Development of Woven fabric using Ipomoea Nil, Gossypium Herbacium and Cannabis Sativa for Technical Applications

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***Abstract*—This research explores the feasibility of combining *Ipomoea nil* fibres with conventional natural fibres, i.e., *Gossypium herbaceums* and *Cannabis Sativa*, to form a new green woven textile. The investigation aims to elucidate the mechanical characteristics, durability, and eco-friendliness of the material and explore its biochemical properties. Using an optimized blend ratio, the fibre was subjected to a controlled weaving process, after which it underwent intensive mechanical and environmental testing. Characterization methods, such as tensile strength testing and biodegradability assays, were used to assess the structural integrity of the fabric and decomposition kinetics under simulated environmental conditions. Results indicate that the incorporation of *Ipomoea nil* enhances the air permeability, moisture-wicking, and tensile strength of the resultant fabric. Furthermore, due to the presence of bioactive compounds, the fibre is intrinsically antibacterial and anti-inflammatory in nature, which could be applied in skin-friendly and antimicrobial textiles and the findings verify that the addition of *Ipomoea nil* enhances the air permeability, water wicking behaviour, and tensile strength of the resulting fabric. Additionally, because the fibre is of bioactive nature with the addition of bioactive agents, the fibre is antibacterial and anti-inflammatory in nature, which can be used for skin-friendly and antimicrobial clothing. With these properties, the yarn created here has significant potential for home textile application, particularly bedding, upholstery, and curtains, where durability, antimicrobial function, and airiness are all in high demand. Secondly, the inherent moisture management capability of the yarn makes it well placed for temperature-sensitive textiles, further improving home thermal comfort. Its antibacterial property reduces microbial growth opportunities, making the material well placed for hygienic furniture and hypoallergenic bedclothing. Its biodegradable nature also makes it suitable for eco-home applications with the new transition to the eco-home textile. Secondly, aside from that, its inherent wear-resistance and longevity enable its wide application in heavy-wear applications such as sofa cover, cushion fabric, and curtain. With the inclusion of *Ipomoea nil* into textile production, this study offers the key to new-generation, sustainable, and performance-oriented home textiles that harmonize performance and sustainability.**

***Index Terms*—Ipomoea Nil, Anti-inflammatory, Anti-oxidant, Anti-bacterial, Sustainable fabric**

1. INTRODUCTION

Textile fibres refer to the basic materials which is used for making fabrics. The strength, durability and texture of the materials are determined by the quality and the properties of the textile fibre used. There is numerous textile fibres used for fabric manufacturing they are classified into Natural, Synthetic and Regenerated fibres. Natural fibres include cotton, jute, wool, silk, hemp, flax etc, Synthetic fibres including polyester, nylon, acrylic and spandex. Regenerated fibres are man-made fibres which are derived from natural polymers and undergoes several chemical processes. These fibres include rayon, lyocell, modal. In this study *Ipomoea Nil* one of the species from the *Convolvulaceae* family was processed with potential methods to acquire fibre for textile use. *Ipomoea nil* native to the East Asia commonly known for its vibrant flowers and it is primarily used for ornamental purposes but it also contains various medicinal properties including Anthelmintic, Antifungal, Anti-Inflammatory Etc…, The stem of the plant *Ipomoea nil* is long, slender and flexible which can grow up to 5 meters in length that can be processed with different operations to make fibre bundles. The rapid growth of the stem in warm sunny environments can reach several meters in single season. Main function of the stem is to support the leaves and flowers transporting the essential nutrients and water from the root. The outer layer of the stem is known as Epidermis which is a single layer of cells that is build up to protect the stem from environmental stress. Cortex is the second layer of the stem beneath the epidermis which is responsible for transporting water and essential nutrients. The stem contains Vascular bundles these bundles contain xylem which transfers minerals and water, and phloem that transports sugar and other organic compounds. The central part of the stem is known as pith, this provides structural support for the plant.

Ipomoea nil is not typically harvested for fibres unlike other species this has not been studied as much. The extraction process is done by Retting the stems. By harvesting the mature stems and soaking them in water for 24 hours. Next by mechanical beating method the outer epidermis of the stem is completely removed and the core of the stem is used as fibre.

In my research, I have blended *Ipomoea Nil, Cannabis Sativa* and *Gossypium Herbaceum* to create a novel yarn. This carefully executed blending process ensures uniform distribution of each fibre.

