MECHANICAL PROPERTIES EVALUATION OF BANANA FIBRE REINFORCED POLYMER COMPOSITES: A REVIEW

Surya P Gairola*
Department of Mechanical Engineering, DIT University Dehradun
Uttarakhand, India, suryapg07@gmail.com
https://orcid.org/0000-0001-7135-4269

Yogesh Tyagi
Department of Mechanical Engineering, DIT University Dehradun
Uttarakhand, India
https://orcid.org/0000-0001-7700-6425

Nitin Gupta
Department of Mechanical Engineering, DIT University Dehradun
Uttarakhand, India
https://orcid.org/0000-0002-0140-8206

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Abstract
In today's fast-developing world, the use of composite materials is closely related to environmental pollution, renewable and biodegradable resources. A researcher is looking for environmentally friendly materials. Natural and synthetic fibres come in a wide range of shapes and sizes. Natural fibres include jute, straw wheat, rice husk banana fibre, pineapple leaf fibre, cotton, Sisal, Coir, Oats, and Bagasse. Every year, 13.5 tonnes of banana fibre are produced in India. Teabags, paper, and polymer composite reinforcement are just a few of the applications for banana fibre. This article focuses on the manufacture of banana fibre with epoxy and a variety of other natural fibres. By combining banana fibre with some current technology, waste will be reduced, and energy efficiency will be increased, all while supporting sustainability. Banana fibres are covered in this work, along with their uses, applications, and mechanical qualities, as well as how banana fibre might improve mechanical properties.

Keywords
banana fiber; epoxy; mechanical testing; composite material; natural fiber.

Introduction
When compared to other fibres, banana fibre offers superior mechanical qualities. Banana fibre has a higher specific strength than glass fibre. Until today, we couldn't completely exploit banana fibre to the fullest. Banana fibre is an underappreciated or misunderstood waste product in the banana industry. If we can effectively use this fibre, the cost of serval products may come out and it will be boon to the society. Banana fibre is strong, fire-resistant, light, absorbs a lot of moisture, has a low elongation, and is biodegradable. Banana fibre has a lot of potential in the paper industry, particularly for handmade papers. Handling cards, pen stands, filter paper, rope, paper bags, lamp stands, mats, and composite materials employ banana fibre. It's utilized in cars to make underfloor protection panels. Automobile makers employ banana fibre and polypropylene. Interior designers employ banana fibre composite material. Banana fibre paper has a long shelf life.
In order to improve performance, we use matrix and reinforced composite materials. Fiber is mostly used to strengthen. Fiber, natural or synthetic, is usually employed as a reinforcing element (non-biodegradable). Matrix materials include ceramic, polymer, and metallic. Thermoset and thermoplastic (phenolic, polyester, Polycaprolactone, Polyhydroxy butyrate, and epoxy) are two types of polymer matrix (polyethylene, Polypropylene and polyvinyl chloride). A composite is a matrix material reinforced with fibres. A hybrid composite has many fillers and reinforcing elements. A matrix's properties vary depending on the criteria. As a result, understanding mechanical qualities, applications, and manufacture is impossible. This study studied the mechanical qualities, application, and production.

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Historical context

- Fiber from bananas

Unlike other natural fibres, banana fibre has several distinct properties. Banana fibre is harvested from a banana tree. Banana fibre, also known as Musa fibre, is one of the world sturdiest natural fibres. The natural fibre is made from the stem of the banana tree and is biodegradable. Banana plant outer sheaths produce thicker, more durable fibres, and the inner sheaths have softer fibres. According to Bilba [1] banana leaves (BL) and the pseudo-stem banana core were investigated as two sections of a banana tree (BC). It was assumed that the existence of more hydrogen in BL fibres was related to the fact that BL fibres had fewer double links as compared to others. Bananas are a tall herbaceous plant (2-16 m) with a pseudo-stem made up of densely overlapping long fibres. According to Samel [2], Banana fiber has strong tensile, flexural, and resistance. After further investigation, it was discovered that the majority of researchers, such as William Jordan [3], Shih, and Yeng-Fong [4] employed pseudo-stem banana fibre.

