

# Production of Fabric From Coffee Arabica Ground and Aloe Vera

Pooja G T<sup>1</sup>, Annapurneshwari N R<sup>2</sup>, Haripriya G T<sup>3</sup>, Rajat Hadri M<sup>4</sup>,  
Rojaya J Helemne<sup>5</sup>

<sup>1</sup>Student of R V College of Engineering

<sup>2,3,4,5</sup>Student of G M University

## Abstract

Agricultural waste utilization presents an innovative and sustainable approach to reducing environmental pollution while generating value-added products. This study focuses on producing biodegradable fabric from waste *Coffea arabica* grounds and Aloe vera fibers through eco-friendly processing techniques. Fibers were extracted using washing, retting, alkali treatment, enzymatic treatment, and tannic acid cross-linking, followed by weaving through a handloom. The developed fabric was evaluated for thermal resistance, phytochemical safety, elastic properties, pilling behavior, washability, dimensional stability, and colour fastness. Results indicate that coffee-aloe vera fabric exhibits good tensile strength, excellent light fastness, biodegradability, and enhanced moisture absorption. The study demonstrates that agricultural residues can be successfully converted into functional, sustainable textiles, offering a promising alternative to synthetic fibers and contributing to circular economy practices in the textile industry.

## 1 INTRODUCTION

*Coffea arabica* grounds and aloe vera fiber represent a fascinating intersection of nature and innovation in the realm of textile fibers. These botanical fibers possess a range of unique properties that make them highly desirable for various applications, particularly in the textile industry. One of the most notable characteristics of *Coffea arabica* grounds and aloe vera fiber is their composition of healthy amino acids, which offer nutritional benefits for the skin. This feature makes them not only functional but also beneficial for personal care applications, such as skincare products and garments worn directly against the skin. Additionally, these fibers excel in moisture absorption, ventilation, draping, and warmth, surpassing the performance of both natural and synthetic fibers[1]. This versatility makes them suitable for a wide range of textile products, from clothing to household textiles.

The softness and smoothness of *Coffea arabica* grounds and aloe vera fabrics rival that of cashmere, providing a luxurious feel to the touch[2]. This luxurious quality, combined with the fibers botanical origins, adds an element of sustainability and eco-friendliness to the textile industry. By sourcing these fibers from plants rich in nutrition, manufacturers can create textiles that not only feel good but also align with consumers increasing preference for environmentally conscious products.

In terms of production methods, there are various approaches to bonding these fibers to create fabrics. Traditional methods involve impregnating the fibers in a binder solution and then heating them to facilitate fiber-to-fiber adhesion. However, these methods can be costly and energy-intensive, posing challenges in

terms of sustainability and efficiency. As a response to these challenges, foam application of aqueous binder systems has gained acceptance in the industry[3,4]. This method offers a more environmentally friendly alternative, particularly when using plant-based protein binders that are both inexpensive and biodegradable.

Aloe vera, in particular, has garnered attention for its potential applications beyond skincare. Due to its high hydrophobicity, it has been explored extensively as an adhesive and plasticizer.

Its availability and low cost make it an attractive raw material for bonding cellulosic substrates, offering a sustainable alternative to conventional adhesive materials. Recent research has focused on harnessing the properties of aloe vera protein-based binders for the production of non-woven fabrics[5]. These bio-binders offer a sustainable alternative to commercial acrylic binders, with comparable performance in terms of mechanical, thermal, and water absorption properties. Scanning electron microscope analysis has confirmed the effectiveness of aloe vera-based binders in bonding viscose fibers, further validating their potential in textile applications.

*Coffee arabica grounds* fiber, produced through wet spinning and thermoforming, represents another advancement in textile fiber technology. This fiber combines the best qualities of natural and synthetic fibers, offering superior comfort, beauty, and ease of care. With its potential applications in a variety of products, including dry and wet wipes, *Coffee arabica grounds* fiber holds promise for driving innovation and sustainability in the textile industry. *Coffee arabica grounds* and aloe vera fiber represent a compelling combination of botanical origins and technological innovation in the textile industry[6]. These fibers offer unique properties that make them highly desirable for various applications, from personal care products to clothing and household textiles. As sustainability and eco-consciousness continue to drive consumer preferences, these botanical fibers are poised to play a significant role in shaping the future of textiles.

## 2 OBJECTIVES

1. To produce fibers from waste *Coffee arabica grounds* and aloe vera.
2. To weave the produced fibers into fabrics.
3. To analyze the properties of fabrics.

## 3 REVIEW OF LITERATURE

The following are few literature related to fiber extraction and biodegradable fabric process.

### 1 Raghuvver H. Desai, L. Krishnamurthy, T.N. Shridhar, *Lighting and Effectiveness of Coffee (Betel) Fiber as a Reinforcing Material in Eco-friendly Composites* 32-34, 2016.

In this paper investigates the properties of betel nut husk fiber, focusing on variations in fiber maturity, length, diameter, and density. It notes that raw betel nut folium fiber possesses the longest length, followed by ripe and matured fibers. These fibers are derived from the fibrous covering of betel nut fruits, containing both fine and coarse fibers. The coarse fibers, characterized by robust mechanical strength and exceptional toughness, consist of a blend of cellulose, hemicellulose, lignin, pectin, and protopectin in varying proportions. This composition contributes to their unique properties and suitability for diverse applications. Understanding these characteristics is crucial for leveraging betel nut husk fiber in various industries, from textiles to composite materials. Moreover, it sheds light on the potential for utilizing agricultural by-products effectively, promoting sustainability and resource efficiency in manufacturing processes. Overall, the research provides valuable insights into the properties and potential applications

of betel nut husk fiber, contributing to the exploration of novel and eco-friendly materials in the field of materials science and engineering.

**2 Yilidirim, Arzu yavas, and Ozan avinc enzyme Working to Create sustainable Textile Materials and Textile Colorants Leading to Sustainable Textile Design. Sustainability in the Textile and Apparel Industries. Springer. 109-126, 2020.**

In this paper, sustainable textile design without harming the environment nowadays is one of the Important is in the textile industry. Environmental concerns lead various researchers and artists to find and explore the applicability of more sustainable, renewable, and environment friendly resources for fibers and colorants the material produced by the advancements in the detection and synthesis methods of the resultant cellulose can be using in a wide range of commercial applications comprising textile, medical, cosmetic, and food applications and products. From the textile point of view, apart from cellulose production due harm for textile substrates, enzyme can also be utilized for textile coloration.

