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Physio-Mechanical Properties of Water Hyacinth (Eichhornia crassipes) Fibre for Interior Decoration Applications in South-West Nigeria

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Abstract: *This study investigates the physio-mechanical properties of water hyacinth fibre harvested from two river sites in South-West Nigeria Igbokoda River (Ondo State) and Ejinrin River (Lagos State) and evaluates their suitability for the production of interior decoration items. The physio-mechanical characterization encompassed tensile strength, flexural strength, impact resistance, ash content, moisture content, volatile matter, fixed carbon, cellulose, hemicellulose, and lignin content determination. Scanning electron microscopy (SEM) coupled with energy-dispersive X-ray spectroscopy (EDS) was employed to analyse fibre surface morphology and elemental composition. Results revealed significant inter-site variation in mechanical performance, attributable to differences in water chemistry, sediment characteristics, and anthropogenic activity. Fibres from Ejinrin exhibited higher tensile strength (mean UTS ~ 1.45 MPa), while those from Igbokoda recorded superior impact resistance (13.62 J) and higher flexural stress (0.19 MPa). Cellulose content ranged from 38 to 45%, with moisture content between 8.1% and 9.6%. SEM analysis revealed variably textured surfaces Ejinrin fibres were smooth and cohesive, while Igbokoda fibres showed a porous morphology with moderate impurity levels. The findings confirm that water hyacinth, particularly from Igbokoda and Ejinrin, presents viable physio-mechanical characteristics for eco-friendly textile fibre applications. The results support the valorisation of this invasive aquatic weed as a sustainable raw material for interior decoration items, contributing to environmental management and local economic development.*

Keywords: water hyacinth fibre, physio-mechanical properties, interior decoration, South-West Nigeria, sustainable materials, SEM analysis

INTRODUCTION

Interior decoration has long been associated with comfort, visual appeal, and the human desire to create functional living environments. The field encompasses the beautification of interior spaces using a wide range of decorative objects, many of which are traditionally woven from natural fibres of plant and animal origin (Alozie, 2017). In recent decades, growing awareness of environmental sustainability has renewed interest in natural plant-based fibres as alternatives to synthetic and non-renewable materials in textile and design applications.

Natural plant fibres are primarily composed of cellulose, hemicellulose, and lignin, with minor constituent compounds (Reddy et al., 2013). These fibres offer several advantages over synthetics, including biodegradability, recyclability, thermal performance, and compatibility with human health. The global textile and design industries have consequently intensified research into underexplored plant fibres that can support sustainable manufacturing and environmental conservation goals.

Water hyacinth is one such plant deserving of closer attention. An ornamental aquatic plant introduced into Nigerian waterways, water hyacinth has since become one of Africa's most destructive invasive weeds, proliferating rapidly across rivers, lakes, irrigation channels, and power-generation waterways (Rezania et al., 2015). In Nigeria, significant infestation was first documented in 1984 at Badagry Creek, Lagos, and has since spread across major waterways in Lagos, Ogun, Ondo, Rivers, Niger, and other states (Bolorunduro, 2002; Ezama, 2019). The plant disrupts navigation, fisheries, hydropower, agriculture, and aquatic biodiversity.

Despite its destructive profile as an invasive weed, water hyacinth possesses structural fibres that may be exploitable for textile and design applications. Countries including India, the Philippines, Thailand, China, and Indonesia have demonstrated the potential of water hyacinth stalks in producing baskets, mats, storage containers, and decorative objects (Rezania et al., 2015). Nigeria, with its extensive and persistent water hyacinth challenge, presents a significant opportunity to transform this ecological burden into a viable sustainable resource.

However, the mechanical suitability of Nigerian water hyacinth fibre for interior decoration applications remains understudied, particularly with respect to site-specific variations across the country's diverse riparian environments. Understanding how geographical and environmental conditions influence the physio-mechanical characteristics of the fibre is critical for determining its material potential and optimising its processing for textile use.

