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## **Design and Development of Bamboo and Cotton Blended Fabric Using Natural Antibacterial Coating for Infant Clothing**

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### **ABSTRACT**

Today natural fiber has become one among the foremost discussed within the research field amongst various scientists and other people within the world rather than using synthetic fibers. This is often thanks to various advantages related to natural fibers like eco-friendly, low cost, availability in abundance and its biodegradability. Bamboo is that the fastest-growing plant on earth. Bamboo fiber is obtained from bamboo pulp, which extracted from the bamboo stem through the method of hydrolysis-alkalization and multiphase bleaching. thanks to the soft silky fabric and environmental benefits of bamboo fiber, bamboo clothing has become popular in some modern luxury fashions. Cotton may be a natural and soft fiber that grows with the seeds of the cotton, round the seed of the cotton plants of the *Gossypium* within the Malvaceous. Cultivated under controlled environmental conditions, these are very soft and clean to use in various purposes. Aloe vera gel contains powerful antioxidants belonging to an outsized family of substance referred to as polyphenols. These polyphenols, alongside several other components in burn plant, help inhibit the expansion of certain bacteria which will cause infections in humans. In this paper the bamboo fabric blended with cotton was weaved, and therefore the antibacterial finish of aloe vera gel was applied with the natural dyes of beetroot. The finished fabric is constructed into a garment.

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### **1. INTRODUCTION**

The fastest-growing plant in the planet is bamboo. One metre can develop on some varieties in a single day. The family Gramineae includes the grass known as bamboo. Bamboo grass can reach a height of one foot (30 cm), whereas enormous bamboo plants of wood can reach heights of more than 100 feet (30 meters). All around the world, bamboo plants can be found and have a significant economic and cultural impact. Bamboo is employed in the textile sector in addition to being used for building, musical instruments, and furniture. Southeast Asian and Chinese cultures have a long history of using bamboo. Bamboo was cultivated and used by the Chinese 7,000 years ago. It served as a source of food, clothes, shelter, transportation, and even weapons and musical instruments. The most significant material used was bamboo strips. Other frequently used materials, like silk, fur, and pebbles, were written on most frequently using strips. Aloe Vera is now demonstrating its potential as a significant mordant for natural dyes. Aloe Vera has already been known for its benefits to human health as well as aesthetic items. The aloe vera plant, which grows between one and two feet tall, has leaves that are covered in a translucent gel that is known for its remarkable healing powers. Nearly 96% of the gel's ingredients are water, along with a few other organic and inorganic substances, various vitamins, and 18 different kinds of amino acids. It can heal practically anything, from diabetes to constipation, and possesses both antiviral and antibacterial properties. If simple and efficient processing techniques are created for these materials They will be more suitable for commercial and other uses as a result. It will increase demand and benefit the farming community. The current suggested effort focuses on the effective fabric production from rural bio waste and the development of infant clothing made from sustainable materials.

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### **2.MATERIALS AND METHODS:**

#### **2.1 SELECTION OF TEXTILE FIBERS :**

##### **BAMBOO FIBRE:**

A regenerated cellulosic fibre made from bamboo may be called bamboo fibre. Bamboo stems and leaves are converted into starchy pulp using an alkaline hydrolysis and multi-phase bleaching process. Bamboo fibre is created through additional chemical procedures. Repeated technological analysis has shown that this sort of fibre has a thinness degree and a whiteness degree that are on the cusp of being comparable to that of typical finely bleached viscose, as well as good durability, stability, and tenacity. Bamboo fibre is anti-ultraviolet, making it ideal for summer apparel, especially for protecting children and pregnant women from the effects of ultraviolet radiation.

##### **BENEFITS OF BAMBOO FABRIC:**

- Powerfully insulating - keeps you cooler in the summer and warmer in the winter.

- Antibacterial - keeps you odor-free, feeling, and smelling fresh;
- Highly sweat-absorbing (pulls moisture from skin for evaporation - moisture wicking) - keeps you dry; One of the world's softest textiles, you'll adore how it feels. Protect yourself from skin cancer by using naturally occurring UV protection.
- Hypoallergenic - allergic reactions are not brought on by natural bamboo. Save the environment by purchasing the most eco-friendly cloth available. Silk and bamboo have fabrics that are similar in softness. Because the fibres have not undergone chemical processing.

