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A Research of Various Natural Fibers from Eco-Friendly Plant Sources

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ABSTRACT

Fiber cells in plants are diverse and economically exploited, with rural populations relying on wild materials. This poses a threat to biodiversity and resource sustainability. New technologies, including plant cell cultures and genetic engineering, are being developed to improve fiber creation and use from agricultural waste, bagasse, fruit processing, and industrial waste. Plant fibers are also used in food, biodegradable films, biopolymers, biofuels, and pharmaceuticals. Since reducing environmental pollution is so important, many researchers and engineers are focusing on developing workable alternatives, such replacing natural raw materials with polymer-based ones. In order to avoid utilizing synthetic fibers derived from petroleum, researchers often make great efforts to discover new sources of natural fibers. The present review discussed on a few natural plant fibers including cotton, long leaf fibers like sisal, and bast fibers like jute, flax, and ramie, etc which are environment-friendly.

Key Words: Fibers, Natural source, Environment, Textile.

INTRODUCTION

Global awareness has led to a push for sustainable development, focusing on reducing environmental challenges like resource depletion, water contamination, and air pollution. Researchers are developing eco-friendly materials to reduce human activities' environmental impact, promoting alternative fuels and promoting eco-friendly behaviors. Everyone is currently focused on reducing their environmental effect through recycling and sustainable activities in an effort to make the world healthy. The vibrant textile sector, which plays a significant role in modern society, has a wide range of environmental repercussions. Advanced technology textile applications use both natural and synthetic fibers with great performance. Mineral, vegetable, and animal fibers are the three main categories of natural fibers. diverse fibers, including natural fibers, have diverse architectures. Natural fibers such as cotton, silk, wool, and others have non-homogeneous, uneven surfaces. Currently, the textile industry employs more than 70% synthetic fibers and only 25% cotton fibers. The production of cotton fiber involves a substantial amount of synthetic chemicals, which is harmful to our environment. Natural fibers are used in many different fields, especially in tropical countries where research on their potential as reinforcing materials has gained traction. The reasons include its low cost of manufacture, low density, low price, and less abrasive wear on processing equipment. Among these industries is the construction sector, which relies on renewable energy sources to encourage greener building techniques and reduce its impact on the environment. Fibers are defined as matter units that possess a high fineness, flexibility, and length-to-thickness ratio. Natural fiber-based materials are better for the environment. Lignocelluloses, or helically wound cellulose microfibrils, are the predominant kind of natural fibers, consisting of a matrix of hemicelluloses and lignin. Asian cultures have historically utilized natural fibers. Cellulosic fibers, found naturally in plants, are renewable and biodegradable, protecting the environment. Traditionally derived from agricultural fibers like cotton and sisal, these fibers are widely available and affordable. They are also easily obtainable, low energy, recoverable from trash, and widely available in the construction industry [Laborel-Préneron et al 2016, Hejazi et al 2012, Whitney and Manore 2015, Kadir et al 2016, Elfaleh et al 2023]. The agricultural products that have been used for technology and non-food purposes the longest are fiber crops. Cellulosic fibers, for example, continue to be a major non-food item utilized in the production of textiles and paper pulp. The ecological "green" reputation of cellulosic fibers has spurred a great deal of invention and product development over the last 10 years. Biodegradable geotextiles, horticultural goods, building and construction materials, and fiber reinforced composites used in the automobile sector are a few examples of these items. Actually, when the old-fashioned retting method of stalk processing was employed to extract bast fibers, the intensive production of bast fiber crops including jute, hemp, flax, and kenaf expanded. The present review discussed on the availability of few natural fiber from plants; such as jute, pineapple, hemp, bamboo, sisal, wood, kenaf, ramie, banana.