Banana fibre can be used to dampen the sound of a stone hitting an automobile. The first component quality fibre is banana fibre. Ibrahim [5] claims that banana fibre and banana micro fibrils can be made from lignocellulose waste using alkaline pulping and steam evaporation. William Jordan [3] argues that all lignocellulose fibres are chemically identical. Cellulose, hemicelluloses, and lignin. However, they will be the same for the same plant species. Lignocellulose offers a variety of mechanical characteristics. Transportation, storage, and the extracted fibre's life cycle may all contribute to this. Raw banana fibres mechanically separated from the stem are utilised to improve the qualities of natural banana fibres subjected to chemical surface changes, according to Shih [4]. The banana fibre is first washed in detergent, then treated with NaOH, and last with saline acetone.

Encouragement of natural fibres in composite materials can significantly minimize the greenhouse effect, as we mentioned in various paper [6]. As a result, the goal of our research was to look into the physio-mechanical properties of walnut shell powder (WNP)-with banana fibre (BF) fiber-based epoxy (EP) composites. We discovered that adding walnut powder to the BF/EP composites significantly improved their mechanical properties and wear resistance.

M. Boopalan [6] says banana fibres are non-abrasive, renewable, and can be burned for energy. It is easy to handle and has a lot of calories. It's also cheap, light, and strong. Its eco-friendliness makes it appealing in engineering industries like construction and automobiles. N. Venkateswaran [7] found that adding 50% sisal to a banana/epoxy composite improved mechanical characteristics while decreasing moisture absorption.

- Banana Fiber Reinforce Polymer and Composite

Several researchers recommend adding a modified compatibilizer to the modified polymer to increase Fiber-Polymer binding. M. Ibahim [5] suggested that lignocellulosic fillers are created from banana plant waste and reinforced with polyethylene. Adding melted fibre to the polymer matrix improves adhesion and tensile strength but increasing fibre concentration from a specific limit reduces adhesion and tensile strength.

Factor Influencing the mechanical properties of fiber Reinforced composite (FRCs)

- Type of fiber used: Characterisation

Natural fibre characteristics are mostly determined by their physical properties and chemical organisation, according to Gupta [7]. Processing "pseudo stems of banana plants" yields banana fibre (Musasepientum). The majority of banana fibre is made up of lignin, cellulose, and hemicellulose, earning it the moniker lignocellulosic fibre. As a result of their chemical make-up and structure, composite materials based on reinforced natural fibres offer outstanding mechanical qualities.

Banana fibre reinforced composite having high tensile, flexural, and impact strength. The physical and mechanical properties of banana fibre reinforced biodegradable. Thermoset, and thermoplastic composites are being studied. Fibers are classified as minerals, plants, or animals. Essential characteristics of the banana fiber are given in Table 1, which states that banana fiber contains cellulose and protein in various concentrations. Chemical composition with the moisture content of banana fiber shown in Table 1 and moisture absorb of banana and walnut chart we have shown in Figure 1. In which we shown moisture absorption in Banana fiber and walnut powder composite in different WNP Loading. As per Banana fiber and walnut powder chart it is conform that as we increase the wt% of walnut powder the water absorption also increases maximum water absorption we can see in 15% WNP and minimum absorption at 5% WNP.

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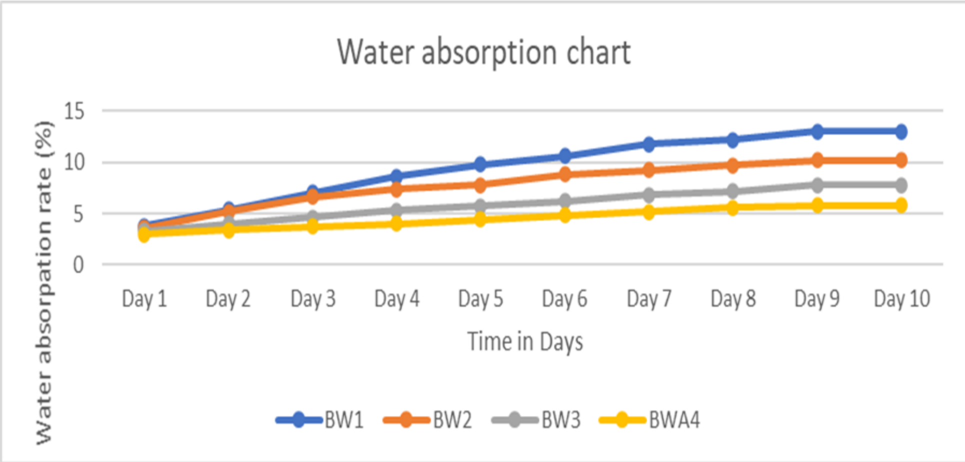

Figure 1. In this BW1-30% B/F and 0% WNP,BW2,BW3,BW4 -5,10,15% WNP with 30 % BF.