### **COTTON FIBRE:**

Cotton is a soft, natural fibre that forms around the seeds of the *Gossypium* genus of cotton plants, which are members of the Malvaceae family of mallows. These are incredibly soft and clean to use for a variety of functions because they were grown in regulated environmental settings.

#### **2.1.1 DEVELOPMENT OF FABRIC PARTICULARS:**

The following parameters were used for developing the fabric samples and the efficacy were also calculated and represented in the below table

YARN COUNT	WARP COUNT - 40s WEFT COUNT - 40s
THREAD COUNT	Ends/Inch - 64 Picks/Inch - 58
FABRIC GSM	Calculated - 98.91g Measured - 75.8g
ABRASION RESISTANCE	94.045%
WICKABILITY	WARP - 300 sec WEFT - 720 Sec

#### **2.2 SELECTION OF ANTIBACTERIAL FINISH**

For hundreds of years, people have valued and utilised the aloe vera plant for its benefits to their health, beauty, and skin. The name "aloe vera" comes from the Arabic word "aloe," which means "shining sour stuff," and "vera," which comes from the Latin word for "truth." Aloe was known to the Egyptians as "the herb of immortality." Today, there are several dermatological uses for the aloe vera plant. The AATCC-147 technique and scanning microscopy were used to qualitatively assess the antibacterial activity of fabrics treated with A. vera. A. vera gel-finished fabric has been found to have much lower bacterial adhesion.

#### **2.3 SELECTION OF DYEING PROCESS:-**

Cross section of a yellow cultivar's root. The beetroot is the taproot section of the beet plant, sometimes referred to as the table beet, garden beet, sugar beet, red beet, or golden beet in North America. They are biodegradable, therefore when they are drained into water bodies, they don't disrupt the aquatic ecosystem. Therefore, dye fixatives are needed to make the dyes adhere to the cloth. These fixatives can take the form of starch, kelp, alum (hydrated double sulphate salt), table salt, or vinegar.

#### **2.4 METHODS OF ANTIBACTERIAL COATING:-**

Bamboo has a bio-agent known as "kun" that prevents bacteria from growing on the fibre, making it naturally antibacterial. Normally, this is carried over to the final product, enabling it to resist the development of bacteria that produces odours even after multiple washings. By forming a physical barrier, antimicrobial finishes on fabrics can reduce the spread of bacteria to the wearer. By padding, it is possible to apply the ideal conditions of chrysanthemum herbal extracts to bamboo fabric. Additionally antibacterial and antifungal, bamboo. This is due to bamboo's ability to naturally flourish and grow in the wild without the need of pesticides or fertilisers thanks to a bio-agent known as "Bamboo Kun," which has anti-bacterial and bacteriostatic properties. The term for the bamboo is bamboo contains a natural antibacterial bioagent. The antibacterial properties of bamboo cloth come from this bamboo. The bamboo plant has the same trait that protects it against pests that might otherwise harm the plant in its natural habitat. Bamboo indicates that no pesticides of any type are required to be used at all throughout the cultivation process. To keep pests at bay, cotton fields are frequently sprayed with a variety of chemical pesticides. This refers to the addition of potentially dangerous substances that could contaminate the material after it has through manufacturing procedures.



Fabric before coating

**Fig 1**

Fabric after coating

**Fig 2**

### **2.5 PAD DRY CURE METHOD:**

A pad-dry-cure procedure is the most popular application technique for press finishes that are easy to maintain and durable. The crosslinking reactant, catalyst, softener, and other elements are dried on the fabric during this procedure. The pad-dry-cure method of coating necessitates a separate machine for each phase. The machine might be the same or different depending on the temperature range needed for drying and curing. Dryers typically need to operate between 50 and 60 degrees Celsius, whereas curing machines need to operate at about 160 degrees Celsius for various coatings.

