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DEVELOPMENT AND CHARACTERISATION OF ACTIVE WEAR FROM PINEAPPLE LEAF FIBRE BLENDS

Pooja P, Subradha S, Rithika M, Santhosh M

[1] *Assistant Professor, Fashion Technology & Kumaraguru College of Technology, Coimbatore*
[2] *B Tech (Scholar) Fashion Technology & Kumaraguru College of Technology, Coimbatore*
[3] *B Tech (Scholar) Fashion Technology & Kumaraguru College of Technology, Coimbatore*
[4] *B Tech (Scholar) Fashion Technology & Kumaraguru College of Technology, Coimbatore*

Abstract - This research aims at designing and analysing the sustainability of yoga pants made from PALF-based blends as alternatives to conventional synthetic materials used in activewear. The purpose of this study is to take advantage of the agricultural waste called pineapple leaf fibre (PALF) and manufacture a suitable fabric material that is environmentally sustainable. To attain the desired physical property in the manufactured fabric, PALF was mixed with cotton and spandex to form the right blend. Subsequently, the fibres were spun to yarn, knitted using a circular knitting method, and finished with antibacterial finishing for added value. Properties of the fabric under analysis included GSM, tensile strength, elongation, air permeability, and stretch recovery. It was observed that the PALF material demonstrated sufficient mechanical strength, elasticity, and air permeability, hence a promising material in the production of yoga pants. The incorporation of PALF in the blending process offers more advantages in terms of environmental sustainability without compromising on comfort.

Keywords: pineapple leaf fibre, sustainable activewear, yoga pants, PALF blends, eco-friendly textiles.

1. INTRODUCTION

Textile industry is slowly changing to sustainable materials that are eco-friendlier and reduce their environmental impact on our surroundings. Currently, synthetic materials such as polyester and nylon are popular for use in activewear because of their durability and moisture resistance. These types of materials are made from petrochemicals and cannot be decomposed, making them harmful to the environment. Natural materials that can be harvested from renewable resources are an alternative to these synthetic fibers. Pineapple leaf fibre is one example of such promising materials that can be used as alternative fibres for textile industries. The pineapple leaf fibre is obtained by extracting fibres from pineapple leaves. These leaves, which are considered agricultural waste after harvest, are available in abundance as a source for extracting fibre. Moreover, using agricultural wastes in this way helps not only reduce their effect on the environment but also gives added value to them. The pineapple leaf fibre possesses qualities such as high tensile strength, high moisture absorbance capacity, and biodegradability. Nevertheless, its rigidity and inflexibility make it unsuitable for use in garments like activewear. One way to overcome this problem is to blend the pineapple leaf fibre with some other fibres such as cotton and spandex. This study attempts to blend PALF with cotton and spandex for manufacturing activewear fabrics such as yoga wear.

2. PROBLEM STATEMENT

1. There is growing demand for environmentally friendly and biodegradable materials in the fashion industry, with PALF being one such material derived from agricultural wastes.
2. Nevertheless, there is very little literature available on reinforcing the stiffness of PALF by blending, which calls for the development of new materials for yoga wear comfort.

3. OBJECTIVES

• To study the characteristics of pineapple leaf fiber (PALF).

• To determine the difficulties in using PALF, in particular its rigidity.

• To create PALF composite yarns using cotton and spandex to improve comfort and flexibility.

• To investigate the possibility of using PALF materials in Commercial Active wear.

4. SCOPE AND SIGNIFICANCE

This study involves developing sustainable activewear materials using the combination of pineapple leaf fibre, cotton, and spandex to enhance the softness and elasticity to make it ideal for yoga wear material. It encompasses the process of making yarns, developing the fabric, and conducting tests on properties such as GSM, abrasion, elastic recovery, and moisture wicking.
The use of pineapple leaf fibre as the eco-friendly fiber material is emphasized in this research.

5. LITERATURE REVIEW

With the increasing concern about environmental preservation, natural fibers have become increasingly popular in the textile industry. Pineapple leaf fiber (PALF) is an example of natural fibers that are extracted from agriculture by-product. Several studies have indicated that PALF is rich in cellulose content and exhibits excellent mechanical properties. Unfortunately, the rigid structure and rough surface limit the applicability of the fiber in producing clothing.
The mixing process of natural fibers with other materials can significantly increase the usability of the fibers. One reason for choosing cotton is the softness, moisture absorbency, and breathability of the fiber, which can contribute to the improvement of fabric comfort properties. Spandex fiber can be included in the blends for elasticity and recovery propertiesBesides, past literature has pointed out the significance of attributes such as moisture handling capability, flexibility, and durability of sportswear materials. The preference for knitted constructions, such as single jersey, has been observed due to their inherent stretching capacity and breathability. Finishing methods that do not harm the environment and employ natural antibacterials, such as neem, have also gained attention.
In general, the previous literature indicates the sustainability of PALF as a fibre; however, their application in activewear apparel is underutilized. Consequently, this study aims to investigate the development and evaluation of PALF-blended fabrics for yoga apparel.

