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ALTERNATİVE FIBERS II: PINEAPPLE, POLAR BEAR, BANANA AND CARIBOU FIBERS

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Abstract: *Recently, with increases rapidly of the need for new raw materials and products in the textile sector, the use of alternative fibers has gained importance. Specific characteristics of alternative fibers are thinness, length, strength, brightness, biodegradable and undulation (for hair origin fibres). The increasing of researching in these characteristic material properties in the past several decades has increased the interest of alternative fibres. A lot of work has been done around the world on about alternative fibres. Alternative fibers can be used alone or mixed together with conventional fibers. In mixed fibers could be seen more efficiently properties such as viscoelastic behavior, processing, tensile strength and flexural. Hair origin fibres (polar bear and caribou) especially provides thermal insulator to keep warm. Herbal fibres (pineapple and banana) composed of composites because of their eco-friendly, easy availability and high reinforce, renewable and specific characteristic properties. With the recent developments in composite technology, alternative herbal fibres based composites are expected to be developed in global sustainability. For these reasons, alternative fibres could be used in a variety of areas. The aims of this review are to explain properties, production methods and applications of alternative fibers including pineapple, polar bear, banana and caribou fibers. With the development of the fiber industry, it is thought that the importance given to these fibers will increase.*

Key words: *Pineapple Fibres, Polar Bear Fibers, Banana Fıbers, Caribou Fibers, Alternatives Fibres*

1. INTRODUCTION

In the last decades, as the need for new raw materials and products in the textile sector has increased rapidly, the use of alternative fibers has gained importance. Alternative fiber production is laborious and requires special knowledge and prices are quite high but their mixed fibers with conventional fibers have more efficiently properties such as viscoelastic behaviour, processing, tensile strength and flexural. This study examines some fibers that are not commercially used by means of literature review method. Pineapple fibers in the first part of the study, polar bear hairs in the second section, and in the third section, the fibers obtained from the banana tree and caribou hairs in the last part have been analysed.

2. PINEAPPLE FIBERS

Pineapple fiber (Ananas bracteatus) grows up coastal regions in tropical countries such as India, Malaysia, etc. (see in Fig. 1(a)). Pineapple plant is 1-2m height and width and belongs to the Bromeliaceae family [1-2]. Pineapple mostly cultivated for its fruits (see in Fig.1 (b)) and is the source of bioactive compounds, particularly in proteolytic enzymes and a very rich source of bromelain enzyme which supplies to help digestion and inflammation [2]. Pineapple leaf fibre (PALF) (see in Fig.1 (c) and 1 (d)) is produced by the mechanical method and retting method in water. Fresh leaves yield about 2 to 3% of fibres [3]. The diameter of the elementary fiber is 25–34 µm [1] and multicellular lignocellulosic with very small lümen size [3]. Physical and mechanical properties of PALF could be seen in Table 1. PALF has superior properties such as high specific strength, eco-friendly, stiffness, fine quality, the structure is without mesh, hygroscopic, low density, relatively inexpensive and abundantly available [4-5]. In addition, superb mechanical properties of PALF is directly related to high cellulose content (70 – 80%) (see in Table 2) and relatively low microfibrillar angle (14°). Due to the perfect properties viewed by PALF they can be used as high potential reinforcing efficiency for application in composite matrices. Properties such as viscoelastic behavior, processing, tensile strength, flexural, and impact properties of the composites connected with fiber length, fiber loading, and fiber orientation [6]. The two main deficiencies of using PALF is the hydrophilic character of the cellulose structure and the low processing temperature permissible [7]. Make away with these disadvantages, the surface of the fiber must change by physical and chemical methods to reduce the hydrophilic nature of the natural fiber and thereby improve the fiber-matrix bond [6].

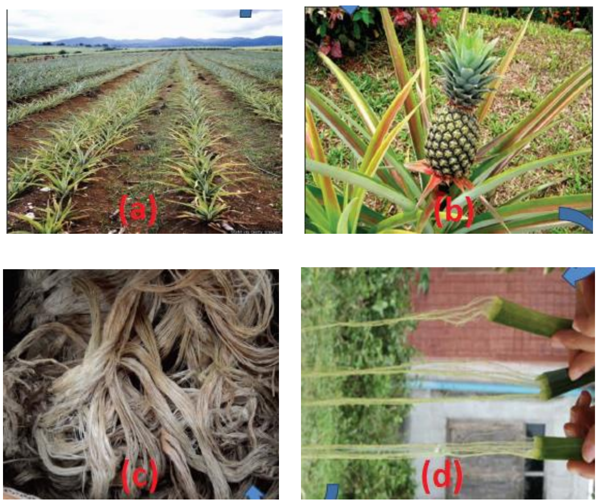

Fig.1: *(a) Pineapple field, (b) Fruit of pineapple, (c) Pineapple leaf fibres, (d) Fibres from pineapple leaves [2]*

Natural fibre based composites have great attention because of their eco-friendly, easy availability, high reinforce, renewable and specific characteristic properties. Useful composites in good strength can be produced with PALF as reinforcing material for the polymer matrix comprising mainly polysaccharides and lignin and other compounds. PALF reinforced composites are composed of thermosets (polyester and epoxy) [7], thermoplastic (polyethylene, poly(propylene [9]), poly(vinyl chloride)), rubber and cements matrices [2]. It is important to the properties of composites related to individual components and interfacial compatibility of PALF. Between fiber and adhesion, the matrix is obtained by mechanical connection of the fiber and surface ends into the matrix [2]. With the recent developments in composite technology, PALF based composites are expected to be developed in global sustainability.