Moisture absorption chart of Banana fiber and Walnut powder in different proportion.
Indria, K.N., et al. [8]. Treated reinforced composites (40 wt%) have better thermal stability than untreated fiber-reinforced composites (40 wt%). The researcher, Kiran [9], reported that a banana-pineapple hybrid composite showed distinct weight friction with epoxy resin. It increases flexural strength by increasing fibre weight friction. He also adds that using two natural fibres instead of one increase flexural strength. The mechanical property of banana fibre is very much comparable to other natural/synthetic fibre shown in Table 2.

Table 1. Chemical Composition and Moisture Content of Banana Fiber. *Source: [8,9].*

Cellulose (%)	**Hemi cellulose (%)**	**Lignite (%)**	**Moisture (%)**	**Ash (%)**	**Density (g/cm²)**
63±1	19±1.2	5±0.5	11±0.1	1.02	1.3±0

Table 2. Comparative Mechanical properties of banana with other natural/synthetic Fiber.
Source: [8–13]

Fiber	**Density g/cm²**	**Tensile Strength (MPa)**	**Elongation (%)**	**Young modulus (GPa)**	**Specific modulus (Approximate)**
Banana	1.35	500	1.5-9	12	9
Bamboo	0.6-1.1	40-800	2.5-3.7	11-32	25
Coir	1.2	75-220	15-30	4.0-6.0	4
Cotton	1.5-1.6	287-800	3-10	5.5-12.6	6
Sisal	1.33-1.5	63-700	2.0-4	9.0-38.0	17
Jute	1.3-1.49	20-800	3.7-5.9	8-78	30
E Glass	2.5-2.59	2000-3500	1.8-4.8	230-240	29
Nettle	-	223-930	-	1.7	30
Hemp	1.4-1.5	270-900	1-3.5	23.5-90	40
Kenaf	1.4	223-930	1.5-2.7	14.5-53	24

Dhaka [10] focuses on the characterisation of raw banana fibre polyester composites. He mentions that natural fibres include hemp, jute, banana, sisal, kenaf, and others. Natural fibres' lignocellulosic character has helped them gain popularity in recent years. Rathore [11] summarises the value of combining banana and jute fibres in the same natural polymer matrix, since they often impart their own qualities and produce a nice hybrid composite.

- Matrix Type used

Kumar [13] claims matrix is vital in-plane shear. Strengthening of compression and interlaminar joints. Bananas and other natural fibres have been demonstrated to be compatible with thermoplastics and thermosets. Many researchers investigate banana fibre reinforcement with thermosets such as polyester, vinyl ester, epoxy, and phenolic resin. A number of researchers have created unique composites that are both ecological and biomedical, according to Shih [4]. PLA is a biodegradable thermoplastic that can be utilised in biocompatible/bio absorbable medical equipment or industrial packing. Researchers used oil palm wood flour (OPWF) as a wood basis filler for bio-based thermoplastic composites in a recent study, with good results.
After cleaning and chopping the biobas fibre, Shahinur [14] added thermoplastic granules to boost its mechanical characteristics. With chopped and cleaned fibre combined in thermoplastic granules, he noticed that the mechanical properties were quite comparable to injection moulding. Table 3 shows the Impact Strength of Different Thermosets and thermoplastic resin with banana fibre.

Table 3. Comparative mechanical properties of pure thermoset composites and respective Banana reinforced composites. *Source: [4,13–16]*.