**3 Kamil Kaminski, Magdalena Jarosz Grudzein . Hydrogel plant cellulose (Coffee aloe vera fabric) a path to improved materials for new eco-friendly textiles. Cellulose, 27, 53--55,2021.**

The paper introduces an innovative, environmentally friendly approach to synthesizing and modifying cellulose for textile production. It focuses on creating stable hydrogel cellulose from *Coffee catechu*, a readily available and inexpensive source. By optimizing manufacturing processes, the method emphasizes maximum raw material recovery, minimal energy consumption, and reliance on natural and renewable resources. The resulting materials undergo thorough characterization, assessing properties like wettability, mechanical strength, and flame resistance. The study underscores environmental and social responsibility in promoting sustainable practices within the fashion industry. It advocates for the active pursuit of alternative materials as a means to uphold global ecosystem protection. Overall, the research highlights the potential of ecologically sound technologies in enhancing textile production while fostering a greater sense of responsibility towards sustainability.

**4. Rajan, A., J. G. Kurup, and T. E. Abraham. Biopolishing of Coffee nut fiber for value added products. Biochemical Engineering , 237–242,2021.**

Enzymes have become increasingly vital in the textile industry, particularly in recent years. They are utilized in various applications, with notable examples including stone washing denim and modifying cellulosic fabrics. Traditionally, denim was stone washed using pumice stones to achieve a faded or worn look. However, enzymes now offer a more environmentally friendly alternative, as they can produce similar effects without the need for abrasive stones. One of the key enzymes used in textile processing is cellulase. Cellulase is highly versatile and finds widespread application in processes such as bio-preparation, bio-polishing, and softening of cellulosic fibers. Bio-polishing, in particular, has gained significant attention due to its ability to enhance fabric quality while being environmentally sustainable. Bio-polishing involves treating fabric with cellulase enzymes to improve its appearance and feel. During this process, the cellulase enzymes act on the surface of cellulosic materials, removing protruding fibers and leaving the fabric surface smooth and clean. As a result, bio-polishing reduces the tendency of fabrics to pill and become fuzzy, thereby enhancing their overall quality. One of the key advantages of using enzymes in textile processing is their eco-friendliness. Enzymes are readily biodegradable and do not leave chemical residues on processed materials. Additionally, the color changes observed in dyed goods when using enzymes are minimal, further highlighting their suitability for textile applications.

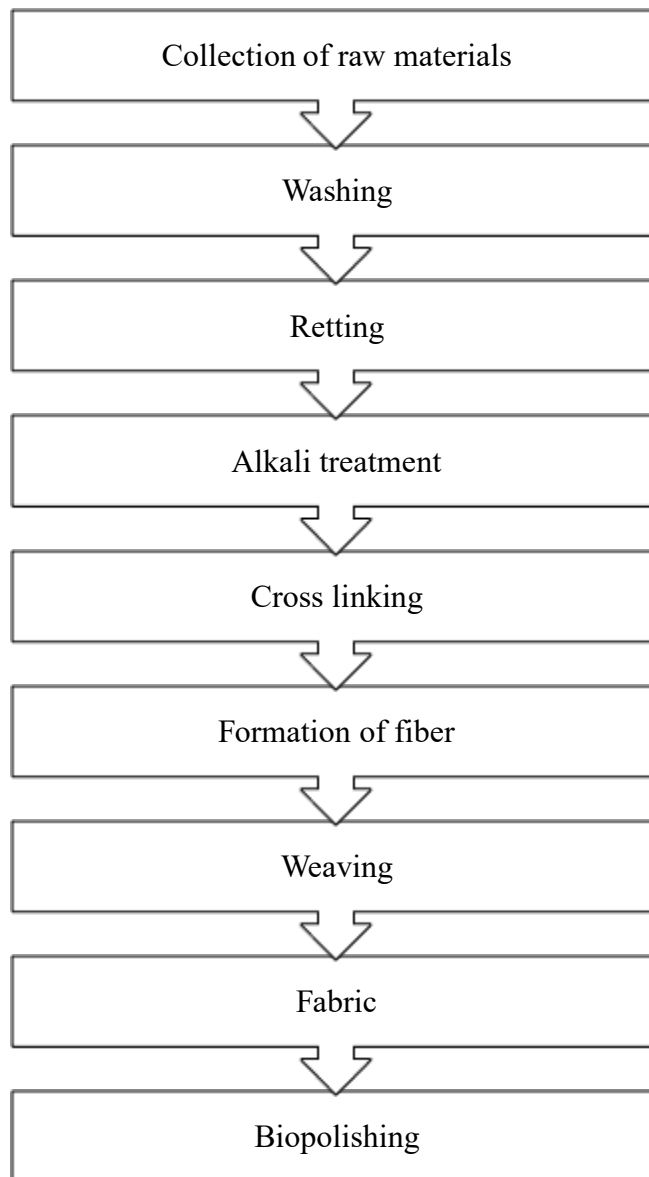
#### 4 MATERIALS AND METHODOLOGY

**Material required:** Coffee grounds Aloe vera

**Reagents required :**

NaOH, Deionized, Tannic acid, cellulose enzyme powder, Lime water FeCl<sub>3</sub>.

#### 4.1 METHODOLOGY



Flow chart of fabric formatio

#### Collection of raw material

Collection *Coffee* and aloe vera *folium* different ageing of plant suitable *folium* are collected.

#### Washing

The pure crystals of NaOH and neem oil is used because it acts as detergent to wash the minute impurities and colour it is used for bleaching. It helps in removal of dye or natural colour to give it colourless texture.



**Fig 4.1.1 : Washing *Coffee arabica* grounds and aloe vera**

### **Retting**

The *Coffee arabica* grounds and aloe vera is loosened by soaking in deionized water in every alternate day with fresh deionized water for about 5 days. Using normal tap water may cause growth of microbes which spoil the fiber and influences decaying. The separated fibers are spread on plastic sheet to dry items under sunlight. for about 3 days.