The Natural Fibers Extraction

Retting is the process of separating, dissolving, and breaking down pectins, gums, and other mucilaginous compounds in order to remove fibers from non-fibrous tissues and the woody portion of the stem. The effectiveness of the retting process has a major impact on the fiber's quality. The most crucial part of retting is the liberation of the fibers and the breakdown of pectic components. The length of retting and the extraction technique used under various natural circumstances determine the quality of the fiber [Ali et al 2015]. Plants often have thicker, harder bottom parts that require more time to rotten than their top portions. The bottom sections of these un-retted bark materials are chopped down in the mills and are referred to as cuttings because of over maturity, variety, and incorrect retting. In addition to these, some fibers that are inherently coarse, sharp, spiky, and less malleable remain at the conclusion of the process [Ali et al 2015]. These fibers, which make up 30–40% of all fibers, are referred to as low-grade fibers since they are less useful and cannot be spun. These fibers are known as low-grade fibers and have less utility, which amount 30-40% of the total fibers, and are not suitable for spinning. In order to extract the fiber, the cementing material must be separated mechanically or broken down physically, chemically, and microbiologically. This allows the fiber bundles to get free of the adhering tissues and be washed away. Appropriate control over various processes determines the quality of the resulting fiber and how easily it may be spun into yarns [Selmi et al 2022].

Fibers from Different Natural Sources

Sugarcane bagasse fiber Cellulosic materials, such as sugarcane bagasse, are often waste materials with specific use in mind. There is a considerable quantity of cellulose in it, which may be extracted and used for a variety of purposes. The textile and civil engineering industries may also employ fibrous materials as fiber, albeit their application may need special handling. More precisely, according to Loh et al [2013], this bagasse may be utilized to strengthen composite materials in order to create an entirely new kind of material. The primary benefit of using bagasse is that it is a pure waste material that can be used in any application with just a few basic pretreatments. This makes the process extremely cost-effective, and the final product will undoubtedly be fully or partially biodegradable, a feature that is becoming increasingly significant. Additionally, if the right method is applied, the extracted fiber can exhibit rather acceptable mechanical characteristics [Loh et al 2013]. Additionally, sustainably regenerated textile fibers may be made from the harvested cellulose [Costa et al 2013]. In addition, bagasse can be used to make nanoparticles, however this would cost more than other options. There are two distinct kinds of fibers found in the rind and inner pith of sugarcane bagasse. Because of their greater mechanical qualities and longer length, rind fibers can often be beneficial. Although inner pith fibers can be employed for a variety of purposes, Mahmud and Anannya [2021] note that because of their short fiber length, they are not anticipated to exhibit superior mechanical qualities. Any length of these fibers, from micro to milliliter, may be applied. Additional properties to the original material are provided by varying the length or size of the fiber. However, the researchers have discovered that smaller size is a better choice since it is simpler to create a homogenous mixture with shorter fibers, particularly those that fall into the nanoscale size range. Because bagasse fiber is hydrophilic and does not establish connections with matrix molecules that are entirely opposite in character, better mixing is more required when using it with hydrophobic matrix material. Since sugarcane bagasse is a waste product, it's a great source of cellulose, and any use of these resources again would be beneficial. However, its uses are not confined to the paper sector. Cellulose from bagasse fibers is a resource that has several uses. Compared to other cellulosic fibers, sugarcane bagasse has a somewhat different structure.