### **2.6 TESTING OF MATERIALS:**

Materials testing for bamboo cotton mix fabrics and fabrics with antibacterial coatings in accordance with particular standards were done in this study. Materials' physical characteristics can also be assessed.

#### **2.6.1 TENSILE STRENGTH:**

Various forces must be supported by fabric during its performance life in clothing. Therefore, a fabric must meet the required minimum level of strength in order to satisfy customer demands. The standard test entails examining a number of the fabric's parameters. ASTM D5035 -09 Standard test procedure for measuring the elongation and tensile strength of textile textiles. For assessing the tensile strength and elongation of the majority of textile textiles, this test method includes the grip and modified grasp test procedures.

#### **2.6.2 TEARING STRENGTH:**

The force needed to initiate or maintain a tear in a fabric is known as the tear strength. The tear strength test procedure standard is ASTM D5587.

#### **2.6.3 ABRASION RESISTANCE:**

The ability of a surface to withstand being worn away by rubbing or friction is known as abrasion resistance.

#### **2.6.4 ANTIBACTERIAL EFFICIENCY TEST:**

There are two methods for conducting an antibacterial test: qualitative and quantitative. Here, a qualitative test is being used. The test is assessed for both the coating process before and after. Antibacterial Eval (Quan) - AATCC 100 2019 is the title of the examination. Spread plate plating is the plating technique, and distilled water is the dilution medium. The spread plate method is a method for plating a liquid sample that contains bacteria so that it is simple to count and separate the bacteria. A spread plate that works well will have a consistent distribution of a countable number of isolated bacterial colonies. The test organisms, staphylococcus aureus AATCC 6538- $2.4 \times 10^5$  CFU/mL and klebsiella pneumoniae ATCC 4352- $2.4 \times 10^5$  CFU/mL, were streaked, and the fabric sample was cut with 4.8 cm in dia for each bacteria (1g). After putting the samples, all the plates were incubated at 37 degrees C for 24 hours. The plates were checked after incubation for the bacterial inhabitation zone surrounding the cloth sample. The clear zone's size was utilized to gauge the sample's level of inhibition.

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## **3.RESULTS AND DISCUSSION:**

### **3.1 TENSILE STRENGTH:**

The results of Tensile Strength are represented in the table -1 and chart-1

**RESULT:**

SAMPLE NO	Br. FORCE(kg)	ELOGATION (mm)	T BREAK (S)
1	16.00	8.20	1.64
2	15.80	7.70	1.54
3	15.40	7.70	1.54
Mean	15.73	7.53	1.15

Table 1 : Tensile strength of the bamboo fabric

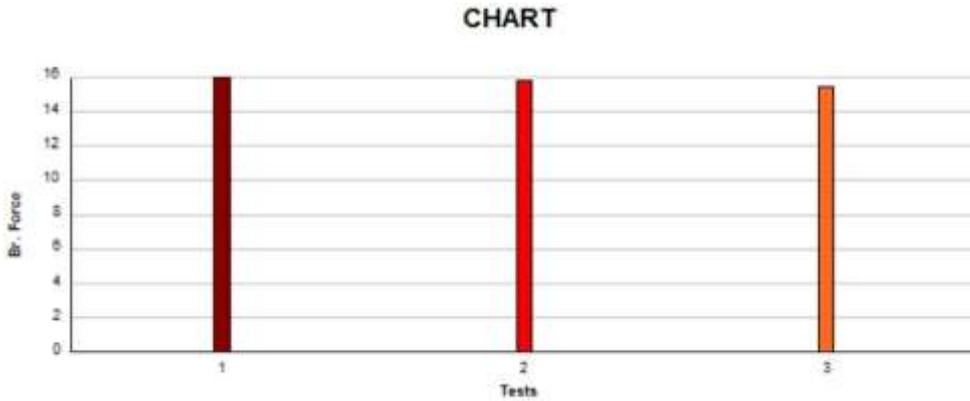


Chart 1: Tensile strength of the bamboo fabric

**DISCUSSION:**

When anything is pulled until it breaks, such as a rope, wire, or a structural beam, its tensile strength is calculated. The maximum tensile stress that a material can withstand before failing, such as breaking, is known as its tensile strength. Typically, a material's tensile strength is greater than its yield strength in terms of numerical value. A material's tensile strength can be determined with absolute precision. According to the test report mentioned above, the fabric's tensile strength in this instance is average.