**Fig 4.1.2 : Retting of *Coffee arabica* grounds and Aloe vera**



### **Alkali Treatment**

The loosened and sundried *Coffee* and aloe vera fibers after retting is subjected for alkali treatment using a solution of 3% NaOH at normal ambient temperature of a room, usually around 20-25 degrees Celsius

(68-77 degrees Fahrenheit). The fibers again cleaned with deionized water. washed with deionized water until to reach neutral pH and spread over mesh or polythene sheet for drying in room temperature for about 72 hours.



**Fig 4.1.3: *Coffea arabica* grounds and aloe vera fibers treated with NaOH**

### **Enzymatic Treatment**

The fibers treated with alkali Treatment, washed and dried at normal ambient temperature of a room were considered for cellulase enzyme treatment. A suspension of cellulase enzyme powder is dissolved distilled water (about 3 g in 100 ml concentration) was prepared and the *Coffee* fibers are soaked providing optimal parameters of pH 6.7 and temperature about 55<sup>0</sup> C required for the cellulase enzyme to on cellulose of the *Coffee* fibers for about 60 minutes[7]. The *Coffee* fibers were cleaned with deionized water. sundried for 2 days. The procedure will be repeated 3 times to ensure cellulose of *Coffee* fibers was removed to the maximum extent.



**Fig 4.1.4 : *Coffea arabica* grounds and aloe vera fibers treated with cellulase enzyme**

### Cross-linking

Tannic acid is used for cross-linking of the obtained both fibers . which helps in forming strong cross link to obtain fabric structure which gives it good strength for further usage.



**Fig 4.1.5 : *Coffea arabica* grounds and aloe vera fibers treated with tannic acid**

### Lime water

Lime water is used for washing after the process of washing with NaOH to reduce or maintain the less or neutral pH of the *folium* it is also used after the cross linking process to neutralize the pH and also washing the excess of tannic acid.



**Fig 4.1.6 : Fiber treated with lime water**

### FeCl<sub>3</sub>(Ferric Chloride)

FeCl<sub>3</sub> is used for the confirmatory test of the cross-linkage which is obtained by addition of tannic acid.

### The formation of fibers

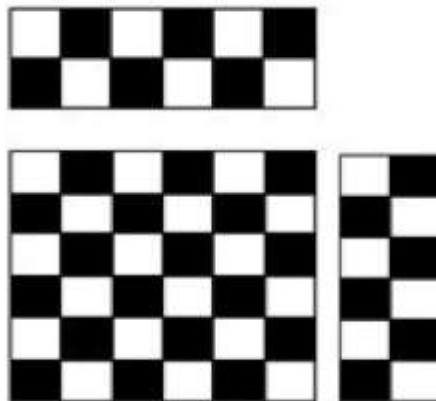
After 6-7 days the cross-linked fibers are separated from the tannic acid and sundered[8,9]. Then the cross- linked fibers are sun dried using mesh. (The mesh position is slant )Then the long fibers are obtain.



**Fig 4.1.7 : *Coffee arabica* grounds and aloe vera fibers**

### **Weaving of fibers**

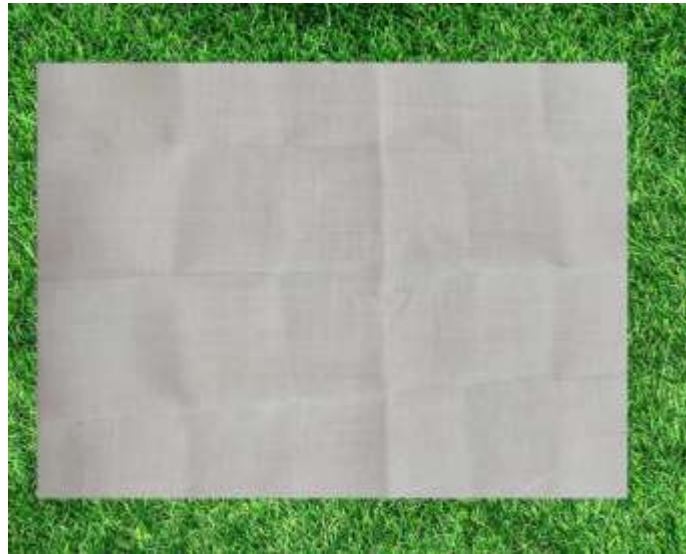
The fibers are weaved using the hand loom to fabric and the cloth is formed.



**Fig 4.1.8 : Plane weaving pattern**



**Fig4.1.9 : Weaving**



**Fig 4.1.10 : weaved fabric using hand loom**

## **BIOPOLISHING FOR WEAVED FABRIC**

### **Biopolishing**

Biopolishing is a textile finishing process aimed at improving the quality of cellulose knitted fabrics. Enzymes are utilized to achieve permanent effects by selectively removing protruding fibers, reducing pilling tendency and fuzziness. This process significantly enhances fabric softness and appearance. By targeting small fiber ends, enzymes weaken them via hydrolysis, making them easier to remove through minimal abrasion. Biopolishing can be conducted at any stage of wet processing but is typically performed post-bleaching for convenience[10,14]. Its efficacy lies in the enzymatic breakdown of protruding fibers, resulting in reduced fabric hairiness and improved overall texture. The process not only enhances fabric aesthetics but also increases durability by minimizing pilling, thus extending the lifespan of the textile. Biopolishing represents a sustainable approach to textile finishing, offering both functional and aesthetic benefits while reducing the environmental impact compared to traditional chemical treatments..

It can be done in both continuous or batch processes. However, continuous processes require some incubation time for enzymatic degradation to take place[15]. Removing the fuzz makes the colour brighter, the fabric texture more obvious, and reduces pilling. Unfortunately, the treatment also reduces the fabric strength. Smoother yarns also increase the fabric softness, appearance and feel. Since it is an additional process, the bio-polished garments may cost slightly more. Next time you buy apparel, look for the label Bio-Polished.

### **Objects of Biopolishing are**

1. To removes protruding fibers.
2. To removes Hairiness, fluffs and pills.
3. To Prevented material sticking.
4. To softens fabric hand & improved handle.
5. To achievement of surface smoothness and a clear structural appearance & improved luster.
6. To improved material texture relaxation & increased flexibility.
7. To improved sew-ability & fast to washing, low pilling tendency, no napping in use, or during care operation.