Cannabis Sativa belonging to the family *Cannabaceae* originated in central Asia is grown for its fibre or its seeds. *Cannabis sativa* a cane like variety is raised for the fibre. Well drained, nitrogen rich and non-acidic soil are essential for hemp cultivation. Hemp favors a mild climate, humid atmosphere and a rainfall of at least 25-30 inches per year. Soil temperatures must reach a minimum of 42-46^{0}F (5.5-7.7^{0}C) before seeds can be planted. There are three types of fibres primary bast fibre long and low in lignin, secondary bast fibre intermediate and high in lignin, libriform short and high in lignin. *Cannabis sativa* grows up to 1-5 meters and 16-50 microns respectively. They are a good conductor of heat, resists mildew, resistance to

UV rays, and has anti-bacterial properties. *Cannabis sativa* production can be more expensive compared to other fibres due to their need of nitrogen processing, they are hard process and require specific techniques to achieve quality, some people may find this fabric to be rougher and less comfortable compared to other natural fibres.

Gossypium Herbaceum is a species of cotton that is native to the Sub-Saharan, Arabia and parts of India. It is a shrub that grows to a height of 2-6 feet. The stems are thick and woody, the leaves are broad about 5-15cm long, the flowers are small, yellow and they bloom in clusters. The plant produces short, staple cotton fibres that are used in textile industries. It is natural sustainable fibre that requires less pesticides compared to other *Gossypium* species. This species produces short, long and fine fibre that is ideal for textile manufacturing. This variety can withstand drought making it a great crop in regions with limited water availability. This fibre is known for its hardiness and they are more resistance to pests and diseases compared to other species. *Gossypium hirsutum*, which can limit certain textile a pplications. There is limited market demand for *Gossypium herbaceum* compared to *Gossypium hirsutum* which can limit its commercial availability.

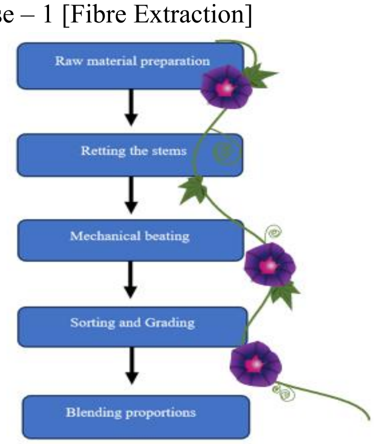
By studying the results of the process, they will be moved for further processing.

2. Objective

- To develop Eco-friendly fabric.
- To explore potential applications of the developed fabric.
- To create biodegradable alternative to synthetic fabrics.
- To introduce unique textile material.
- To promote natural fiber utilization.
- To contribute to the research and development of sustainable textile material paving way for future eco-conscious fabric innovations.

3. Experimental Procedure

3.1. Phase – 1 [Fibre Extraction]



1. Raw Material Preparation
Fresh *Ipomoea Nil* plant is harvested and mature stems is collected to have stronger fibres. Procure *Gossypium herbaceum* and *Cannabis sativa* fibres of consistent quality.

2. Retting the stems
Soak the stems for about 24 hours in fresh water and remove the outer layer Epidermis using retting process. By this process long filament fibres are acquired.

Retting the Stems
PLATE – I

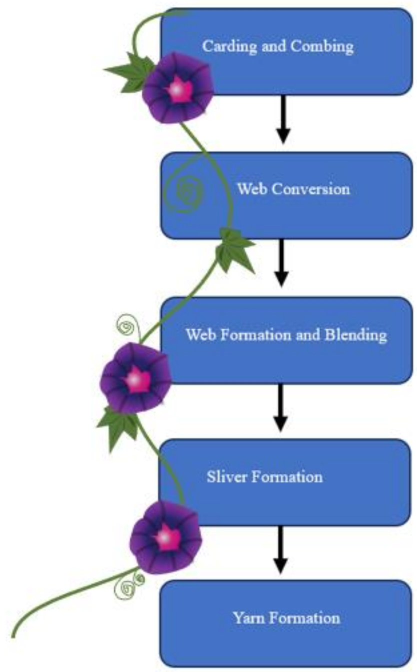
3. Mechanical beating
Beat the stems well through mechanical beating process to remove all the unwanted residuals and to loosen the fibre making them suitable for the next process.

4. Cleaning and Conditioning of Fibres
Clean the fibres to remove impurities like dirt, waxes and oils. Condition the fibres in a controlled temperature and humidity for uniformity.

5. Sorting and Grading
Now sort the fibres according to their length and grade them for making quality fibres. This will enhance the performance and durability of the fabric.

6. Blending proportions
Ipomoea Nil fibres are blended with natural fibres like *Gossypium herbaceum* and *Cannabis sativa* fibres in a ratio of [50:25:25]. To enhance the properties of Ipomoea Nil fibres. As *Gossypium herbaceum* increases the smoothness of the fabric and *Cannabis sativa* has been recognized as a source of extraordinary tensile and durable textile fabrics.

