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RESEARCH ARTICLE

A REVIEW ON EXTRACTION, CHARACTERIZATION AND APPLICATION OF PINEAPPLE LEAF FIBER (PALF) IN TEXTILES AND OTHER FIELDS.

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Abstract

The demand of fibers is increasing with the growth of population. To meet this demand the use of synthetic fibers is also increasing that is great threat for our environment. The scientific community and environmentalists are trying their best to replace the use of natural fiber in place of synthetic fibers. Among different types of natural fibers, Pineapple Leaf Fiber (PALF) shows outstanding fiber properties which are rich in cellulose, cost effective, eco-friendly having good fiber strength. In this study, the authors have tried to focus on the extraction process of PALF from leafs, characterization of PALF and its applications to produce different value added products.

Introduction:-

In tropical and sub-tropical countries like Bangladesh, pineapple is cultivated for its fruit from many years ago. The leaves of Pineapple were considered as agro-waste in the past due to lack of knowledge about the potentiality of Pineapple Leaf Fiber (PALF). But in the era of modern science it is thought as a good source of eco-friendly fibers. Although it was not well known and most useable fiber, now researchers are trying to introduce Pineapple Leaf Fiber as a golden fiber like jute from the commercial point of view. Increase in the living standards of the people as well as in consumption lead to the development of fibers and fabrics focusing on the green environment. Natural fiber has been an important textile material in human civilization. The fabrics of pineapple leaf fiber are easy to print and dye, sweat-absorbent and breathable, hard and not wrinkling and it has good antibacterial and deodorization performances [13].

PALF are obtained from the leaves of pineapple plant (A. Comosus) from the family of Bromeliaceae. Pineapple fiber is white, creamy and lustrous as silk fiber and is more coarse than cotton and the fiber can easily retain dyes [13].The Food and Agricultural Organization (FAO) has reported that most of the world pineapple fruit production in 2001 amounting to about 13.7 million tons of fresh fruits were produced in Asia. Pineapple leaves from the plantations are being wasted as they are cut after the fruits are harvested before being either composted or brunt. Burning of this beneficial agricultural waste causes environmental pollution [4].

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Extraction Process of PALF:-

The decorticator machine used for scrapping the pineapple leaf is shown in figure I (a). The machine has three rollers, (i) feed roller (ii) leaf scratching roller and (iii) serrated roller. The leaves were fed through feed roller and then scratched by other roller to remove the waxy layer followed by serrated roller creating space for retting microbes. Figure I (a) shows the scrapping machine operation.

By using ceramic plate over the pineapple leaf with pressure and fast movement of it, will give the fiber beneath the leaf shown in figure I (b). The extraction of fiber from long leaves is done easily by this process.

Another process of PALF extraction is retting in which the scratched leaves are tied and immersed in a retting tank. Urea or di-ammonium phosphate is added for quick retting. At the end of retting, leaves are taken out and washed mechanically by fresh water [13].

a *b*

Figure I:- a) Mechanical Extraction of PALF by decorticator machine, b) Manual Extraction of PALF by ceramic plate [13].

Chemical Modifications:-

Alkali treatment or mercerization using sodium hydroxide (NaOH) is the most commonly used treatment for bleaching and cleaning the surface of natural fibers to produce high quality fibers. NaOH reacts with hydroxyl groups of the cementing materials in natural fibers and brings on the destruction of the cellulear structure, thereby spiting the fibers into filaments. Hydrogen peroxaide (H_2O_2) bleach improves PALF fineness by 5-6% but reduces the tensile strength by 40-45% [4].

Characterization of PALF:-

Chemical Composition:-

Table 01 shows PALF chemical composition obtained from previous studies. Differing composition may be attributed to factors including source of fibers, age of fibers, climate conditions and the process used in obtaining the fibers.

Table 01:- Chemical composition of PALF [4]

Contents	Chemical Composition %
Cellulose	67.12-82
Hemicelluloses	9.45-18.80
Lignin	4.4-15.4
Pectin	1.2-3
Fat and Wax	3.2-4.2
Ash	0.9-2.7

Physical and Mechanical Properties:-

Table 02 shows the different physical and mechanical properties of PALF that are collected from the articles of different researcher.