8. To Converted fabrics from Poor quality, uneven, napped, knops material surface to lustrous, soft, elegant, top quality with a fine, high quality surface appearance.

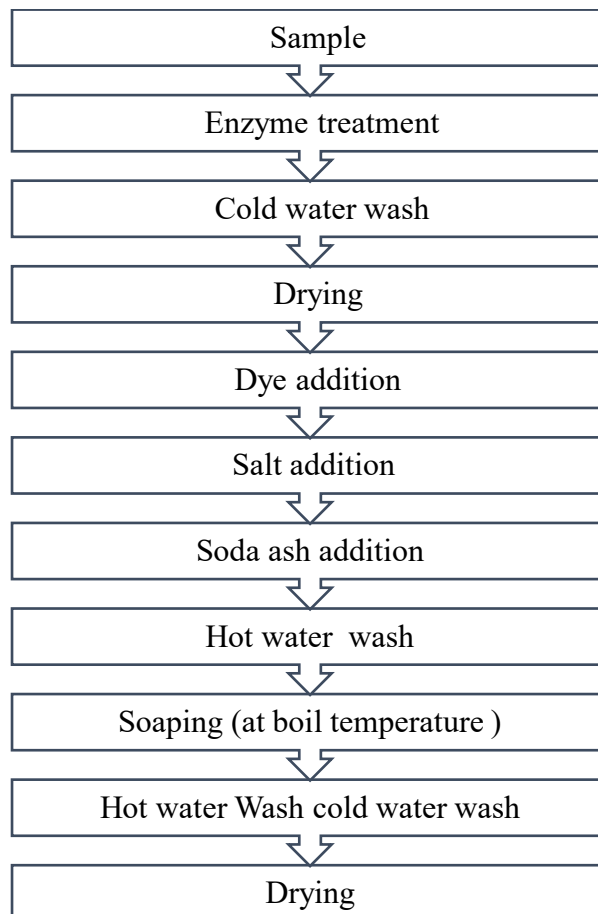
**Bio-polishing before Dyeing.**

With the apply of this technique, fabrics will attain a smooth luster as well as enhance the quality of the fabric. Basically, enzymes such as cellulose are used on the cotton fabric to remove protrusion[16,18]. These enzymes are further de-activated by increasing the temperature.

Bio-polishing applied before dyeing renders the fabric a better look and feel.



**Fig :4.1.11 : Process of biopolishing before dyeing**



Flow chart of bio-polishing before dyeing

### Standard for Biopolishing

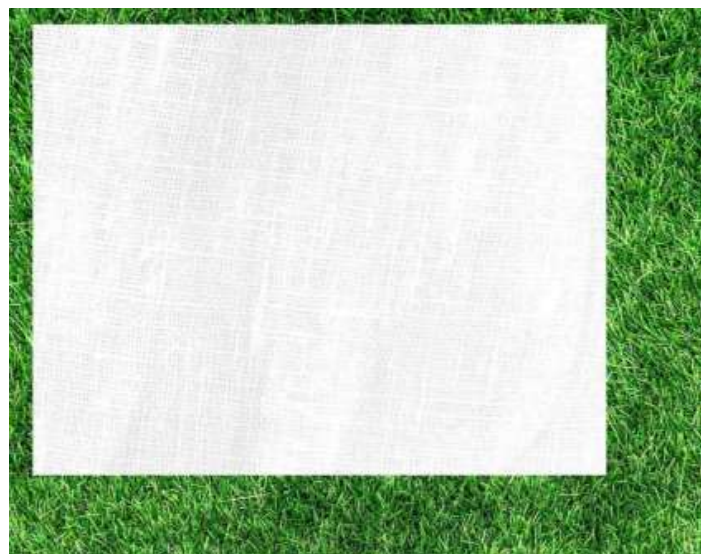
- Concentration of Enzyme = 3%
- Temperature = 55 °C
- Time = 55 minutes
- pH = 4 – 5

### Method

Enzymatic cellulose degradation is also possible during reactive dyeing. Here the dyeing process as well as bio-polishing will be affected. We can apply this process Number of washes, time, cost and energy can be saved by this one bath method[19,20]. However, it should be noted that there is some reduction in colour yield of reactive dyeing. This is because reactive dyeing is carried out in acidic pH during bio-polishing. But precaution is taken during addition of soda-ash as reactive dyes require alkaline condition for its fixation[21]. The fabric is made neutral before adding soda-ash. It is found that neutral stable enzymes are more suitable in this process.

### Advantages of Biopolishing

1. Enhanced Fabric Quality: Biopolishing reduces pilling and fuzziness in cellulose fabrics, leading to improved softness and appearance.
2. Increased Durability: By selectively removing protruding fibers, biopolishing minimizes wear and tear on textiles, extending their lifespan.
3. Environmentally Friendly: Unlike traditional chemical treatments, biopolishing uses enzymes, reducing the need for harsh chemicals and conserving water.
4. Sustainable Option: Biopolishing aligns with eco-friendly practices, contributing to a reduction in environmental impact in the textile industry.
5. Cost-Effective and Efficient: Integrating biopolishing into existing wet processing stages is seamless, making it a practical and economical choice for textile manufacturers.



**Fig4.1.12 : Biopolishing fabric**

## IMPORTANT OF ANALYSIS (TESTING) FABRIC AND FABRIC PROPERTIES

Lab testing allows brands, retailers, and vendors to test their textiles and apparel for various factors, including physical and chemical properties, such as colourfastness, durability, shrinkage, flammability, flame retardancy, and more.

Also known as textile testing, fabric testing or garment testing, lab testing is critical in today's global supply chain, where brands and retailers rely on suppliers worldwide to manufacture their products to their specifications.

Commonly tested items include

- Yarn
- Fabric
- Trims
- Accessories
- Apparel
- Footwear

During textile testing, auditors evaluate the products against the required standards and regulations by stretching, rubbing, and washing the fabric to check for any defects or irregularities. It can involve testing specific elements like zippers, buttons, and other fastenings or the entire product itself.

Either way, lab testing is an Essential quality control tool brands, retailers, and vendors who want to ensure their products meet the highest quality standards.