3.2 Phase – 2 [Yarn Manufacturing]



1. Carding and Combing
The fibres are blended through a carding machine, there they are separated, cleaned of impurities and aligned into thin webs. The short and thin fibres are removed through combing process this method improves the strength and smoothness of the yarn.

2. Web Conversion
The carded fibre web is then transformed into a more uniform blending of *Ipomoea Nil*, *Gossypium Herbaceum* and *Cannabis Sativa.* This process

improves the consistency of the fibre distribution before further processing

Web Conversion
PLATE – II

3. Web Formation and Blending

At this stage the fibres are thoroughly blended to ensure an even mixture throughout the yarn. Here proper blending is crucial as it affects the final yarn's texture, durability and absorption properties.

Web Formation and Blending
PLATE – III

4. Sliver 0Formation

The blended web is converted into slivers. This process helps in forming a continuous, manageable fibre strand, that is easier to draft and spin it into yarn.

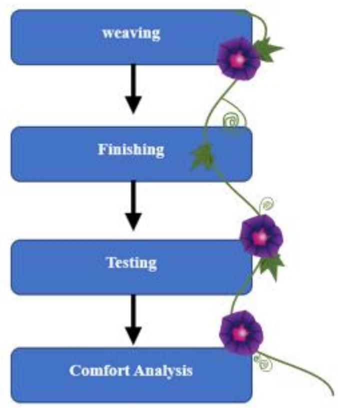
Sliver Formation
PLATE – IV

5. Yarn Formation

The sliver is drawn and twisted through the spinning process to create yarn with the desired thickness, strength and properties of *Ipomoea Nil* fibre.

Yarn Formation
PLATE – V

3.3 Phase – 3 [Fabrication]



1. Weaving

The blended yarn is woven into fabric using plane weave structure. This ensures strength, flexibility and comfort. *Ipomoea nil* is woven in the weft yarn and *Gossypium herbaceum*, *Cannabis sativa* is woven on the warp yarn**.**

Weft yarn spinning in shuttle pump
PLATE – VI

Frame and Reed
PLATE – VII

2. Finishing

Warp fixed in loom Weaving
PLATE – VIII

Weaving
PLATE – IX

3. Testing
The material is evaluated for primary attributes like Anti-inflammatory, Strength and Durability.

4. Comfort Analysis
The fabric is evaluated for breathability, moisture management and skin-friendliness. *Gossypium herbacium* provides softness and absorbency, *Cannabis sativa* enhances durability and Ipomoea nil known for its Anti-inflammatory properties contributes to the skin comfort making it suitable for all skin types.

4. RESULT AND DISCUSSION

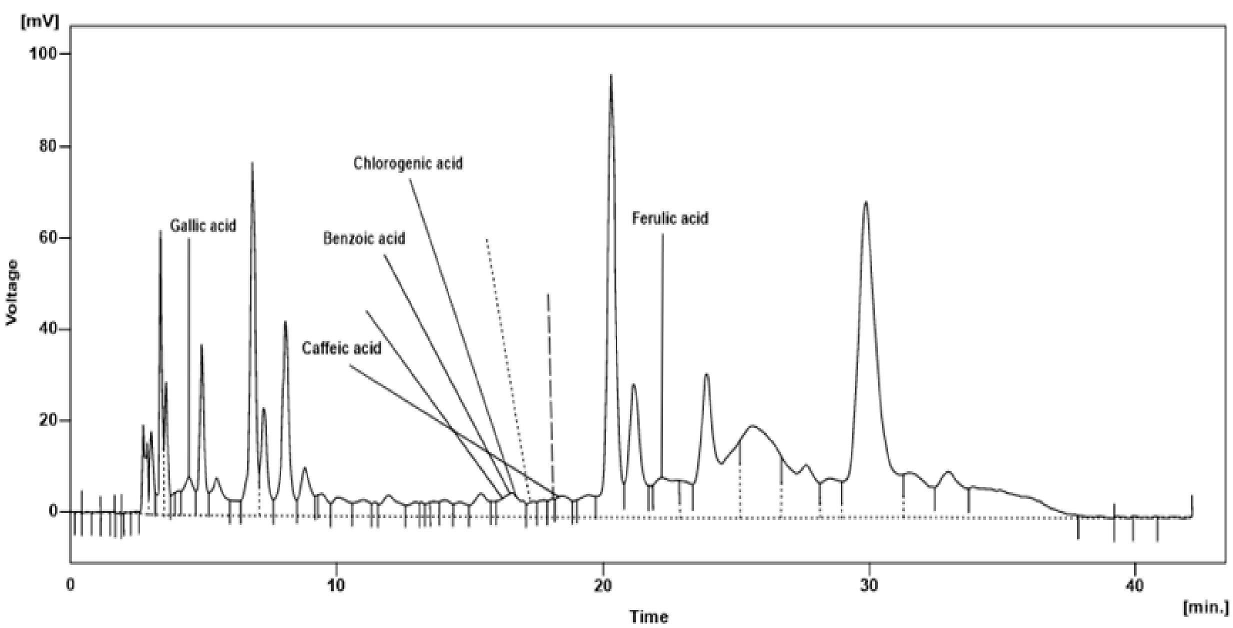


PLATE – X. The HPLC chromatogram of various polyphenols in In. Mcx.

