.

DYEING PARAMETERS

The selected cotton fabric was dyed at a Material:liquor: ratio 1: 20for 1 hourat 90℃. The dyed fabric was assessed for colorfastness properties.

COLOR FASTNESS TESTS

Dye fibre interactions are varied and their strength or combined strength determines both the outcome and performance of the dyeing. Colorfastness properties, of the dyed textile material depend upon the nature of dye, dyeing procedure and washing methods. The grey scale employed for color fastness test is 1-5 grades. In this scale one means poor and 5 represents excellent colorfastness. Color fastness tests were carried out for fastness to sunlight, washing and crocking.

RESULTS AND DISCUSSION

EXTRACTION OF NATURAL DYE

The various parameters that influence the dye extraction was optimized (Table 1).The dye was extracted under optimized conditions with dye source concentration of 5 %at 90°C for 1 hour using aqueous medium from papaya leaves and filtered. The dye extract was used to dye the fabric.

TABLE 1 OPTIMIZED CONDITIONS FOR THE EXTRACTION OF NATURAL DYE FROM PAPAYA LEAVES

Parameters	Optimized conditions
Medium	Aqueous
Time	60 mins.
Temperature	90°C
Concentration	5 %

COLOR FASTNESS TESTS

Color fastness properties of the dyed fabric to sunlight, crocking and washing were determined and the results are presented in Table 2. The dyed fabrics showed very good fastness to sunlight and washing. With regard to crocking, the dyed fabric showed good to excellent fastness.

TABLE 2 COLOUR FASTNESS TO SUNLIGHT, CROCKING AND WASHING

S.No.	Sample	Sunlight		Washing		Crocking			
						Dry		Wet	
		Colour change	Staining	Colour change	Staining	Colour change	Staining	Colour change	Staining
1.	Dyed fabric	4	4	4	4	5	4	4	5

5 – Excellent; 4 – Very Good

CONCLUSION

Natural dyes are safe to color textiles and does not harm the environment. The demand for natural dyed products increased due to the ill effects caused by synthetic dyes. Natural dyes not only provide color to the fabric but also exhibit various functional properties. The present work confirms that, papaya leaves can be utilized as a potent natural dye source for coloring textiles.

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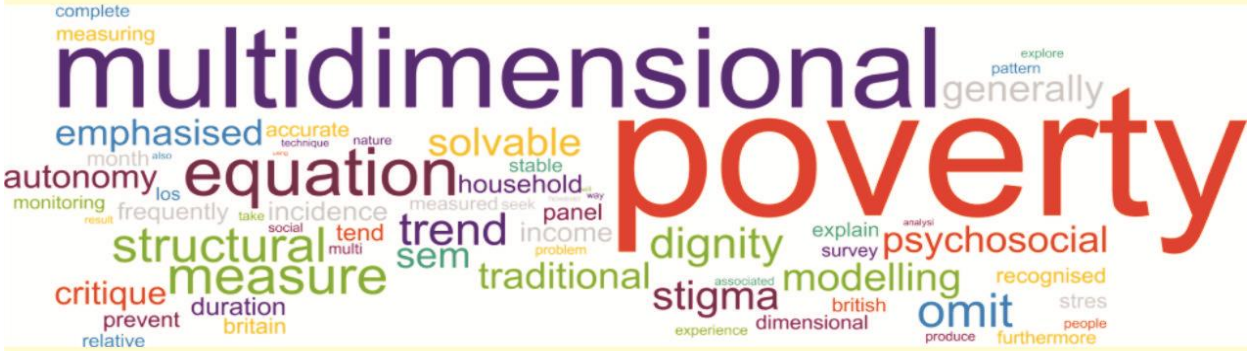

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