Innovative Textile Fiber: Blending Cat Hair with Cotton Fiber for Sustainable and Novel Fiber Production.

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Abstract - This research investigates the creative and environmentally friendly application of cat hair as a fiber for yarn manufacturing, presenting a natural alternative within the textile sector. Similar to other animal fibers like wool, cat hair possesses warmth and a silky texture, yet it is frequently discarded during grooming sessions. The objective of this study is to evaluate the practicality of collecting, cleaning, processing, and spinning cat hair into functional yarn for textile applications. The focus will be on effective cleaning and de-shedding techniques, along with an analysis of the fiber's length, texture, and durability to determine its suitability for spinning. Furthermore, the research will examine the possibility of combining cat hair with cotton fibers to produce a distinctive and sustainable yarn. Cotton is renowned for its softness, strength, and breathability, making it a staple in textiles, while cat hair provides additional insulation. By merging these fibers, the project seeks to create a fabric that harmonizes softness, durability, and environmental responsibility. Prototype yarns will be developed and evaluated for their warmth, softness, durability, and comfort. This initiative responds to the increasing demand for cruelty-free and eco-friendly materials, aiding in waste reduction and promoting sustainability in the textile industry. The project underscores the overlooked potential of cat hair as a valuable resource, fostering innovative small-scale fiber production.

Key words: cat hair, sustainable fibers, cotton, textile, Animal fiber, spinning

1. INTRODUCTION

The word 'textile' originates from the Latin term textiles, which is derived from the verb texere, meaning to weave. Textiles encompass materials crafted from spun yarns or fibers, which can be woven, knitted, bonded, or crocheted into diverse forms. Up until the 18th century, India was renowned as a premier producer of high-quality textiles, celebrated globally for their exceptional craftsmanship. Woven fabrics, formed by interlacing two sets of yarns—warp (longitudinal) and weft (horizontal)—are recognized for their strength, durability, and limited stretch. Common examples of woven fabrics include satin, linen, cotton, and denim, each offering unique textures and applications in fashion, home décor, and industrial uses.

The initial phase of fabric production involves fiber creation, where synthetic fibers such as polyester and nylon are chemically manufactured, while natural fibers like cotton, wool, and silk are sourced from plants or animals. These fibers undergo processing through carding and combing before being twisted into yarns. The weaving technique can yield various patterns, including plain, satin, and twill weaves, resulting in fabrics suitable for clothing, upholstery, and other applications. The increasing demand for sustainable fibers, such as organic cotton and recycled polyester, is

influencing the future landscape of textile production.

2. MATERIALS AND METHOD

2.1 Collection and Cleaning of Cat Hair: Cat hair will be gathered during routine grooming sessions. Following collection, the hair will be cleaned with natural detergents and solvents to ensure it is free from oils, dust, and other contaminants. Any excess moisture will be eliminated through air drying.

2.2 Fiber Analysis: The cleaned cat hair will undergo fiber analysis to evaluate its length, texture, and strength, which will assist in determining its appropriateness for spinning.

2.3 Blending with Cotton: Various ratios of cat hair will be combined with cotton fibers (for instance, 70% cotton and 30% cat hair) to identify the optimal blend for yarn production. This blending process will be carried out manually by carding the fibers together.

2.4 Spinning into Yarn: The combined fibers will be spun into yarn using either a spinning wheel or a hand spindle. The resulting yarn will be assessed for smoothness, strength, and consistency.

2.5 Fourier Transform Infrared (FTIR) Spectroscopy: FTIR analysis will be conducted on both the cat hair and the blended yarn samples to determine their chemical composition and the functional groups present in the fibers. This analysis will provide insights into the molecular structure of the materials and highlight any notable differences or similarities between them.

2.6 Antibacterial Testing: The antibacterial characteristics of the yarns will be examined using established laboratory techniques, such as the agar diffusion method. This will evaluate the capacity of both pure cat hair and cotton-blended yarns to inhibit bacterial growth. The procedure will involve inoculating agar plates with common bacteria (such as E. coli or S. aureus) and measuring the inhibition zone surrounding the yarn samples.

2.7 Biodegradability Testing: The biodegradability of the yarns will be assessed by burying samples in a controlled environment.

2.8 Twist Test: The quantity of twists per unit length of yarn is evaluated to determine its stability and uniformity in twisting.

2.9 Tensile Strength Test: The strength of the yarn is assessed by measuring the force necessary to break it, yielding information regarding its durability and appropriateness for textile applications.

3. RESULT

A fabric made from a blend of cotton and cat hair was created to offer warmth, comfort, and a luxurious feel. The smooth texture of cat hair enhanced the fabric's drape and thermal insulation, making it ideal for colder climates. However, the inclusion of cat hair reduced durability, causing issues like fiber slippage and breakage during production, as well as increased pilling due to the shorter, less cohesive fibers. Despite these challenges, the blend resulted in a soft, breathable, and attractive fabric. With improved processing techniques, this innovative blend could be used in high-end, eco-friendly textile applications.