## LAB TESTING IMPORTANT IN FABRIC PRODUCTION

Lab testing plays a pivotal role in the apparel industry, serving various crucial purposes that contribute to the overall success and integrity of products. Here's a detailed breakdown In essence, lab testing is indispensable in the apparel industry as it ensures that products meet stringent quality, safety, and legal standards while also aligning with consumer expectations. By investing in comprehensive testing processes, manufacturers can uphold the integrity of their brands and deliver products that inspire confidence and trust among consumers.

### Top 3 reasons why lab testing is so important for before using

1. **Quality assurance** : Companies invest a lot of money in production, so they must ensure the end product meets the specified quality standards. Lab testing helps identify any physical or chemical defects in the fabric that could result in a sub-par product.
2. **Compliance** : Lab testing helps brands and retailers adhere to global standards, such as ISO, It also ensures that products meet the applicable safety regulations for their intended use.
3. **Avoiding the risk of liability or recall** : It's essential to identify and rectify any problems with the product before it reaches the market and decrease the risk of liability or recall due to faulty material or manufacturing defects. Lab testing helps brands and retailers detect potential product issues before they become a problem.

### How does lab testing usually work

- Brands or retailers typically conduct in-house textile testing or forward their textile and apparel samples to a third-party testing laboratory, where the products are tested against the relevant standards and regulations.
- The process usually starts with random sampling, followed by physical testing such as tear strength, abrasion, or pilling tests. Depending on the product, chemical testing may also be required to check for any hazardous substances that might be present in the material.

- Once all tests are completed, results are compiled in a report which can then be used as evidence that the product meets the required standards and can be safely used by consumers.
- Any discrepancies between test results and specifications are usually highlighted in a report, allowing brands, retailers and their vendors to take corrective measures.
- All lab tests fall into two categories quality and safety. Quality tests relate to consumer satisfaction, while safety tests prevent products from jeopardizing the health and safety of the consumer.

Most of the time, lab testing follows a standardized process to ensure accuracy and consistency. However, brands may also request additional tests if they have specific requirements that need to be met.

### **DIFFERENT TYPES OF LAB TESTING IN THE TEXTILE**

The most common lab tests in the garment industry or textile industry are Heat resistance property, Phytochemical test, Wash ability, Elastic property, Light fastness property, this five test similar fabric.

#### **Pilling testing**

Pilling testing is one of the most common problems faced by garments and fabrics. Pilling occurs when fibres become tangled or matted together, creating small balls of fabric on the surface. Pilling tests help assess a fabric's resistance to this phenomenon by subjecting it to wear and tear over a set period of time.

#### **Flammability testing**

Flammability tests help assess the fire resistance of a fabric or garment. Tests check the flame spread, flammability (the ease at which a fabric catches fire), and afterglow time to help determine the level of fire resistance. Some product categories requiring these tests include sleepwear, upholstery fabrics, curtains, carpets, and rugs.

#### **Top 3 parameters for testing are**

While the type of tests will depend on the product, three key parameters should be tested in all garments: fabric construction, dimensional stability, and colourfastness.

These tests assess the fabric's integrity, ability to withstand wear and tear, and resistance to fading or discolouration.

#### **Fabric construction**

All garment industry manufacturers must test their products' fabric construction, including their strength, durability, and uniformity. Picks per inch (PPI) and ends per inch (EPI) are two methods of testing the construction of fabrics. PPI tests measure the number of threads per inch in a fabric's warp and weft, while EPI tests measure the number of threads per inch in a fabric's warp or weft. Fabric construction tests can identify inconsistencies in the fabric, such as weak or thick spots, and ensure that it maintains its shape and size.

**Dimensional stability** A common problem with many fabrics is that they shrink or stretch when exposed to heat, moisture, and different types of detergents. Dimensional stability tests measure property of the fabric resistance to these changes. These tests involve subjecting the fabric to the different conditions, such as washing, heat and humidity, and then measuring its size and shape before and after the test. Most textile manufacturers use a standard test protocol called to measure the dimensional stability.

#### **Colourfastness**

An important parameter in assessing the quality of fabrics is their colour fastness. Often, fabrics can be prone to fading or discolouration when exposed to light, water, or detergents. Colourfastness tests measure the fabric's resistance to these changes and involve subjecting it to different conditions before assessing its colour.

retention. Brands and retailers should always conduct colour fastness tests to ensure their fabrics retain their colour and vibrancy over time.

**How lab testing can improve product quality**

Lab testing plays a crucial role in ensuring product quality throughout the production and development stages. It allows brands and retailers to maintain high standards by detecting defects and potential hazards in fabrics and garments early on. By conducting thorough testing before products hit the market, companies can provide consumers with safe and reliable items, while also safeguarding themselves from expensive recalls or liability claims. However, this process is intricate and demands expertise and industry-specific knowledge. Hence, selecting a reputable lab partner with the requisite experience, technology, and resources is imperative for accurate results and minimizing costly errors.

**4.2 RESULT OF ANALYSIS ( TESTING) OF FABRIC PROPERTIES**

**1. Thermal Resistance Test**



**Fig 4.2.1: Hot plate machine**

Thermal Resistance Test: put the tested sample on the upper surface of the test plate, adjust the lift button test bench inside the test chamber, and cover the four sides of the metal crimp, when the metal crimp is the exact horizontal position, then put down the Plexiglas cover, cover the instrument door, press the start button, and the instrument will run automatically. When it is stable, press the stop button, and the instrument will keep displaying the thermal resistance value as the test result.

Shrinkage source	(Percentage)%
Shrinkage in boiling water	2.2 %
Shrinkage in dry heat air	2.3 %

**Table 1 : Thermal resistance test value in percentage**

**2. Phytochemical Test**

Several Phytochemical are harmful to humans. Fabrics containing a Phytochemical it reaction on skin this reason conducted Phytochemical test in the result .Harmful Phytochemical are absent.

Phytochemical	Result
Aristolochic acid	Negative

**Table2 : Phytochemical Test**

### 3.Wash ability

knitted and woven -fabric samples were laundered in the standard conditions. The test results indicate that the fabric can be machine washed, while the knitted samples shrink markedly after washing. The light fastness of fiber was tested under outdoor condition for two weeks. After the test, the color of fiber fades a little, the strength decreases 11% and no mold fungus appears. Furthermore, the strength of fiber decreases only 9.8% under the ultraviolet irradiation for 120 hours. The test results indicate that the aloe vera.