**3.2 TEAR STRENGTH:**

The results of tear strength are represented in the chart-2

**RESULT:**

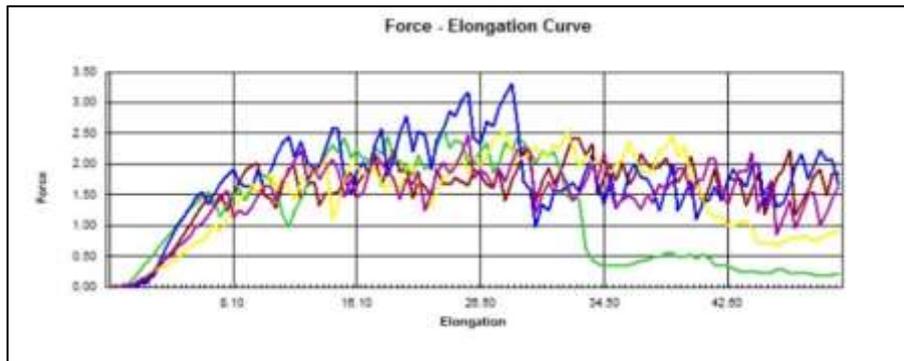


Chart 2: Tear strength of the bamboo fabric

**DISCUSSION:**

To determine how well a material can withstand the effects of tearing or cutting when under tension, the tear resistance or tear strength of a cloth is assessed. A fabric's GSM provides information about its tear strength. More tearing strength is correlated with higher GSM. The tearing strength of the cloth is directly correlated to the yarn's strength. The tear strength increases as yarn strength increases. The fabric's warp-wise tear strength is demonstrated by the results. It is a plain weave cloth (15 x 5). This demonstrates that the elongation of the warp yarns is lower than that of other knit materials.

### 3.3 ABRASION RESISTANCE:

The results of abrasion resistance are represented in the table-2

#### RESULT:

S.NO	Initial weight (grams)	Final weight (grams)	Weight loss (%)	Abrasion resistance (%)
1	0.118	0.112	5.08	94.92
2	0.118	0.112	5.08	94.92
3	0.117	0.109	6.83	93.17
4	0.117	0.109	6.83	93.17
<b>average</b>	<b>0.117 grams</b>	<b>0.442 grams</b>	<b>5.95 %</b>	<b>94.045</b>

ABRASION RESISTANCE OF THE TESTED SAMPLE: 94.045%

**Table 2: Abrasion resistance of the bamboo fabric**

#### DISCUSSION:

The ability of a surface to withstand being worn away by rubbing or friction is known as abrasion resistance. 3kpa of weight and 240 revolutions were provided to test the sample. The cloth exhibits good abrasion resistance in the tested sample. In this test, wear is simulated by rubbing the fabric against a worsted fabric.

### 3.4 ANTIBACTERIAL COATING TEST

The results of antibacterial coating test are represented before and after coating .

#### RESULT BEFORE COATING

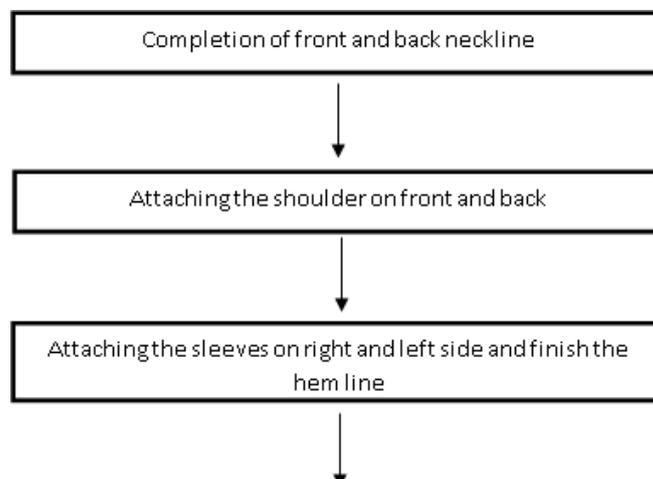
The sample showed 0% antibacterial activity against Staphylococcus aureus ATCC 6538 and 0% antibacterial activity against Klebsiella pneumoniae ATCC 4352 when tested according to AATCC 100 test method.