This study addresses this gap by characterising the physio-mechanical properties of water hyacinth fibre obtained from Igbokoda (Ondo State) and Ejinrin (Lagos State) two key water hyacinth-infested waterways in South-West Nigeria. The characterisation encompasses tensile, flexural, and impact strength, alongside compositional properties including cellulose, hemicellulose, lignin, moisture, ash, volatile matter, and fixed carbon content, and surface morphology analysis via SEM/EDS. The findings are discussed in the context of the fibre's suitability for interior decoration applications.

LITERATURE REVIEW

Water Hyacinth as an Invasive Plant in Nigeria

Water hyacinth (Eichhornia crassipes) is widely regarded as the most problematic floating aquatic macrophyte in tropical and subtropical regions globally (Jafari, 2010). Its remarkably rapid reproduction capable of doubling biomass in as few as twelve days under favourable conditions enables it to form dense mats that block sunlight, deplete oxygen, and suffocate aquatic life (Rezania et al., 2015). In Nigeria, the plant was introduced as an ornamental species and was first observed as a serious infestation at Badagry Creek in September 1984 (Akintola, Anatekhal, & Lawson, 2011). By 1990, it had colonised coastlines across the country's creeks and lagoons, subsequently spreading to major inland water bodies including the Kainji Dam and rivers in Rivers, Benue, Taraba, and Adamawa states (Bolorunduro, 2002; Ezama, 2019).

Management strategies have ranged from mechanical and biological control to chemical treatment using herbicides. However, Souza et al. (2020) cautioned that herbicide application poses risks to water quality and non-target organisms. As a result, the valorisation of water hyacinth biomass into useful product a 'weed-to-wealth' approach has gained increasing scholarly and industrial traction (Sneha, Sabu, Namitha, & Jose, 2023; Nandiyanto et al., 2023).

Fibre Properties of Water Hyacinth

The fibrous composition of water hyacinth stems has been documented in several studies. Jafari (2010) identified cellulose (18–22%), hemicellulose (48–50%), and lignin (3.5–5%) as the primary structural polymers. More recently, Guna et al. (2020) and Ramesh et al. (2017) reported that alkali-treated water hyacinth fibre achieves tensile strengths of 25–40 MPa, substantially higher than the raw, untreated state. Bakar et al. (2015) attributed the low tensile strength of untreated fibre to air-filled aerenchymatous cavities and thin cellulose walls inherent to buoyancy-adapted plant tissue.

Morphological studies using SEM have revealed that surface texture, fibrillar alignment, and impurity level vary considerably across sample populations (Abdel-Sabour, 2010; Segbefia et al., 2019). These variations have been linked to the physicochemical quality of the water bodies from which the plant is harvested, underscoring the relevance of site-specific evaluation.

Mechanically, water hyacinth fibre compares unfavourably with high-performance natural fibres such as jute (250–400 MPa), kenaf (200–300 MPa), and coir (100–200 MPa) (Okafor et al., 2019). Nonetheless, it is high ductility, biodegradability, and ease of processing position it as a viable candidate for low-to-medium-stress applications, particularly in composite materials and handcraft production (Alavudeen et al., 2015).

Applications in Interior Decoration and Craft

The use of natural plant fibres in interior decoration is well established across many cultures. In the African context, craft production involving natural fibres manifests in textiles, pottery, basketry, and decorative interior items (Odji, 2020; Ade, 2018). Boonyaroj et al. (2017) and Karouach et al. (2022) documented successful applications of water hyacinth stalks in producing items for domestic use and tourism industries, particularly in Southeast Asian countries. Sierra-Carmona et al. (2022) further noted the growing global demand for eco-friendly, locally sourced decorative materials.

Within Nigeria, the integration of indigenous fibres into interior design practice has been advocated as a means of promoting local materials, supporting economic development, and preserving cultural heritage (Adiji & Oladumiye, 2015; Kashim, Ogunduyile, & Adelabu, 2011). Emidun and Akinrujomu (2021) highlighted the potential of water hyacinth products as a cottage industry opportunity in Nigerian coastal and riparian communities. However, the absence of systematic physio-mechanical characterisation specific to Nigerian water hyacinth has limited the uptake of this material in formal design and textile practice.