3.1 TWIST TEST EQUATION

The twist test results indicate that the cotton and cat hair blend has a twist level of 1597.71 twists per metre (TPM) and 40.67 twists per inch (TPI). This high twist level

indicates a tightly spun yarn, which is strong, dense, and smooth. Generally, a higher TPI improves tensile strength and abrasion resistance, enhancing durability and minimizing the risk of tearing.

3.2 TENSILE STRENGTH EQUATION

The results of the tensile strength tests for the fabric composed of cotton and cat hair reveal significant differences between the warp and weft directions. The yarns aligned along the length of the fabric exhibit considerably greater strength and resistance to breaking under tension, as indicated by a tensile strength of 0.0364 N/tex in the warp direction. In contrast, the tensile strength in the weft direction measures only 0.00804 N/tex, which is markedly lower.

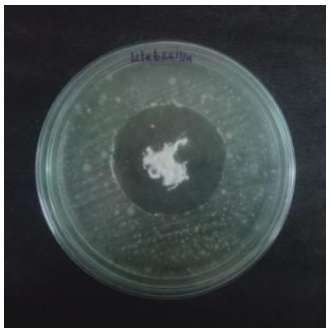
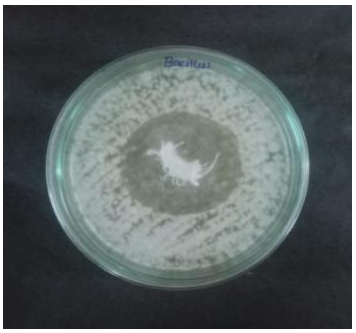
3.3 ANTI-BACTERIAL TEST

Bacterial inoculums were prepared by transferring a loopful of culture from fresh plates into 10 ml of nutrient broth, followed by 24 hours of incubation at 37°C with periodic shaking to promote growth. The study focused on Staphylococcus aureus, Bacillus spp., Escherichia coli, and Pseudomonas spp.

AGAR WELL-DIFFUSION METHOD:

The antibacterial effectiveness of the cat hair cloth was assessed using the agar well- diffusion method. Petri dishes were filled with 20 ml of sterile Mueller Hinton agar. Bacterial strains (Staphylococcus aureus, Streptococcus spp., Escherichia coli, and Pseudomonas spp.) incubated for 24 hours were utilized for the assay. A sterile cotton swab was used to evenly spread the bacterial suspension on the agar surface. Wells measuring 6 mm in diameter were created with sterile cork borers, and the cat hair cloth (1 mg/ml) was placed in the wells at concentrations ranging from 10 to 50 g. The plates were incubated overnight at 37°C, and antibacterial activity was evaluated by measuring the diameter of the inhibition zone in millimeters.



ANTI-BACTERIAL TEST

3.4 BIO-DEGRADABLE TEST

In Tamil Nadu, India, a biodegradability assessment of blended cotton fiber and cat hair was conducted over a week in soil conditions. The region's high temperatures and moderate to high humidity promote microbial activity, potentially speeding up decomposition. After one week, initial signs of biodegradation, such as softening, discoloration, fraying, or microbial growth, are anticipated. The combination of heat, moisture, and microbes is expected to facilitate the breakdown of the fibers, as both cotton and cat hairs are biodegradable. However, the differing structures of protein and cellulose fibers may result in varying rates of degradation. If further testing shows continued degradation, it would

confirm the composite fiber's suitability for sustainable applications and its environmental benefits.

BIO-DEGRADABLE TEST

3.5 YARN TWIST TEST

This research examines the degradation of multifilament carbon yarn during friction tests, focusing on two specific mechanisms: yarn decohesion and fiber breakage. The experimental setup simulates the shedding motion between two yarns on a weaving loom and facilitates an angular friction test that incorporates variations in yarn tension and optical characterization. The study of cohesion involved applying different twist values to an untwisted yarn during

the setup phase, allowing for a comparison between the twisted configurations and the untwisted yarn. The impact of twist is emphasized through the analysis of the two degradation mechanisms, supplemented by principal component analysis. The configuration that exhibited the least degradation occurred when both yarns in the experiment were twisted in the same direction at a rate of 22 turns per meter; further studies should explore lower twist rates. WALTHER, J

YARN TWIST TESTER

4. CONCLUSION

This research explores the innovative use of cat hair combined with cotton to create a sustainable and unique textile fiber. The aim is to assess the feasibility of using often- discarded cat hair as a fiber source. This combination enhances warmth, softness, and comfort, making it suitable for colder climates, while also supporting eco-friendly and cruelty-free textile production. Despite challenges like reduced strength and increased pilling, cat hair provides a distinctive, breathable fabric with potential in sustainable fashion.

The study highlights the importance of waste reduction and sustainability in the textile industry, offering a new alternative to traditional fibers such as wool. It encourages further investigation into fiber processing techniques, varying fiber ratios, and the exploration of other underutilized animal fibers, including dog and rabbit hair. Moreover, it promotes the development of personalized, emotionally meaningful textiles for a niche market focused on custom,

ethically sourced products. In conclusion, this research contributes to the growing trend of sustainable fashion and material innovation.

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