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Its rind is rather tough, but the smaller, weaker fibers are found inside the pith. It is therefore difficult to utilize in its unprocessed form. It takes several methods to extract fibers, pure cellulose, nanocrystals, or nanofibers. Several typical elements that may impact the characteristics of composite materials reinforced with bagasse. Both completely and partially biodegradable materials that fit the present trend of replacing synthetic materials with biodegradable alternatives are included in the wide range of applications. Therefore, bagasse from sugarcane may be a great source of raw material for goods that are good for the environment. One such lignocellulose that is easily accessible, low in weight, biodegradable, and reasonably priced is sugarcane bagasse. It is possible to see the long-term sustainability of these natural fiber reinforced composites as a development in the field of bio-composites and polymer composites [Devadiga et al 2020, Islam et al 2022]. Sugarcane bagasse fibers have the potential to replace glass-reinforced composites as the core material in the creation of new Natural Fiber Reinforced Composites (NFRC). They are a viable substitute for synthetic fiber-reinforced polymeric composites due to their high mechanical strength, availability, and ecological friendliness, recycling, and biodegradability [Vidyashri et al 2019]. Environmental concerns and the growing cost of synthetic materials have been the main drivers of the growth in sugarcane bagasse fiber research. Sugarcane bagasse fiber has several appealing qualities, including being biodegradable, lightweight, having a high specific modulus, being inexpensive, and being renewable [Kumar et al 2022]. The selection of sugarcane bagasse fibers can be based on the characteristics required for the recently constructed reinforced composites.

Fibers extracted from Agave americana Certain agave plants' leaves are used to obtain agave fibers. Following their extraction, these fibers are found as bundles made up of many ultimate fibers bound together by sticky, waxy materials. The typical equivalent diameter of ultimate fibers is 24 µm, and their length ranges from 1.0 to 7.5 mm. These long technical fibers are categorized as "hard" fibers within the long vegetable fibers class because they are often stiff, rough, and gritty in texture. The significant resilience, lightness, and composite nature of these fibers indicate their rather significant textile potential. Examining the mechanical and physical characteristics as well as investigating the potential for faster extraction which is a barrier to economic growth are crucial steps in the process of making this source of raw materials for textiles more valuable [Whitney and Manore 2015, Selmi et al 2022]. Fibers from *Agave americana* can thus be applied to technological products like geotextiles and reinforced materials.

Sansevieria Trifasciata (snake plant) fiber *Sansevieria trifasciata*, often called mother-in-law's tongue or snake plant, is a member of the Asparagaceae family of plants. Snake plants include cellulose, hemicellulose, lignin, and other impurities in their composition, much like other natural fibers. While lignin is hydrophobic, hemicellulose is hydrophilic and dissolves in alkali. The cellulose content of snake plants is higher, more than 50%, and is essential for composite reinforcing. The high-quality composites that originate from the fiber's base [Hariprasad et al 2022]. Fiber from *S. trifasciata* leaves, which may be utilized as reinforcement in polymer composites, offers a number of benefits, including low cost, broad availability, high specific strength, renewability, and low density. Few research on the characteristics of *S. trifasciata* fiber and its application as reinforcement in the creation of composites have been published in recent years, and these studies have indicated that *S. trifasciata* fiber is underutilized as a viable replacement for synthetic fibers. The thermal deterioration and tensile characteristics of the fiber in a polypropylene resin were investigated by Abral and Kenedy [2015]. The dynamic mechanical characteristics of the fibers in an epoxy resin were investigated by Rwawiire et al [2014]. Sameer et al [2015] created a hybrid composite by combining fibers with carbon fibers. Asaye [2019] has reported on the chemical characterization of the fibers. Kanimozhi [2011] and Ramanaiah et al [2011] reported on the physical characterization of the fibers. Research was done on the mechanical and thermal characteristics of the fibers by Rwawiire and Tomkova [2015] and Mardiyati et al [2016]. The impact of various chemical treatments on the fiber and its composites has also been investigated in previous research [Pradipta et al 2017]. *S. trifasciata* fiber can be employed as reinforcement in polymer composites because of its inexpensive cost, wide availability, high specific strength, renewability and low density. It was observed that *S. trifasciata* fiber provides polymer matrices with good reinforcing capabilities. In addition to its potential use in the manufacturing of rope, carpets, and mats, this fiber may be utilized to create composites that have a variety of technical uses. The fiber of *S. trifasciata* may be extracted from the plant using a variety of methods. The most popular methods among these are retting and hand scraping. The species, crop culture, age, location, fiber position within the plant, climate, decortication, and transportation circumstances all affect the mechanical and physical characteristics of *S. trifasciata* fibers. Experimental parameters including fiber length and size, as well

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as the kind of polymer matrix employed, also have an impact on the mechanical characteristics of composites made with the fiber.