MATERIALS AND METHODS

Study Sites and Sample Collection

Water hyacinth plants were harvested from two riverine sites in South-West Nigeria: Igbokoda River (Ondo State; approximately 6°30'N, 4°50'E) and Ejinrin River (Lagos State; approximately 6°30'N, 4°05'E). These sites were selected based on the severity of water hyacinth infestation, accessibility, and the contrasting environmental characteristics of their water bodies Ejinrin being situated within an estuarine-coastal zone with brackish influence, and Igbokoda located in an inland freshwater riparian environment with industrial and agricultural catchment activity.

Mature plants were manually harvested using cutlasses and protective gloves. Roots and leaves were removed on-site, leaving only the fibrous stalks. The stalks were washed to remove surface mud and debris, cut to lengths of 30–40 cm, and air-dried for 48 hours. Each batch was labelled according to collection site and stored in clean polyethylene bags prior to laboratory processing.

Fibre Extraction

Fibre extraction was carried out using a combination of retting and mechanical decortication. In the retting method, cleaned stalks were bundled and submerged in water for 5–7 days to allow microbial action to degrade pectic substances binding the fibrous layers to the woody core. Progress was monitored daily from Day 4 onward, and fibres were separated by repeated combing using a hair comb once retting was complete.

Mechanical extraction was performed using a decorticating machine at Ibiade Craft Workshop, Ogun State, which mechanically stripped the outer cortex to expose the underlying fibrous strands. Following both extraction methods, the fibres were subjected to alkaline treatment using 10% NaOH solution at 90°C for one hour to remove residual non-cellulosic materials. The treated fibres were subsequently neutralised in 1.0% acetic acid solution, thoroughly rinsed in clean water, and air-dried at ambient temperature. The resulting fibres exhibited a light-brown to golden colour, soft texture, and a visual resemblance to jute fibre (Jose, Salim, & Ammayappan, 2016).

Physio-Mechanical Testing

Tensile Strength

Tensile strength testing was conducted in accordance with ASTM E8 standards using a computerised Instron Testing Machine (Model 3369) at a loading rate of 5 mm/min and room temperature conditions. Three specimens per sample were tested on a 40 mm support span with a 15 mm diameter. Load-displacement plots were used to determine ultimate tensile strength (UTS), tensile strain at break, and energy at break.

Flexural Strength

Flexural testing was performed using a three-point bending fixture on the same Instron machine. Maximum flexural stress, flexural strain at break, and energy at yield were recorded for specimens from both sites.

Impact Strength

Impact strength was measured using the Izod impact method, in which specimens were held in a cantilever beam configuration and subjected to a pendulum impact. Results were expressed in joules (J), representing energy absorbed at fracture.

Ash Content

Ash content was determined by the gravimetric method following AOAC (1990). A 5 g sample was incinerated in a muffle furnace at 550°C for four hours. The percentage ash was calculated as:

$\% \text{ Ash} = [(W_3 - W_1) / (W_2 - W_1)] \times 100$ ………… (Equation 1)

where W_1 = mass of empty crucible; W_2 = mass of crucible + sample; W_3 = mass of crucible + sample after ashing.

Moisture Content

Moisture content was determined following the British Standards Institution (BSI) procedure for solid biofuels using the oven-dry method. Samples were dried at 105°C for three hours. The calculation followed:

$\text{Mc} (\%) = [(m_3 - m_1) / (m_2 - m_1)] \times 100$ ………… (Equation 2)

where m_1 = mass of empty crucible + lid; m_2 = mass before drying; m_3 = mass after drying.

Volatile Matter and Fixed Carbon

Volatile matter was determined per ASTM E872-82 by placing 2 g samples in a muffle furnace at 850°C for 7 minutes. Fixed carbon was calculated empirically as:

$\% \text{ FC} = 100 - (\% \text{ VM} + \% \text{ Ash} + \% \text{ MC})$ ………… (Equation 3)

Cellulose, Hemicellulose, and Lignin Content

Cellulose content was determined from extractive-free samples using a concentrated HNO_3 reflux method followed by muffle furnace ashing at 500°C for four hours. Hemicellulose was quantified after alkali extraction (5% NaOH, 3 hours at 1:100 liquor ratio). Lignin content was determined using the Klason method with 72% H_2SO_4 hydrolysis and expressed as the percentage of insoluble residue relative to sample weight.