### 4.Elastic property

The crimp ratio, residual crimp ratio and elastic recovery rate of *Coffee arabica grounds* and aloe vera fiber were tested, as illustrated.

Crimp ratios	Percentage%
Residual crimp ratio	0.88 %
Elastic recovery rate	45.4 %

**Table 3 : Elastic property test value in percentage**

### 5. Light fastness property

The light fastness of fiber was tested under outdoor condition for two weeks. After the test, the color of fiber fades a little, the strength decreases 11% and no mold fungus appears. Furthermore, the strength of fiber decreases only 9.8% under the ultraviolet irradiation for 120 hours. The test results indicate that the *Coffee* and aloe vera fiber has good light fastness property and good resistance to ultraviolet radiation, which is better than cotton, viscose and silk.

### 6. Pilling property

Tests were conducted on three knitted fabric samples made from different yarns: *Coffee* and aloe vera, cotton, and PAN (Polyacrylonitrile). The results showed that the pilling degree of the fabric sample was similar to that of the cotton sample and better than the PAN sample. However, the fabric sample had longer fuzzing fibers compared to the cotton and PAN samples. Overall, due to its low frictional coefficient, crimp number, and crimp stability, the fabric sample was prone to fuzzing but not pilling, achieving a pilling grade of 2.

### 7. Flame test

Cellulose fibers not catch quickly,(*Coffee* fiber strong mechanical property) burn bright, and leave behind powdery ashes and a burnt paper odor.

### 8. Fabric construction

- Fabric construction tests can identify are absents weak or thick spots.

- Good strength, durability, and uniformity.

### 9. Dimensional stability

Good washing ability in different types of detergents, and good stability in heat and humidity.

### 10. Colourfastness

No earlier colourfastness in *Coffee arabica grounds* and aloe vera fabric

## 4.3 GENERAL PROPERTIES OF COFFEE ARABICA GROUND SAND ALOE VERA FABRICS

### 1. Magnificent and noble appearance

*Coffee arabica ground sand* aloe vera fiber has luster of silk which is joyful and an excellent drape which makes the fabric elegant [10]. fabrics of yarn with high count has fine and clear appearance and is ideal for top-level shirt.

### 2. Dry and comfortable

The moisture absorption of *Coffee arabica ground sand* aloe vera fiber is similar to the one of cotton.

### 3. Good colour fastness

SPF can be dyed by acid and active dyes and provides fresh and lustrous colour fastness while also being stable in sunshine and perspiration. Compared with silk products, there is no problem concerning freshness of colour or stability of the dye. Its anti-ultraviolet characteristic is superior to cotton, even more superior than viscose and silk.

### 4. Healthy and functional property

SPF (presumably a type of fabric) exhibits favorable properties for skin health and functionality. It contains amino acids beneficial for skin protection and activates collagen proteins, providing resistance against irritation. Additionally, integrated bacteria-resistant elements within the fiber enhance its longevity and antibacterial properties.

## 4.4 MECHANICAL PROPERTIES OF COFFEE CATECHU AND ALOE VERA FABRIC

- 1. Tensile Strength :** Tensile strength refers to the maximum amount of tensile (pulling) force that a material can withstand without breaking. *Coffee* fabric exhibits moderate tensile strength, which can vary depending on factors such as the processing method, weave/knit structure, and fiber quality. While not as strong as some synthetic fabrics like nylon or polyester, *Coffee* fabric generally has enough tensile strength for usual textile uses.
- 2. Flexibility :** describes a material's ability to bend or deform under applied stress without breaking. *Coffee* fabric is known for its flexibility, allowing it to conform to the shape of the wearer's body or the contours of furniture. This property contributes to the comfort and ease of movement when wearing garments made from *Coffee* fabric and enhances the drape of curtains or upholstery.
- 3. Abrasion Resistance :** Abrasion resistance refers to a material's ability to withstand wear and tear caused by rubbing or friction. *Coffee* fabric generally exhibits good abrasion resistance, making it suitable for applications where the fabric
- 4. Crease Resistance :** Crease resistance is the ability of a fabric to resist wrinkling or folding when subjected to bending or compression. *Coffee* fabric may have moderate crease resistance, depending on factors such as the weave structure and finishing treatments applied to the fabric. While it may not

be as inherently crease-resistant as some synthetic fabrics, *Coffee* fabric can maintain a relatively smooth appearance with proper care and handling.

5. **Elasticity** : refers to a material's ability to stretch under applied stress and return to its original shape once the stress is removed. *Coffee* fabric typically has limited elasticity compared to stretch fabrics like spandex or elastane. However, some *Coffee* fabric blends with elastic fibers may exhibit enhanced stretch properties while retaining the natural feel and breathability of *Coffee* fabric.
6. **Tear Strength** : Tear strength measures a material's resistance to tearing or ripping when subjected to a sudden force or sharp object. *Coffee* and aloe vera fabric generally has moderate tear strength, which can vary depending on factors such as the density of the weave or knit and the thickness of the fibers. While not as tear-resistant as some heavyweight synthetic fabrics,

#### 4.5 SUITABLE FOR USES

*Coffee arabica grounds* and aloe vera Biodegradable fabrics find applications across various industries and everyday uses, thanks to their eco-friendly nature and versatility. Some common applications include