Fiber from jute and kenaf Because jute fibers include lignin, hemicellulose, and mostly cellulose, they are ligno-cellulosic [Duan et al 2017]. Pectin and hemicellulose are two cementing agents that hold the many cells that make up each fiber together [Ray et al 2016]. The combined action of water and aquatic microbes causes these fibers to separate from the stem during retting [Ali et al 2015]. While ineffective retting results in lower-quality fiber, good retting produced higher quality fiber with a high market value. The thickness and maturity of the stem determine the retting time. Thus, retting is associated with both the process of extracting fiber and the factor that determines the quality of the fiber, namely the market value of jute fiber [Jahan et al 2016]. Jute fiber, which is found naturally, has a high mechanical strength. Humidity cum heat treatment gives jute fiber an improvement in tensile strength. The X-ray fiber diffraction analysis provides proof that cellulose chain packing is the cause of these gains in tensile strength. Using paper-tamarind seed gum and paper-tamarind seed gum bonded with jute fiber, a bio-composite material (paper bag) is created. The created composite paper bag has the potential to replace plastic bags because it is completely biodegradable, environmentally beneficial, and able to support a 9.0kg weight load. Jute fiber, sometimes called the "golden fiber," is a kind of bast fiber that is obtained from the jute plant's bark. Three chemical substances make up the majority of it: cellulose, hemicellulose, and lignin. Furthermore, there are trace levels of additional ingredients such lipids, pectin, and aqueous extract [Shahid et al 2012]. The process of turning jute fibers into blended textiles, in which they are combined with viscose, cotton, and other fibers to create finer yarns intended for household textile applications, represents a sizable industry in which jute is used. Jute fiber is a blend of bast fiber and plant bark that is made up of three main chemical component categories: cellulose (58.63%), hemicellulose (20.24%), and lignin (12.15%), along with a few additional minor components including lipids, pectin, and aqueous extract. Lignin and hemicelluloses encircle and hold the tiny cellulose units of jute fiber together [Ullah et al 2016]. A single jute fiber's cells are about polygonal in form and have a central hole called a lumen. Roughly 10% of the cell's cross-sectional area is made up of the lumen. Beyond its technical benefits, jute fiber is agro-renewable, biodegradable, readily accessible, and reasonably priced. It also has strong sound and heat insulation properties, high tensile strength, initial modulus, moisture recovery, dimensional stability, and color acceptance. Its shortcomings include a broad range of fiber length and fineness, a branching character, poor washability, relative coarseness, brittleness, harshness in feel, and a propensity to turn yellow in the sun. The limited extensibility of jute has both benefits and drawbacks [Samanta et al 2020]. The jute technical fiber has the structure of a number of parallel short ultimate cells embedded in a non cellulose matrix, similar to multiple fiber reinforced composite. The modified Weibull distribution can predict the breaking strength of jute fiber at 2 mm, 3 mm, and 25 mm gauge lengths more accurately than the two- and three-parameter Weibull distributions. Chemical modification at the fiber and fabric levels without sacrificing flexibility appears to be a better alternative to the processes used so far to improve the resistance of jute geotextiles to degradation. Chemically treated jute's water affinity seems to reduce the textiles' hydrophilicity; the fiber level treatment works better than the fabric level treatment. No toxicity or chemical hazard was found during the assessment of the degradation products of treated jute fiber-based and treated jute geotextiles [Saha et al 2012]. The bark of the perennial tropical shrub Hibiscus cannabinus is used to make kenaf fibers. To make kenaf/cotton mix yarns, processed kenaf fiber bundles are combined with Pima cotton and spun using a cotton processing machine. The fibers are separated from the stem by peeling off the surface skins, and ropes, mats, and jute bags can be made from them. Fibers are being utilized to make paper, electrical insulation, and other materials. The fibers are also used as roofing material binding strings, harnesses, fishnets, and joint filling material for boats.