Properties	**PP**	**Banana/PP (MPa)**	**Epoxy (MPa)**	**Banana/Epoxy**	**PLA (MPa)**	**Banana/PLA**
TS (MPa)	19.71	11.45-24.16	33.86	114	39.3	78.6
FS	38.82	38-42	118.75	74	39.4	65.4
Impact kg/m^2	19-22			10.439 (Joule)	22.2 (J/M)	17.1 J/M

According to Dhakal [10], matrix is used to secure fibres and transfer weight between them. It also protects the fibres from the elements. Kiran [9] claims that the matrix organises the fibres regularly. The matrix material takes many forms. Ceramic, polymer, or metal. A metal matrix is an alloy reinforced with metal fibres like boron carbon. Examples of polymer matrix composites are PMCs and ceramic matrix composites.

- Separation of Fiber

After drying, most natural fibres, especially banana fibre, must be chopped horizontally to provide strength and variation. According to Sapuan [17], fibre separation is affected by length, temperature, and pressure. R. Karthic [18] used woven and nonwoven banana fibres to generate fibre dispersion in order to examine the length effect. The significance of fibre coarseness and length has been demonstrated.
According to Mishra, [19] Poly(lactic acid) is easily available in pallet form and is frequently used for the production of bio-composites, particularly by melt extruder and injection moulding. Several positive changes in PLA's mechanical and wear characteristics have been recorded and some future recommendations. With the addition of filler, PLA demonstrated a decrease in tensile and flexural strength, which can be changed by using compatibilizers or mixing appropriate biopolymers.

- Fiber orientation

The orientation of the woven jute fibre has a significant impact on the mechanical and thermal properties of composites made with different resins. Unlike natural fibres, banana fibre offers a wide range of lengths. According to Amir [15], optimal mechanical properties are obtained when fibres are parallel and of required length. As Alavuden [20] discovered, woven banana/kenaf hybrid has a higher mechanical strength than individual banana/kenaf fibre. He compares the mechanical properties of random and woven fibres, concluding that weaved fibre beats random orientation.
Ezema [21] found that variation in properties due to fibre orientations was observed

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indicating a higher value of properties in the 00-fiber orientation than in 45˚ and 90˚ directions, which is shown in Figure 2 and 3.

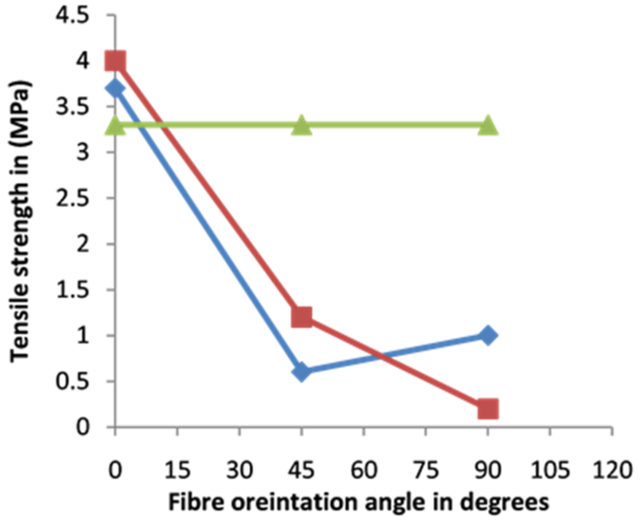

Figure 2. Effect of fibre treatment and orientation on the ultimate tensile strength of banana fibre-NR composite.

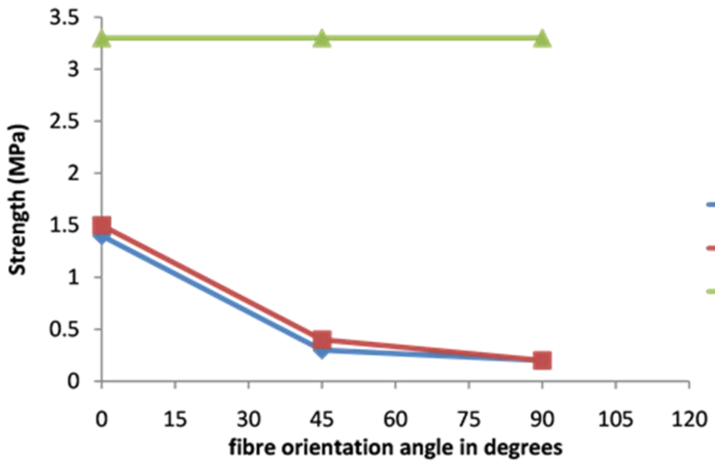

Figure 3. Effect of fibre treatment and orientation on banana fiber-NR composite failure strength.