6. METHODOLGY

6.1.MARKET ANALYSIS

There is a rapid growth in the global activewear market owing to the increase in health consciousness, fashioning of athletic wear, and performance apparel. Sustainable fashion too is emerging as an important trend where there is a greater preference towards eco-friendly and biodegradable materials. In this backdrop, pineapple leaf fibre (PALF), being an agricultural waste-based material, can be considered as a source material for making activewear items such as yoga pants and sportswear.
Some positive attributes associated with PALF include its strength, lightness, moisture absorption, and biodegradability. By blending PALF with other fibres such as cotton and spandex, one can produce the desired qualities required for activewear garments. Despite its underexploited potential in making sustainable products, PALF faces certain limitations, such as difficulties in fiber extrusion and quality consistency. However, with the favorable conditions in certain countries including India, Philippines, Thailand, and Indonesia for PALF production, there is ample scope for its utilization in activewear.

6.2. FIBER SOURCING

Pineapple leaf fibre (PALF) was used in a pre-cleaned and combed state, allowing it to be directly used for blending and spinning. This minimized extra processing and ensured better uniformity in the fibres. Being a natural waste product from pineapple farming, PALF also supports the sustainability focus of this study and acts as the main fibre in the blend.
Cotton was added to improve the comfort of the fabric. Its softness, breathability, and good moisture absorption help reduce the stiffness of PALF, making the fabric more suitable for activewear.
Spandex (elastane) was included to provide stretch and recovery. Even in small amounts, it enhances flexibility and helps the fabric maintain its shape during movement, which is important for performance wear.

6.3. FIBER OPENING AND PROCESSING

Even though the palf was supplied in a conditioned form by cleaning and combing, it was subjected to the opening stage to separate the fibre bundles and eliminate any impurities that might have remained after the conditioning stage. Palf is relatively stiff, and hence slow feeding speeds were employed to avoid fibre damage during opening. On the other hand, cotton was easy to open due to its soft nature.

6.3. FIBER BLENDING

After the opening of both the fibres, they were weighed and mixed in order to achieve the required proportion of 60:40.

• 60% of cotton provided softness, absorption capacity, and flexibility.

• 40% of PALF provided tensile strength, durability, and sustainability.

In the hopper, the fibres were alternately layered for initial mixing. It was necessary to ensure proper mixing prior to mechanical blending. Repeated mixing in the blending machine facilitated homogeneous mixing, which was very important as any imbalance in mixing would cause problems in slivers and yarns.

6.4. YARN PREPARATION

This process involved converting the mixed PALF and cotton material into yarn that could be used for making fabrics. Following carding and drawing, the sliver was subjected to rotor spinning. During rotor spinning, fibres were separated, fed into the rotor, twisted together, and made into yarns having a uniform composition that could be knitted.
Spinning was conducted at a rate of 70,000 to 90,000 revolutions per minute (rpm). This rpm is adequate for the mixed PALF and cotton material. The yarn was finally wound into cones. Auto-clearers were used to get rid of any flaws and weak spots..

6.5. FABRIC DEVELOPMENT

For the development of fabric using the PALF-cotton blend yarn, a single jersey knitting machine was employed. This technique involves the formation of interwoven loops that result in a soft and supple fabric. The reason behind the selection of single jersey as the knitting technique was its comfort properties as well as breathability. Spandex is incorporated through plating feeders to ensure stretching and shape retention capability in activewear such as yoga pants.
The fabric designed in this project had a targeted GSM of 160, making it an appropriate choice for activewear. This type of fabric offers comfort, easy breathing properties, and excellent mobility for athletes..

6.6. APPLICATION OF FINISH

The antimicrobial finish of the developed fabric has been imparted by using an all-natural compound in order to enhance its health as well as performance characteristics. Plant extracts have been used because of their proven antimicrobial nature. This finishing procedure was performed by applying the pad-dry technique, which involves dipping the fabric in the natural solution before passing it through rollers. After padding, the fabric was dried at a controlled temperature to fix the finish onto the material. This treatment helps in reducing the growth of microbes, controlling odour, and improving the freshness of the fabric during use. The use of natural antimicrobial agents ensures that the finishing process remains eco-friendly and safe for the skin, making it suitable for activewear applications.

6.7. TESTING AND EVALUATION

• The finished fabric was tested to evaluate the effect of natural finishing on its performance.
• Fabric weight (GSM) was measured using a GSM cutter and electronic balance to assess thickness and compactness.
• Tensile strength testing showed improved resistance to breaking force due to the PALF–cotton blend.
• The wicking test recorded a value of 4.03 cm^2/min, indicating good moisture absorption and quick spreading.
• Antimicrobial testing confirmed effective resistance to microbial growth due to natural compounds like phenolics.
• The finish helps reduce bacterial contamination and control odour.
• Overall, the treated fabric shows improved hygiene, freshness, and suitability for activewear.

3. RESULT AND CONCLUSION

This study focused on developing and evaluating a sustainable activewear fabric made by blending pineapple leaf fibre (PALF) with cotton and spandex. The aim was to use PALF, an agricultural waste material, as an eco-friendly alternative in textiles. The process included fibre blending, yarn formation, and fabric production using a single jersey circular knitting machine, resulting in a lightweight fabric suitable for activewear.
The fabric was tested for key properties such as GSM, abrasion resistance, elastic recovery, and moisture management. The results showed that adding cotton improved softness and comfort, while spandex provided the necessary stretch and flexibility. Overall, the study demonstrates that PALF blended fabrics can support sustainable textile development while meeting the performance needs of modern activewear.

Figure 1. Pineapple Leaf Fiber

Figure 2. PALF – Cotton Yarn

Figure 3. Fabric Developed

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