1. **Clothing and Apparel** : *Coffee catechu* and aloe vera Biodegradable fabrics such as organic cotton, hemp, bamboo, and linen are used to make sustainable clothing items like shirts, pants, dresses, and activewear. These fabrics offer breathable, comfortable, and durable alternatives to synthetic materials.
2. **Home Textiles** : Biodegradable fabrics are used to produce eco-friendly home textiles such as bedding (sheets, pillowcases, duvet covers), towels, curtains, and upholstery fabrics. Natural fibers like organic cotton and linen are popular choices for these applications due to their softness and durability.
3. **Packaging Materials** : Biodegradable fabrics are increasingly used in packaging materials as eco-friendly alternatives to traditional plastics. They can be used for bags, pouches, wrappers, and even as padding or cushioning materials for fragile items. These fabrics help reduce plastic pollution and promote sustainable packaging solutions.
4. **Medical textiles** : utilize biodegradable fabrics in diverse applications like wound dressings, surgical attire, masks, and bandages. Biocompatible materials, particularly biodegradable polymers, provide benefits such as lower risk of allergies and enhanced wound healing.
5. **Agricultural Textiles** : Biodegradable fabrics are used in agriculture for applications such as crop covers, mulch films, and nursery pots. These fabrics help improve soil health, conserve water, and reduce the need for synthetic pesticides and fertilizers.
6. **Geotextiles** : Biodegradable fabrics serve in civil engineering as geotextiles, aiding in erosion control, soil stabilization, drainage, and filtration. Natural fibers like jute and coir are preferred for their biodegradability and strength in these applications.
7. **Fashion Accessories** : Biodegradable fabrics are used to make eco-friendly fashion accessories such as hats, scarves, gloves, belts, and handbags. These accessories offer style and functionality while promoting sustainability and ethical fashion practices.
8. **Outdoor and Recreational Gear** : Biodegradable fabrics are used in outdoor and recreational gear such as backpacks, tents, sleeping bags, and hiking apparel. Natural fibers like hemp and recycled materials offer lightweight, durable, and sustainable alternatives for outdoor enthusiasts.

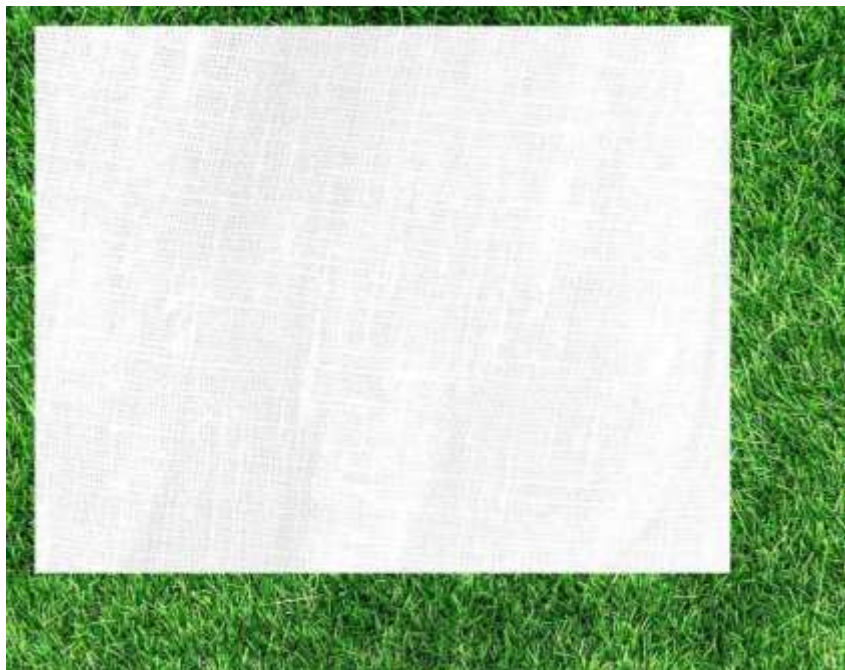
These examples are just a glimpse. of the diverse applications of biodegradable fabrics across various industries. As the demand for sustainable and eco-friendly materials continues to grow, the use of biodegradable fabrics is expected to expand further into new and innovative applications.

#### 4.6 BENEFITS

- 1. Environmental Friendliness:** *Coffee* fibers naturally decompose, easing landfill burden and pollution, offering a sustainable alternative to synthetic fabrics that can persist for centuries.
- 2. Reduced Carbon Footprint:** Biodegradable fabrics boast a smaller carbon footprint, needing fewer resources and less energy in production, thereby curbing greenhouse gas emissions.
- 3. Renewable Materials:** Derived from renewable sources like plant fibers (e.g., cotton, *Coffee*, bamboo), biodegradable fabrics promote sustainability and reduce reliance on finite resources such as petroleum-based synthetics.
- 4. Biocompatibility:** Biodegradable fabrics pose fewer risks to humans and ecosystems, breaking down into harmless compounds, ideal for skin contact and environmental use.
- 5. Versatility:** Biodegradable fabrics find applications across clothing, home textiles, packaging, and medical products, offering diverse eco-friendly solutions for various industries.

#### 5 RESULT AND DISCUSSIONS

The outcome of the project, done through the product fabric from discarded *Coffee arabica grounds* and Aloe vera, extends beyond mere textile creation. By repurposing agricultural waste, the initiative for a tangible reduction in environmental impact, contributing to waste minimization and the conservation of natural resources. The commitment to eco-friendly practices, marked by minimal chemical usage and reliance on biodegradable materials, positions the project at the front of sustainable textile production. After formation of fibers, then produced fiber into long yarn, after These fibers are transformed into fabric through weaving, resulting in fine cloth material.



**Fig 4.6.1 : Developed fabric**

## 6. CONCLUSION

Sustainability has become a critical aspect of the textile and clothing industry, necessitating a transformation towards more eco-friendly practices. Incorporating sustainable fibers into textiles represents a pivotal step in this endeavor. Organic materials like *Coffee arabica grounds* and aloe vera Fiber have emerged as promising alternatives to conventional, high-impact fibers due to their superior properties and wide-ranging applications. Despite their advantages, their limited adoption in textile fashion stems from resource-intensive cultivation methods, necessitating substantial water, pesticide, and fertilizer usage. However, organic variants offer resource-efficient growth and pose minimal risks to the environment and human society.

While these fibers exhibit commendable quality and yield, their reliance on specific geographical regions, notably China, poses a challenge to global supply chains. Nevertheless, they present an environmentally sound substitute for cotton, mitigating the use of hazardous chemicals and opening new markets and trends for fashion companies and consumers alike. Although their utilization in the textile industry remains limited, their potential extends beyond fashion, promising greener practices across various sectors.

Additionally, the by-products derived from these fibers find utility in diverse industries, including medicine, showcasing their multifaceted benefits. The evolving landscape of consumer preferences underscores the growing demand for sustainable products, prompting fashion companies to reevaluate their practices. While many still adhere to conventional production methods, the shift towards sustainability is increasingly evident, driven by consumer awareness of environmental concerns and the desire for products that prioritize skin health and comfort. Companies like Bergman AB exemplify this transition, offering a comprehensive range of sustainable materials, particularly organic fabrics, at reasonable prices. Their commitment to profitability aligns with a responsible approach to business, emphasizing transparency and accountability throughout their supply chain.