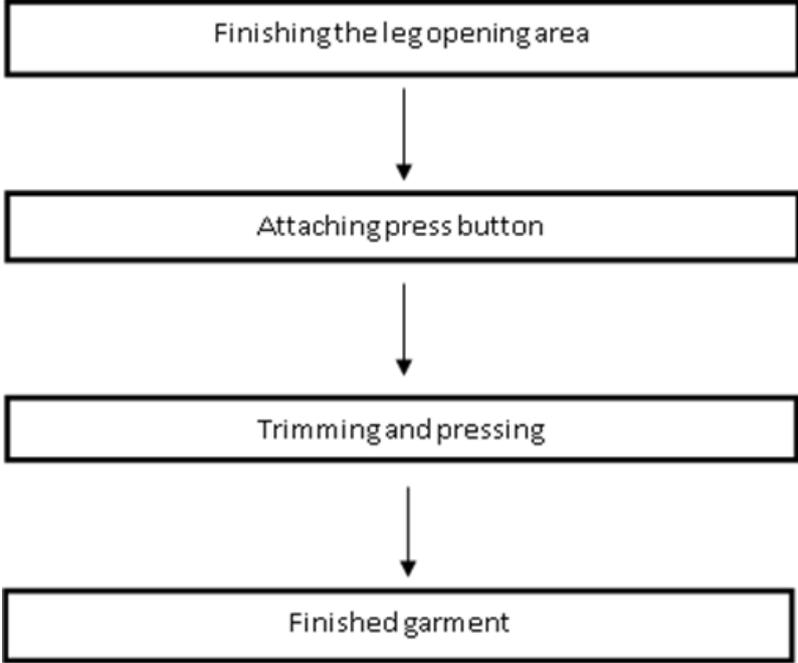
#### RESULT AFTER COATING

The sample showed 80% antibacterial activity against Staphylococcus aureus ATCC 6538 and 80% antibacterial activity against Klebsiella pneumoniae ATCC 4352 when tested according to AATCC 100 test method. Therefore the given sample is tested for before and after coating of antibacterial solution. The fabric which is coated is 80% bacterial free.

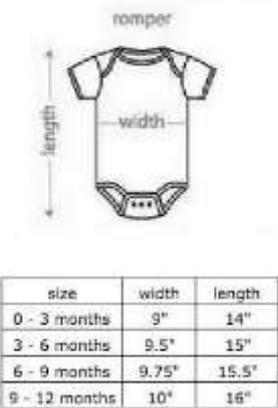
#### PATTERNING AND CONSTRUCTION OF PRODUCT:

The following construction flow processes were developed based on that the product were constructed





**MEASURMENT CHART**



**Fig 3**

**ROMPER PATTERN**



**Fig 4**

**FINAL GARMENT**



**Fig 5**

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## 5. CONCLUSION

Developed a naturally dyed bamboo cotton fabric with antibacterial finish for infant clothing . The fabric was made of 100% bamboo yarn and 100% cotton yarn with count of 40s. The fabric weaved in power loom. The developed fabric was coated using aloe vera gel and hibiscus dye. Aloe vera has its coolant effect and it has antibacterial effect. It Reduces the multiplication of bacteria's and Avoid skin problems and allergies. The fabric is designed in such a way that it provides comfortability to wearer and provides a better fit. The experimental research design was used keeping in view the objectives of the study. beetroot natural dye and aloe vera gel used for dyeing with alum mordent. It can be concluded that creating something new is the need of hour for the apparel industry and they are aware of it. Power loom bamboo fabric was used for apparel in this study considering its dye exhaustion properties. The study was successful innovative bamboo apparel products with natural dyes. The fabric has both the properties of bamboo and cotton. The developed fabric is 100% sustainable, it is eco – friendly, it easily degradable and it has 80% antibacterial activity.

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