Chandrasekar et al. [22] analysed the effect of fibre inter-ply orientation on the mechanical and free vibration behaviour of banana fibre reinforced polyester matrix composites. Characterization of 50 ± 2 wt% banana fiber reinforced polymer composites were carried out using cross-ply laminates ([90/0/90] and [0/90/0]), [0/45/0], four-layered angle ply laminate ([90/0]s) and quasi-isotropic laminates ([0/90/45]s, [0/45/90]s,).The study reviled that composite having [0/90/0] laminates showed superior elastic modulus, tensile strength, impact strength and natural frequency. In comparison to other configurations, Quasi-isotropic laminate composites exhibit better flexural properties.
Chavali's [23] research looked at a banana fiber-reinforced composite's tribological and mechanical properties with various orientations. He discovered that strength decreases more rapidly by 41.82 % from 0 to 45 orientation due to higher tensile stress developing in fibres than shear stress, whereas strength decreases by 14.21 % from 45 to 90 orientation.

- Composite Void and porosity

Many volatiles and air bubbles become trapped in composites during manufacture and remain as tiny voids. P. Deepak [24] recommends rolling over the mould when producing compost to reduce voids induced by the exothermic reaction of hardener and resin. Rathore [11] claims that nanocomposite has successfully minimized voids by using nanofiber. According to Amir [15], PP/banana composite has the lowest tensile strength due to void. Load transfer between fibres and matrix is reduced due to the composite's weakness. Biba [1] studies the natural fibre of banana and coconut trees chemically and texturally. He discovered that by calculating the temperature of pyrolysis of fibre before it changes in the cement matrix, we may predict the behaviour of composites in the presence of large porosity.

Banana Fiber Reinforced Thermoset Polymer Composite

The combination of banana fibre with a thermoset polymer matrix increases mechanical properties. Many researchers are investigating banana fibre reinforcement with thermosets. Table 3: Impact strength of different thermostats (IS or ST). Rathore [11] elaborates on the production of natural fibre reinforced thermosets. He also compounds sheet moulding and Thermoset compression moulding with resin.

- Resin and Fiber

When fibre and resin meet. By increasing the fibre's strength, toughness, and rigidity, it increases its load-bearing capability. We use technologies like twin vacuum, injection pressure moulding, and injection wall to raise the pressure gradient. Bhoopthi [25] used banana, hemp, and glass fibre as reinforcement materials in three different laminated hybrids. The experiment revealed that a banana-hemp-glass hybrid with epoxy resin has excellent mechanical properties and can be used as a substitute for synthetic fibre reinforcing material.

- Fiber with sheet moulding

Fiber is produced to sheet and laminate by hand, then thermal, such resin, is combined to enhance the chemical reaction, increasing temperature resistance.

- Fiber Compression Moulding

Liu [26] observed that banana fibre reinforced well with various thermosetting resins such as unsaturated polyester. Using thermoset to diminish banana fibre loading also affects the banana's water absorption characteristics at ambient proportions. Ravi Bhatnagar [27] asserts that banana fibre composite is perfect for thermoset for transportation and the vehicle industry. There was a lot of research on how natural fibres like banana and coconut functioned with thermoplastics.

Banana Fiber Reinforced Thermoplastic Polymer composite

A number of researchers have created unique composites that are both ecological and biomedical, according to Shih [4]. PLA is a biodegradable thermoplastic that can be utilized in biocompatible/bioabsorbable medical equipment or industrial packing. Researchers used Oil palm wood flour (OPWF) as a wood basis filler for bio-based thermoplastic composites in a recent study, with good results. After cleaning and chopping the biobas fibre, Shahinur [14] added thermoplastic granules to boost its mechanical characteristics. With chopped and cleaned fibre combined in thermoplastic granules, he noticed that the mechanical properties were quite comparable to injection moulding.