As the textile industry navigates these changes, technological advancements and innovations continue to reshape market dynamics, influencing consumer trends and product diversity. With sustainability emerging as a central theme, businesses are compelled to adapt, not only to meet regulatory standards but also to address consumer demands for eco-friendly alternatives. In this evolving landscape, companies that prioritize sustainability stand to not only meet market expectations but also contribute to a greener, more responsible future.

## 7 FUTURE SCOPE

Among the array of natural cellulose fibers, *Coffee* fibers and aloe vera emerge as highly promising materials for fabric production. *Coffee* fibers, recognized for their exceptional tensile strength, serve diverse applications across industries such as automotive, aerospace, and construction. Additionally, they play a vital role as allied fibers, enhancing the quality of other materials, while also offering environmental friendliness and mechanical superiority. Their versatility extends to various applications including textile fabrics, yarns, and the manufacturing of handicraft products.

Moreover, the utilization of *Coffee* catechu and aloe vera in the production of biodegradable fabrics holds significant potential. These fabrics are not only environmentally sustainable but also possess unique properties that make them suitable for specialized applications. Notably, their incorporation into bulletproof jackets highlights their capability to meet stringent requirements, contributing to the protection and safety of military personnel, including the INDIAN Army Forces. Overall, the innovative utilization

of *Coffee* fibers and aloe vera in fabric production underscores their remarkable potential and the positive impact they can have across diverse sectors, from industrial to defense applications.

## 8 REFERENCES

1. S.K. Ghosh, M.K.Sinha, S.B. Bandopadhyaya, *An attempt for the use of Coffee fiber for textile purposes, J.Plant* Vol.1, pp29-33,1975.
2. AL-Oqla, F. M., S. M. Sapuan, M. R. Ishakc, and A. A. Nuraini. Predicting the potential of agro waste fabric for sustainable automotive industry using a decision making model. *Computers and Electronics in Agriculture*, pp 116–127, 2000.
3. Cai Z, Qiu Y, Zhang C, Hwang Y, Marian M Effect of atmospheric plasma treatment of desizing of PVA on cotton, pp 670–675,2003.
4. Yayu. *The aloe vera Fibre A Healthy Comfortable Fibre For The 21st Century*. International Journal of Research in Applied Fibres & Textiles in Eastern Europe,vol 2,pp 111, 2004.
5. Narendra Reddy and Yiqian Yang- Biofibers from agricultural by products for industrial applications.Department of textiles, Clothing and design, Published ,20-22, 2004.
6. Rajan, A., J. G. Kurup, and T. E. Abraham. Biopolishing of *Coffee* nut fiber for value added products. *Biochemical Engineering* ,pp 237–242,2005.
7. Azizan, K. Fabrication of antibacterial bio composite from bacterial cellulose and *Coffee Catechu* extract. Faculty of Chemical & Natural Resources , pp 1–24,2006.
8. C.V. Srinivasa, K.N. Bharath, *Impact and Hardness Properties of Coffee Fiber-Epoxy Reinforced Composites*, J. Mater. Environ. Sci, pp 351-356,2011.
9. Thyavihalli Girijappa, Y. G., S. Mavinkere Rangappa, J. Parameswaran Pillai, and S. Siengchin. Natural fibers as sustainable and renewable resource for development of eco-friendly composites, pp 255-560, 2013.
10. Nagaraja , B. R. Gurumurthy & M. B. Shivanna, *Bio softening of Coffeenut waste Coffee arabica grounds, or leaf sheath for value added compost*, impact International Journal of Research in Applied, Natural and Social Sciences (IMPACT IJRANSS) Vol.1, pp 21-22,2014.
11. Mahesh, M. M.,Pelissari, F. M.; blacido, D. R. ,Menegalli, F. C. Achira as a source of biodegradable materials Isolation and characterization of nanofibers. *Carbohydrate polymers*, v.12, pp.406-415.,2015.
12. Keerthi, A., S. Imaad, R. M. Mark, K. S. Keerthan, and K. B. Pavana. . *Processing and characterization of epoxy composite with Coffee nut and casuarina fibers. American Journal of Materials Science* ,pp 96–100,2015.
13. Raghuvveer H. Desai1, L. Krishnamurthy, T. N. Shridhar, Lighting and Effectiveness of *Coffee* (Betel) Fiber as a Reinforcing Material in Eco-friendly Composites Vol5, pp29,2016.
14. Piccin, J. S.; Guterres, M.; Salau, n. p. g.; Dotto, g. l. Mass transfer models for the adsorption of Acid Red 357 and Acid Black 210 by tannery solid wastes. *Adsorption Science & Technology*, pp.300-316,2017.
15. Du G, Liu L, Song Z, Hua Z, Zhu Y, Chen J Production of polyvinyl alcohol-degrading enzyme with *Janthino* bacterium sp. and its application in cotton fabric desizing.Biopolishing, pp752– 758,2018.
16. Avinc, O., H.A. Eren, P. Uysal, and M. Wilding. . The Effects of Ozone Treatment on aloe vera Fibers. *Ozone Sci. Eng*, pp143–150,2019.

17. Muralidhar, N., V. Kaliveeran, V. Arumugam, and I. Srinivasula Reddy. *A study on Coffee nut husk fibre extraction, preparation and mechanical characteristics of the composites. composite panel* Journal of the Institution of Engineers. pp 12-18,2019.
18. Yildirim, Arzu yavas, *cellulose enzyme Working to Create sustainable Textile Materials and Textile Colorants Leading to Sustainable Textile Design. Sustainability in the Textile and Apparel Industries.* Springer. 10-26,2020.
19. Gartiser S, Wallrabenstein M, Stiene G *Assessment of several test methods for the determination of the anaerobic biodegradability of polymers.* J Environ Polym Degrad pp 173. 2020.
20. N Hut Tran Minh and Ha Ngo Ngan-. *Vegan leather An eco-friendly material for suitable fashion towards environmental awareness.* Vol. 2, pp 06-19,2021.
21. Kamil Kaminski, Magdalena Jarosz Grudzein . *Hydrogel plant cellulose (Coffee aloe vera fabric) a path to improved materials for new eco-friendly textiles.* Cellulose, pp 53-55,2021.