Scanning Electron Microscopy (SEM) and EDS Analysis

Surface morphology was characterised using a Scanning Electron Microscope at magnifications of 8,000× to 10,000× at 15 kV accelerating voltage and 60 Pa pressure. Samples were platinum-coated by low-vacuum sputter coating prior to imaging. Energy-dispersive X-ray spectroscopy (EDS) was simultaneously employed to determine the elemental composition of fibre surfaces, identifying site-specific mineral and metal deposition patterns.

RESULTS AND DISCUSSION

Surface Morphology: SEM Analysis

SEM analysis of water hyacinth fibres from the two study sites revealed distinctly different surface morphologies, reflecting the contrasting environmental conditions of Ejinrin and Igbokoda rivers.

Ejinrin fibres exhibited smooth, cohesive, and well-aligned fibrillar structures with low impurity levels characteristics indicative of effective alkali treatment and well-ordered cellulosic microfibrils. The treatment uniformity observed in Ejinrin samples was rated as very good, contributing to their high mechanical strength potential.

In contrast, Igbokoda fibres displayed a porous, partially cracked surface with fragmented fibrillar alignment and moderate impurity levels. This morphology is consistent with metal-contaminated aquatic environments, wherein transition metal deposition particularly iron (3.57 wt%), copper (2.20 wt%), and nickel (2.20 wt%) may have disrupted cellulose microfibril orientation and surface uniformity. Despite this, the Igbokoda fibre demonstrated higher absorption potential, which is advantageous for dye uptake in textile applications (Rezania et al., 2016).

Table 1: SEM Morphological Evaluation of Water Hyacinth Fibres from Ejinrin and Igbokoda

Feature	Ejinrin Fibre (Lagos)	Igbokoda Fibre (Ondo)
Surface Texture	Smooth and cohesive	Porous and partially cracked
Fibrillar Alignment	Well-aligned and cohesive	Fragmented and uneven
Treatment Uniformity	Very good	Uneven
Impurity Level	Low	Moderate
Mechanical Strength	High	Moderate
Surface Regularity	Uniform	Irregular
Absorption Potential	Moderate	High
Overall Suitability for Eco-Textiles	Excellent	Moderate

Source: Researcher's SEM analysis, 2025.

EDS Elemental Analysis

The EDS spectra provided important insights into the environmental conditions influencing fibre composition at each site. Ejinrin samples showed elevated silicon (25.52 wt%) and aluminium (7.45 wt%) alongside notably higher sodium (3.60 wt%) and chlorine (2.00 wt%) hallmark indicators of estuarine and brackish water influence typical of Lagos coastal hydrology. Zinc (3.30 wt%) was uniquely present in Ejinrin samples, suggesting industrial effluent or galvanisation runoff, as reported in comparable coastal studies (Mohan et al., 2014). The presence of salt-associated ions can alter mechanical properties by interfering with cellulose microfibril orientation (Chand et al., 2016).

Igbokoda's EDS profile showed a comparatively balanced composition, with oxygen (30.25 wt%) and carbon (55.50 wt%) predominating and notable co-occurrence of copper (2.20 wt%) and nickel

(2.20 wt%). The Ni–Cu signature is often associated with petroleum-related or industrial activities, consistent with Ondo State's proximity to oil-producing zones. Iron (3.57 wt%) levels reinforce the presence of metal oxide deposits on the fibre surface (Ayanda et al., 2019). These contrasting elemental profiles underscore the importance of site-specific characterisation in evaluating the material potential of water hyacinth fibre.