Biodegradable Polymer Composite Reinforced with Banana Fibers

According to Shih [4], biodegradable polymers are becoming more popular in material science. Poly(lactic acid), which has a high modulus, is one of these biodegradables. PLA is a high-strength thermoplastic polymer which is perfect for medical and industrial packaging. However, its low thermal deformation temperature and high cost limit its use. Combining BP (Biopolymer) with banana fibre produces a natural green composite with improved mechanical and thermal qualities while lowering costs.

Impact strength of banana fibre reinforced polymer composite

Composites containing molybdenum disulphate, such as banana fibre, have lower impact strength and thus lower toughness, according to Deepak [24]. According to Rathore [11], some researchers have observed that bio nanocomposite with catalyst has a significant impact strength. Liu [23] analysed the banana fibre composite made of HDPE/Nylon-6 (80/20) was made in two stages by altering SEBS-g-MA and PE-g-MA. SEBS-g.MA was found to enhance the reinforcing effect and impact. With a 5 mm thick banana fibre matrix, hardener, and catalyst, Sarub Dhaka [10] provides the highest impact strength with tensile. Alavudeen [20] studied the tensile, impact, and flexural strength of woven hybrid composite of Kenaf/Banana fibres. [16]. According to Ramesh, glass epoxy has a far higher impact strength than banana epoxy when mixed with glass fibre.

Limitation of Natural Fiber:
In spite of the many benefits of natural fibers in NFPCs, there are some disadvantages, such as excessive water absorption and poor thermal properties. These lignocellulosic composite materials also exhibit heat conductivity and acoustic insulation properties, which have been less explored. In order to make these materials more widely available and safer, future research into the characteristics of various natural fibres will be necessary. According to Raghavendra, a natural fibre's ability to reinforce depends on cellulose's composition and crystallinity [28].

- Fiber treatment

All-natural fibres can be treated using chemicals. Treatments include NaOH, saline, dicumyl peroxide in acetone (peroxide therapy), and potassium paramagnet in acetone (paramagnet treatment). Mechanical Properties of Bio-based polymer composite shown in Table 4.
Bhupathi [25] showed that alkali, salt, and acetyl treatments work well on natural fibre. After heat treatment, Indira [8] revealed that there is a change in surface topology between untreated and treated banana fibres. As a result, deterioration, disintegration, and activation of energy demand more energy after treatment.
Asim Shahzad [29] used advanced chemical technologies, such as chemical reagents, to lower the hydrophilic inclination of fibres and therefore increase matrix compatibility.
Chemical treatment of banana fibre is used to improve adhesion between banana fibre and polymer matrix. sodium lauryl sulphate, Alkali, and maleic anhydride are all common chemical treatments. The characteristics of banana fibre reinforced polymer composites improved with increasing banana fibre content, according to the literature. Chemical treatment of banana fibre improves the characteristics of the resulting polymer composites in general [30].
Peroxide treatment is an advanced way for reducing fibre moisture absorption. To obtain the required effects and increase thermal stability, hydroxyl groups react with free peroxide radicals react in this approach [31].
Alkali and SLS (Sodium lauryl sulphate) treatments can also be used to improve banana fibre mechanical properties. SLS treatment outperforms alkali for enhancing mechanical properties and surface modification. SLS has stronger tensile, flexural, and impact strength than Alkali.

Table 4. Mechanical Properties of Bio based polymer composite. *Source: [11,12,14].*

Bio composite	**Tensile strength (MPa)**	**Flexural (MPa)**	**Impact kg/m^2**	**Hardness Rockwell (L)**	**Water absorption (%)**
Jute	320-800		25-85	78-97	0.7-1.26
Treated jute			18-24	77-87	0.73-1.22
Coir	95-230		35-60	80-90	0.3-1.72
Treated coir			40-60	90-105	0.3-0.7
Banana	500		1.2-1.8	60-66	1.5-3.0
Treated banana			0.9-1.5	66-72	1.0-2.5
Coir-PP	22-27	46.50			
Treated coir-PP	27-30	53-60			
Jute-PP	17-34	20-32			
Treated jute-PP	15-51	15-58			
Banana-PP	11-22	38-42			
Treated Banana-PP	23-24	36-39			