Table 02:- Physical and mechanical properties of PALF. [4, 5, 12]

Properties	Values
Average Length of PALF (m)	1.0
Density (g/cm^3)	1.526
Diameter/µm	20-80
Tensile Strength (MPa)	170
Young's Modulus (MPa)	6260
Specific Modulus (MPa)	4070
Elongation at break (%)	3
Moisture Regain (%)	12

PALF Application:-

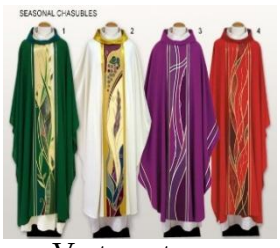
Application of PALF in Textiles:-

One of the SITRA's (South India Textile Research) findings under the UNDP/UNIDO assisted projects revealed that PALF could be successfully spun in the cotton spinning system with slight modifications to produce 100% PALF yarn and their blends with other natural and synthetic fibers, especially with cotton. The yarn thus produced was used to make fabrics, fancy carpets, mops, curtains etc. [5].

The major end use of the pineapple fiber is the Barong Tagalong, wedding dresses and other Philippine formal dresses. Again, table linen, mats, bags, shoes (leather like substance), sports item, baggage, automobiles, cabinets, and other clothing items. Another application is thread and fine casting nets [4, 5, 6, 10]. Pineapple yarn and pineapple–jute-blended yarn are used for fashion fabric development, like fashion bag, curtain and furnishing fabrics and pineapple–acrylic-blended yarns are used to produce fancy apparel products [10].

Barong Tagalog

Kimono



Vestments

Table Linen

Frog

Panjabi

Shoe

Figure II:- Application of PALF in Textiles.

Industrial textiles using PALF are V- belt cord, Conveyor belt cord, Light weight duck cloth. Heald shaft lifting cords, Air bag tying cords, Shoe lace, Wicks etc. [4]. PALF can be blended with polyester fibers to replace jute for making needle-punched nonwovens for technical textiles [4]. A wide range of biomedical and bio-technological applications, such as tissue engineering, drug delivery, wound dressings and medical implants are possible by pineapple fiber nano-cellulose [10].

Some other applications of PALF:-

FRP:- PALF has the very potentiality for being used as fiber reinforced plastics (FRP). With many of the polymeric material like epoxy, polypropylene, vinyl-ester, polyethylene, polyester, polycarbonate etc., it is used in FRP because of its high specific stiffness. It has improved physical and mechanical properties [4, 5, 6, 8, 9]. As these fibers are showing superior mechanical properties, they have potential as reinforcing fillers in thermo sets [11].

Paper: Paper is made from PALF. It is made from decorticated leaf fibers of pineapple that are modified chemically or enzymatically [2, 7].

It may also be applied with recycled newspaper which has the basic properties of such a paper on which it is possible to write, which can be torn and can absorb moisture [1].

Upholstery:-

It is used to produce Tommy Bahama Pineapple Paradise Oblong Toss Pillow. The Cover is machine washable. It is also used in Pineapple Paradise quilt [2].

Figure III:- Upholstery from PALF.

Decorative purpose:-

Pine apple leaf fiber is used for decorative purpose. Sometimes they are combined with silk to give aesthetic effect [2].

Figure IV:- Decorative product of PALF with silk..

Reinforced Roofing:-

PALF is used to reinforce corrugated roofing sheet that increases transverse strength and decreases compression strength [2, 3].

Figure V:- Reinforced Roofing Sheet from PALF.

Conclusion:-

This study has clearly revealed the present research condition of PALF. Different physical and mechanical properties such as density, tensile strength, elongation and diameter have been stated. Although the diameter of PALF is higher than other natural fiber, due to its high strength and outstanding physical and mechanical properties it is possible to convert this agro-waste to value added product by simple chemical modification. It is also possible to produce PALF yarn in conventional spinning process without any additional cost that effectively helps to reach zero waste management. It will be helpful for the researcher to conduct better research on PALF.

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