Coconut fiber The outside shell of a coconut is used to obtain coconut fiber. Coconut fiber is known by the colloquial name Coir, the scientific name Cocos nucifera, and the plant family Arecaceae (Palm). The tropical regions of East Africa and Asia are home to the majority of the world's coconut plantations. Coconut fibers come in two varieties: brown fiber from fully grown coconuts and white fiber from young coconuts. Coconut fibers are robust, rigid, and have a low heat conductivity. Three types of coconut fibers are sold commercially: bristle, which has long fibers; mattress, which has relatively short fibers; and decorticated, which has mixed fibers. Depending on the need, these various fiber kinds have diverse applications. The majority of brown fibers are employed in engineering. Coir fiber, another name for coconut fiber, is combined with composite material. The naturally occurring, thick, coarse, and long-lasting fiber found in coconut husks is called coir. According to Ray et al [2016], it is comparatively impervious to water and resistant to microbiological deterioration and salt water damage. The impact of coir fiber volume on the composite's dynamic characteristics and mechanical attributes was investigated. According to the findings, there is a significant correlation between the dynamic characteristic and the mechanical characteristics. The volume fraction of fibers has a significant impact on each of these qualities. One of the natural fibers that is widely available in tropical areas is coconut fiber, which is taken from the coconut fruit's husk. Not just the mechanical, chemical, and physical characteristics of coconut fibers, but also the qualities of composite materials (such as mortar, cement pastes, and concrete) that contain coconut fibers as reinforcement. The most ductile natural fiber available, coconut fiber has the potential to be utilized as a reinforcing component in concrete. The outside shell of a coconut is used to obtain coconut fiber. Coconut fiber is known by the colloquial name Coir, the scientific name Cocos nucifera, and the plant family Arecaceae (Palm). Coconut fibers come in two varieties: brown fiber from fully grown coconuts and white fiber from young coconuts. Coconut fibers have a low heat conductivity and are robust and strong. Three types of coconut fibers are sold commercially: bristle, which has long fibers; mattress, which has relatively short fibers; and decorticated, which has mixed fibers. Because it decomposes naturally, there won't be much of an environmental impact. This is another method of getting rid of the fibers that come from manufacturing facilities that use coir as trash in order to make high-strength products. Additionally, they are inexpensive, readily accessible, and non-abrasive in nature [Dharmik et al 2021].

Coconut fibers have many general benefits, such as being completely static free, moth-proof, rot and fungal resistant, providing excellent insulation against temperature and sound, not easily combustible, flame-retardant, unaffected by moisture and dampness, tough and durable, resilient, and springing back to shape even after frequent use. There is a thorough discussion of the adaptability and uses of coconut fibers in many industries. According to reports, coconut fibers are the most ductile and absorbent substance. The possibility for using coconut fibers in composites for various applications is concluded. Many researchers have previously reported on the inexpensive and improved results of their investigations into various areas of coconut fiber reinforced composites. Given that coconut fibers have been used to create some amazing items, it is still possible to create new products using coconut fibers that perform better. Coconut fibers have been employed as reinforcement in composites for non-structural components in civil engineering. According to reports, coconut fibers are the most ductile and absorbent substance. The possibility for using coconut fibers in composites for various applications is concluded. Since the usage of coconut fibers has produced some amazing items, it is still possible to create new products with even better outcomes that incorporate coconut fibers. Coconut fibers have been employed as reinforcement in composites for non-structural components in civil engineering. It is necessary to do research on the behavior of coconut fiber reinforced concrete before using it for major structural elements like walls, columns, and beams. It provides good concrete stub column durability, tensile strength, and compressive strength. Therefore, the waste material may be recycled by employing this.