- Additives or Filler

The fundamental distinction between various fillers and additives and treatment is that fillers or additives mix with the matrix to strengthen mechanical qualities, whereas fillers receive treatment. A modest amount of resin is blended with filler or additives. The majority of fillers improve the mechanical properties of composites while also controlling the viscosity and producing a smooth finish. Elanchezhain [32] stated that adding filler (stiff coir

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and jute) to a soft polypropylene matrix improves the flexural modulus. Sweety Shahinur [14] explains how composites are made up of a matrix and a reinforced material and how adding filler can increase performance. Bhatnager [27] discovered in his review that when red mud is added to the filler, it provides maximum mechanical strength as compared to pure BFRPCs (BFRPCs percentage 50 percent)

Filler is well-explained by Pothan [33]. He refers to Nelasion because natural fibre can be employed in automotive structures. According to this, the law of mixture can be used to predict the mechanical properties of composites. He gives one formula for analysing the damping property of composites, which is also useful for studying the damping property of composites.

$$\tan \delta_c = \tan \delta_m (1- \phi_f) \quad (1)$$

$\tan \delta c$ - represents composition damping, which is a matrix proportional contribution to its relative content
$\tan \delta$ m - represents the matrix damping value, and ϕf represents the friction volume of the filler.

- Hybridization

Nagaraja, K. C. [34] created a hybrid composite laminate and studied the reinforcement hybridization effect. The statistics show that 10% MRP increased the mechanical properties significantly. This decreases E-Glass fibre content in composites. Due to its exceptional mechanical properties and low cost, this composite was recommended for many technical applications.

Banana fibre is appropriate for replacing current fibres, according to Subagyo [35]. Banana pseudo steam fibres are removed using fibre extractors. The raw material is cheap and widely available.

Ramesh Kumar [36] developed hybrid composites made of kenaf, glass, banana, and graphene filaments, which are widely used in polymeric networks in automobiles, space vehicles, and aviation development. In this study, nanohybrid composite laminates with varying weight percentages nanofiller of graphene and reinforcing materials such as banana, kenaf, and glass fiber were made with epoxy resin and different weight percentages of graphene as nanofiller. The results reveal that including graphene into epoxy resin enhances the mechanical properties of nanohybrid composites and that kenaf/glass fiber hybrid nanocomposites outperform banana/glass fiber hybrid nanocomposites.

Temesgen [37] investigates the mechanical characteristics of hybrid composite materials reinforced with false banana/glass fibres at different orientations of hybrid (glass and false banana) fibres and fibre volume fractions. The results reveal that both fibre orientation and volume fraction substantially impact the mechanical characteristics of the artificial banana/glass fibre hybrid composite.

Ravi Y.V. [38] creates the composite hybrid helmet with natural hemp and banana fibres and polyester resin as the matrix material, utilising a traditional hand lay-up technique. The helmets are prepared before being put to the test. According to the tests, natural fibres have good strength and impact resistance and are the best alternatives to synthetic fibres, which are extensively employed in the helmet manufacturing industry.

The influence of fibre orientation on the abrasive wear behaviour of banana fibre reinforced Chavali and Taru [39] studied epoxy composites. The wear test was carried out using an ASTM-approved pin-on-disk tribometer. Low wear was observed at 00 fibre orientation, increasing to 900 fibre orientation for 20 N and 50 N at 200 rpm. Wear is related to the contact area; therefore, fibres are more wear-resistant than resin. At 00 fibre orientation, there was less contact between the fibre and the disc, resulting in minimal abrasive wear. In composites with 900 fibre orientation, the contact area between fibre and disc was greater.

- Impacts in Polymeric Composites

The results of the Mahesh, D. [40], experiment that, the 50 percent banana fibre and 50 percent polypropylene composite materials can bear higher loads than the other combinations and can be utilised as an alternative to traditional fiber-reinforced polymer composites.

Neher employed [41] obsolete high-density polyethylene (HDPE) as the polymer matrix and banana fibre as the reinforcement material in this investigation and he discovered that bulk density and tensile strength grew by wt.% while flexural strength declined. Flexural strength increased for 5 wt.% BF-HDPE composites at first, but then decreased for other higher compositions.