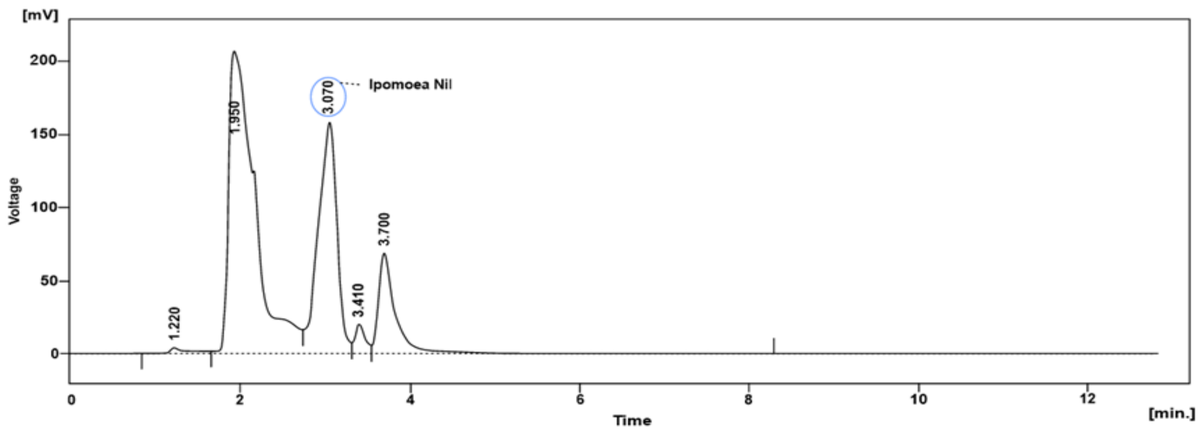


PLATE – XI. HPLC chromatogram of *Ipomoea Nil* identified in In. Mcx.

Table 1-List of HPLC-Identified compounds in the In. Mcx.

Sr #	RT (min)	Area (mV.s)	Quantity (ppm)	Mol.Mass (g/mol)	Possible Compound	Mol. formula
1.	14.533	106.659	11.30	122.12	Benzoic acid	$C_6H_5CO_2H$
2.	12.947	93.496	4.30	180.16	Caffeic acid	$C_9H_8O_4$
3.	186.657	15.360	14.55	354.31	Chlorogenic acid	$C_{16}H_{18}O_9$
4.	22.207	509.700	36.69	194.18	Ferulic acid	$C_{10}H_{10}O_4$
5.	4.453	220.962	7.95	170.12	Gallic acid	$C_7H_6O_5$

4.1. HPLC-Based Characterization of In.Mcx

The HPLC is suitable for both qualitative and quantitative analysis of naturally occurring compounds. Column chromatographic analysis and quantitative modelling were performed on In. Mcx. Flavonoids, including quercetin and *Ipomoea Nil*, along with phenolic acids such Benzoic acid, Caffeic acid, Chlorogenic acid, Ferulic acid, Gallic acid were identified in the HPLC analysis. Plate-X shows the chromatograms of quercetin and phenolic acid while Plate-XI shows chromatograms for *Ipomoea Nil.* Table 1 lists the quantity of components in ppm.

5. CONCLUSION

This research focuses on the potential use of *Ipomoea Nil* fibres as a valuable addition to the natural and sustainable textiles, when blended with *Gossypium Herbaceum* and *Cannabis Sativa this* study demonstrates that incorporating *Ipomoea Nil* improves fabric properties like Moisture management, Breathability, Strength, Durability and additionally its Anti-inflammatory, Anti-oxidant and Anti- Bacterial qualities make it an excellent choice for applications that requires hygiene and comfort. These findings suggests that *Ipomoea Nil* could play a significant role in development of sustainable and high performance fabrics.

In conclusion this study shows the promising application of this fabric in home textiles have the potential to revolutionize home textiles by offering a unique performance and sustainability. The results indicate that the fibre blends can provide a durable Eco-friendly fabric solution. As the industry continues to seek innovative sustainable materials, *Ipomoea Nil* stands out as a promising candidate for the future of textiles.

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