Table 1. *Physical and mechanical properties of PALF [8]*

Properties	***PALF***
Density/(g _ cm_3)	1,44
Diameter(mm)	20–80
Tensile strength (MPa)	413–1 627
Young's modulus/GPa	34,5–82,51
Elongation at break/%	1,6

Table 2. Chemical composition of PALF [8]

Content	***PALF***
Cellulose wt.-%	70-82
Lignin wt.-%	5-12
Microfibrillar/spiral angle (Deg.)	14
Moisture content wt.-%	11,8

3. POLAR BEAR FIBERS

Polar Bear lives in the Arctic region, where the environmental temperature is extremely cold as –50 °C [10]. Polar Bear Hair is white and semitransparent [11] and capability to keep warm, because of their hollow hairs [12]. The transparent section has relatively good light and thermal conduction. The hair of polar bear has labyrinth cavity structure (see in figure 2) and this cavity enables the animal to absorb energy from its outside for thermal insulator to keeping warm [11].

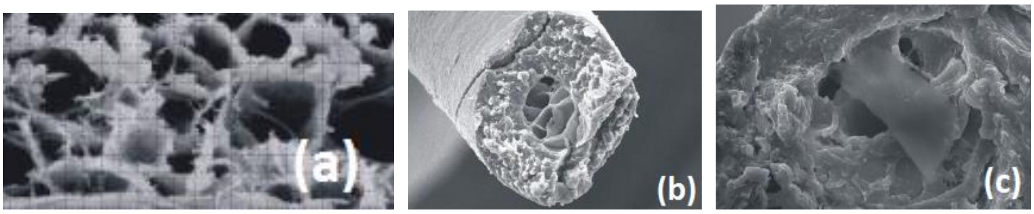

Fig.2: *(a) Inner morphology [13], (b) Scanning Electron Micrographs of Polar Bear Hair [11]*

Polar Bear Hair has not used in the textile production sector, has formed a model to produce some chemical fibers. For example, DuPont inspired by thermolite fiber inside the polar bears, the thermal resistance of the products manufactured from this fiber is also high. High volume Non-Thermolite fibers are also very light fibers for which they are empty [13].

4.BANANA FIBERS

Banana fibers are obtained from the plant types of M. cavendishi and M. sapientum that produce edible fruit types. India and Brazil are the largest banana producing countries, but data on fiber production are few. The fibers are obtained mainly from the plant stem. Approximately 1 kg of good quality fiber is obtained from about 37 kg of stem of banana fruit. Fibers are obtained by hand or with retting method, or by using raspadors or separating it from the stem by using a chemical substance like NaOH at boiling temperature [14]. Banana fiber is a kind of fiber containing 60-65% cellulose (in figure 3) [15].

Banana fibers have been used in many studies to produce composite surfaces [16-19]. Although banana fibers are used for paper production, the production of Kijoka Banana Fiber Cloth, which dates to the 13th century, continues in Okinawa [14]. This fabric is known for its smoothness, lightness, air permeability, fineness and strength [20]. Banana fiber becomes increasingly popular in using multiple sectors such as tea bags and car tires.

Fig 3: *Banana fiber [19], [21]*

5. CARIBOU FIBERS

Caribou animals live in northern climates, are terrestrial herbivores and feed on lichens (see in figure 4(b)) [22]. It could be insulating the cool air because of the presence of air-filled cells. Caribou hairs (in figure 4 (a)) have high insulating properties but there are quite short, low tensile strength and low resistance. Therefore, it cannot be producing fabric construction of caribou hairs. Only, the fabric is made with mixture of wool range from %20 to %33 and mixture are blended by carding. Use of more caribou fibers than these ranges will cause a strength reduction of fabric [23].

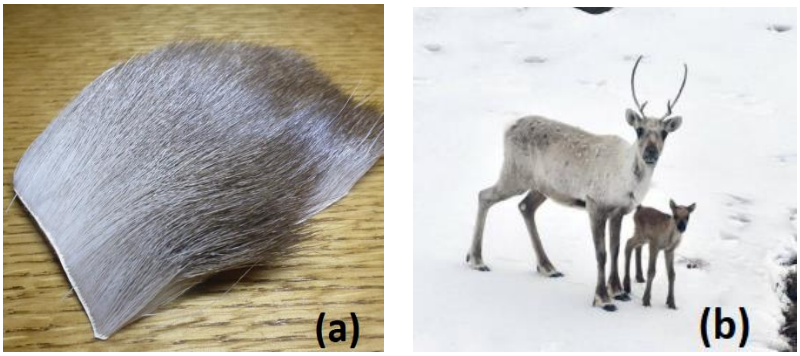

Fig 4: *Caribou hairs [24] and Caribou animals [25]*

6. CONCLUSION

In this review study, pineapple, polar bear, banana and caribou fibers were examined. Characteristic material properties and production conditions of these alternative fibers were investigated. In the light of the obtained data, polar bear and caribou fibers especially provide thermal insulator to keeping warm and pineapple and banana fibers composed of composites because of their eco-friendly, easy availability, and high reinforce, renewable and specific characteristic properties. It can be concluded that with the development of the fiber industry, it is thought that the importance given to these fibers will increase. This review could be useful in understanding parameters and raise awareness for the use of alternative fibre production technology.

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