Samal [2] created banana fibre reinforced polypropylene (BSFRP) composites as well as banana-glass fibre reinforced polypropylene (BSGRP) hybrid composites. He claims that at 30 wt. percent fibre loading, which is regarded as the critical fibre loading, the highest improvement in polymer characteristics is observed. It is also mentioned by Powała [42], polymer can be utilised to increase mechanical qualities. Many scientists are attempting to enhance the properties such as flexural strength, compressive strength, and water resistance. Certainly Polymers can be used to change the cement matrix.

Banana Fibre's Use in Automobiles and Industries

Incorporating natural fibres into a polymer matrix attracted worldwide attention to the importance of environmental consciousness. According to Jordan [4], natural fibre reinforcement is commonly used in engineering applications. Compared to synthetic fibre, Madhukiran [9] thinks natural composite is a great material for lightweight cars.

On the other hand, Sushant [2] cites Hang, who has thorough information on the usage of natural fibre in vehicle structures and has found natural fibre superior to other materials. Boopalan [6] describes natural fibres as non-abrasive, renewable, and energy-recovery composites. They are easy to handle and high in calories. Low-density natural fibre has great mechanical properties. Synthetic fibre displaced cellulose fibre in the 1970s and 1980s, according to Venkateshwarn [7]. Shahinur [14] quotes Mohammed et al. who stated that natural fibre may replace asbestos in automobile interiors and engineering applications. As seen in the table 5, polymer composite is excellent for autos.

Table 5. Compared to traditional vehicle material composite offer.

Better Internal Damping Leads directly to reduce noise and vibration	Reduced tooling cost Composite tooling cost is only 40% of steel stamping tooling cost
Substantial weight reduction FRP composite are typically 25-35% lighter than steel parts of equal strength	
Unparalleled damage resistance Damage resistance of composite is far superior to that of aluminium and steel panels	Unrivalled corrosion resistance Few materials Offer better corrosion resistance than FRP composite in any application automotive or otherwise
Lowered manufacturing complexity Fewer parts required for a finished assembly cuts manufacturing cost and often speeds run-up to design completion and model introduction.	Improve Design flexibility Moulding offers shape complexity, geometry details, and a depth-of-draw range unavailable with metal stamping, in some case, a part just cannot be manufactured out of other materials.

Application and Future scope

In recent years, it has been used more as a reinforcing material, particularly in the plastics industry, increasing its cost and damaging the environment. So we want renewable and biodegradable. Natural fibre can also be used in other automobile parts. It is based on biodegradability, low cost, lightweight, and high rigidity.

It is possible and convenient to use Jute fibres instead of made fibre, resulting in increased cost-efficiency. Jute fibre was introduced as reinforcement in thermoplastic and thermoset polymer-based composites and has found extensive transportation applications (automobile and railway coach interiors, boat, etc.). The automotive sector, in particular, plays a critical role in this subject. Bulletproof panels were created using natural fibre reinforced composites and epoxy as a matrix. Jute fibres can also be employed in these prototype bulletproof panels were thought to be lighter and less expensive than standard bulletproof panels. Moreover, jute fibers and other natural fibres are also finding their uses in prosthetic applications.

Impact

The current review focuses on banana fiber composites' mechanical and physical properties and their chemical makeup. When compared to other natural fibers, banana fibers have exceptional properties. With the help of composite technology, it is feasible to use and apply lower-cost commodities in high-performance appliances. They are beneficial in several disciplines of engineering, high-performance applications such as leisure and sporting products, shipping industries, Aerospace, and so on, since they combine the useful features of two different materials, lower manufacturing costs, versatility, and so on.

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Conclusion

We must stop manufacturing materials that last forever, such as many plastics, in order to protect our environment. Accepting rapid degradation as a result of persistent renewal, as in nature, is not an option. Industry, particularly the automobile industry, which uses a lot of bulk materials, would prefer a midway house of materials that last a long time yet disintegrate back into the environment when they're no longer needed. Reinforced polymers based on natural, primarily plant-derived chemicals show promise in this regard and may prove to be one of the century's material revolutions. In this review , we have gone through the mechanical properties of banana fibres and factors affecting direct characteristics such as fibre length, rebounding, interfacial adhesion, and morphological changes on fibre surfaces. Add more results/outcome statements related to banana fibre.

Conflict of interest

There are no conflicts to declare.

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