Ramie and Banana plant fiber The stems of the ramie plant provide ramie, a kind of bast fiber. It is usually mixed with several types of textile fibers. It was found that yarns with acceptable characteristics could be produced by adding Ramie fiber to cotton blends up to a maximum ratio of 35%. They were able to create ring yarns with tex values of 24.6 and 14.7, specifically. The pseudo-stem of the banana plant yields natural, fine bast fiber, which is known as banana fiber. Yarns combined with banana and cotton are used to create knitted fabric [Velumani et al 2021]. Naturally occurring fibers such as bananas contain a significant degree of diversity both within and between individual fibers. The pseudo-stem of the banana plant yields banana fiber. With flawless mechanical qualities, it is the best fiber available. Compared to glass fiber, its density is lower. It is biodegradable, fire resistant, light weight, and strong. Handmade covers and bags are fashioned using it. According to Vinoth et al [2018], it is used to create a variety of goods, including filter paper, paper bags, composite material, lamp stands, pen stands, ornamental papers, rope, and mats. Environmentally friendly, banana fiber is in high demand in many nations, including Germany, Australia, Japan, and many more. The fourth-most significant food crop in the world is the banana. Banana fibers are the most valuable when it comes to textiles, building construction, etc. The best strength, moisture absorption, hardness, and fineness are found in banana fiber. Currently, banana fiber is a waste product from the production of bananas that is either partially or improperly used. It is not usual procedure to harvest fiber from the pseudo-stem.

Fiber from Sisal and Palms Fibers are extracted from the thick leaves of sisal (*Avage sisalana*) to produce

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strings, ropes, bags, mats, brushes and rough fabrics. The fibers are also used as raw materials for paper. Fibers need to be extracted from the leaves within 24 hours after they are collected. Fibers that are produced through a fiber processor are dried under the sun and are used as materials for various products after being bleached white. The sap produced from the cut section of a scape is sweet and alcohol is produced by fermenting. In the production region, leaf fibers of African wild date palm are used as the material for fabrics (rabane), bags, and weaving; and fibers are collected from wild plants and the plants are not cultivated. Raffia palm (*Raphia ruffia*) is mainly used for its fibers. The fiber (raffia fiber) collected from the surface skin at the back of the young pinna is flat, soft, strong, and does not stretch or shrink easily. The fibers are used as materials for fabrics (rabane), bags, and weaving (hats, baskets, etc.). Wine raffia-palm (Bamboo palm, R. vinifera Bauv.), originated in Nigeria and grows wild in the coastal region of Tropical West Africa. The stem is shorter than *R. ruffia*, however, the leaf stem is longer. The leaf fiber (piassaba fiber) is used for industrial art and handicraft products, as is the raffia palm. The hard vegetable ivory is used as the material for buttons. As alcohol (toddy and bourbon) is produced using the sap collected from the shank of the flower ear, the palm is also called wine-raffia palm. The leaves of fan palm (palmyra palm, *Borassus flabellifer*) are used for the raw material for paper, roofing material, mats, baskets, ladles, and ethnic musical instruments. Fibers are collected from the leaf stems also [Sahu et al 2013]. The timbers are used as building materials and decoration materials (the timber is hard and insect-resistant). Fibers are collected from the inside of the timber also. Fibers are also collected from the exterior skins of nuts. The sweet sap, which is produced from the cut section of the flower ear, is used for making sugar, alcohol, and vinegar.

Milkweed Fiber One of the wasteland weeds that may be cultivated mostly in arid habitats in the southern regions of the United States, Asia, and South Africa is Calotropis gigantea, also known as milkweed (or murumur). Asclepia syriaca, also known as milkweed vines or "vegetable silk," resembles Rux vines (*Caleotropis gigantean*) in appearance. Milkweed is classified as a flexible substitutive fiber with several unique features, mostly due to its hollowness structures, among the range of recently discovered natural resources. Their excellent insulating qualities and light weight are due to the hollow channels that run the length of the fiber. The environmentally friendly and non-allergic textiles manufactured of Milkweed fibers might find many technological applications due to its beneficial chemical and ecological properties, particularly in the manufacturing of medical products. One of the primary constituents of milkweed fibers, hemicellulose is a naturally occurring polymer that primarily assisted in the formation of the branch skeleton of an amorphous structure [Bodirlau et al 2014]. The fibers taken from the stems or seedpods of the milkweed plant have been identified since prehistoric times and have been used as raw materials for textiles, particularly in various parts of the United States and southern Canada. Additionally, dietary and medicinal uses were made of these fibers. During World War II, milkweed fibers were used as the raw material for life jacket production due to its hydrophobic properties and hollow structure [Srinivas and Babu 2013]. Later, there was a huge increase in interest in using milkweed fibers for technical textiles, clothing production, and non-woven applications. It is anticipated that garments made from seedpod Milkweed fibers will be more comfortable to wear as clothing than other natural fiber-based textiles because to their high moisture regain. The technical use of milkweed fibers, particularly for cement composite structure reinforcement, may also be linked to the composite manufacturing sectors [Merati 2014]. Because of their low weight, milkweeds may be used in a variety of industrial applications such as geotextiles, filtration, and composite manufacture. The non-allergic properties of milkweed fibers make them suitable for usage in a variety of medicinal contexts.

Mudar fiber (*Calotropis gigantea*) Similar to cotton, this naturally occurring cellulosic seed hair fiber offers a great deal of potential for development into this kind of fiber. Mudar fiber has the potential to become a new, viable crop for farmers if it can be spun on a wide scale. Mudar fiber is a naturally occurring vegetable cellulose seed hair fiber that falls within the milkweed fiber family. It is a member of the Calotropis gigantea plant family within the Asclepiadaceae family of plants. The majority of this family's members may be found in tropical areas of the globe. They are particularly common in the arid regions of India and South America. Mudar fibers are developing on individual cells within a sizable plant seed. From the Mudar plant, the green seedpods were removed and left unopened. The interior was then revealed when they were split apart and the green husks were peeled aside. The Mudar fibers were manually extracted from the opening pod while the seeds were still attached. The connected seeds easily detached from the fibers when softly brushed against the hand's palm. In terms of physical properties, mudar fiber and cotton fiber are quite similar, but mudar fiber retains more moisture than

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cotton fiber. When compared to 100% cotton yarn, the mudar/cotton mixed yarns with varying blend proportions exhibit intermediate strength and flexibility [Radhakrishnan 2014]. The exceptionally low elongation of Mudar fibers does not negatively impact the elongation of blended yarns made of Mudar and Cotton. If more research is done to explore the possibilities of mudar/cotton mixes, practical and useful goods may be produced.

CONCLUSION

Understanding fiber formation and elongation, creating value-added products, inventorying plants, and breeding crops using molecular biology techniques are crucial for diversifying fiber-containing products. This diversification offers new markets, improved economic growth, and less dependence on fossil fuels, benefiting agriculture and the global population. Natural fibers like jute, ramie, and hemp are being studied for their environmental sustainability and natural decomposition. They are being used in technological applications and personal protective gear due to their low cost and environmental advantages, rather than their strength. Natural fibers have drawbacks like low flame retardancy, poor fungus and bacteria resistance, and high weight, leading to increased interest in synthetic materials for structural and infrastructural applications due to their wide variation in properties and treatments. Natural fibers offer environmental benefits, energy preservation, and affordability, making them biodegradable, renewable, and lightweight. They may be superior to synthetic fibers in some applications, but their financial benefits may be insignificant if waste handling costs are excluded.

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Disclosure of Conflict of Interest

Authors declares to have no conflict of interest.

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