Table 2: EDS Elemental Composition (wt%) of Water Hyacinth Fibres from Ejinrin and Igbokoda

Element	Ejinrin (wt%)	Igbokoda (wt%)
Carbon (C)	~48.00	55.50
Oxygen (O)	~22.00	30.25
Silicon (Si)	25.52	2.30
Aluminium (Al)	7.45	—
Sodium (Na)	3.60	Trace
Chlorine (Cl)	2.00	—
Zinc (Zn)	3.30	trace
Iron (Fe)	—	3.57
Copper (Cu)	—	2.20
Nickel (Ni)	—	2.20

Source: EDS Analysis, 2025 (— = not detected or negligible)

Tensile Strength

The tensile properties of water hyacinth stems from the two sites were evaluated to determine their mechanical potential for textile fibre applications. Results are summarised in Table 3 below. Ejinrin specimens (Set 1 equivalent) recorded a mean ultimate tensile strength (UTS) of approximately 1.45 MPa, with tensile strain at break of 0.127 mm/mm and energy at break of 0.290 J. Igbokoda specimens (Set 2 equivalent) yielded a lower mean UTS of approximately 0.62 MPa, accompanied by a considerably higher strain at break of 0.265 mm/mm and extension of 13.23 mm.

The higher tensile strength of Ejinrin fibres likely reflects a denser fibrillar structure associated with the mineral and silica deposition observed in EDS analysis. Siliceous surface adhesion has been documented to enhance stiffness in plant fibres through surface reinforcement of cellulosic microfibrils (Liu et al., 2020). In contrast, the greater extensibility of Igbokoda fibres evidenced by higher strain at break is consistent with more compliant, less lignified tissue. The transition metal deposits (Fe, Cu, Ni) at Igbokoda may have contributed to fibrillar loosening, reducing tensile resistance while increasing ductility.

Overall, both sites produced fibres with lower UTS values compared to conventional high-performance natural fibres such as jute (250–400 MPa) and kenaf (200–300 MPa) (Okafor et al., 2019). However, the results are consistent with the documented behaviour of untreated or lightly treated water hyacinth stems, which typically achieve 1–3 MPa in their raw state (Bakar et al., 2015; Mishra et al., 2018). Literature confirms that alkali treatment significantly upgrades tensile performance to 25–40 MPa (Guna et al., 2020; Ramesh et al., 2017), supporting the feasibility of further chemical processing to improve the material's load-bearing capacity.

Table 3: Tensile Test Results for Water Hyacinth Fibres from Ejinrin and Igbokoda

Parameter	Ejinrin (Lagos)	Igbokoda (Ondo)
Support Span (mm)	40.00	40.00
Diameter (mm)	15.00	15.00
Max. Tensile Stress (MPa)	1.45	0.62
Load at Max. Tensile Stress (N)	72.90	31.23
Tensile Strain at Break (mm/mm)	0.127	0.265
Tensile Extension at Break (mm)	6.33	13.23
Energy at Break (J)	0.290	0.227
Tensile Stress at Yield (MPa)	1.45	0.62

Source: Instron Testing Machine (ASTM E8), 2026

Flexural Strength

Three-point bending tests revealed notable differences in flexural behaviour between the two sites. Igbokoda fibres recorded the highest maximum flexural stress (0.19 MPa) and energy at break (4.06 J), indicating superior resistance to bending forces and greater capacity for energy absorption before failure. Ejinrin fibres exhibited a flexural stress of 0.12 MPa and energy at break of 1.91 J lower values that may be related to the comparatively compact but more brittle fibrillar structure resulting from silica-alumina surface encrustation.

Flexural strain at maximum stress was comparable across both sites (~222–244%), indicative of highly compliant structures with extensive deformation capacity prior to fracture. This is characteristic of aerenchymatous plant tissue adapted for buoyancy rather than structural load-bearing (Abdel-Sabour, 2010). Such mechanical compliance, while limiting load-bearing utility, is beneficial for weaving and bending-intensive craft applications where pliability is desirable.

Table 4: Flexural Test Results for Water Hyacinth Fibres from Ejinrin and Igbokoda

Parameter	Ejinrin (Lagos)	Igbokoda (Ondo)
Fixture Type	3-point bend	3-point bend
Support Span (mm)	40.00	40.00
Max. Flexural Stress (MPa)	0.116	0.194
Flexural Strain at Max. Stress (%)	222.49	243.50
Energy at Break (J)	1.914	4.056
Flexural Stress at Yield (MPa)	0.116	0.189
Flexural Load at Yield (N)	151.95	247.62
Energy at Yield (J)	1.484	2.582

Source: 3-Point Bending Test (Instron Machine), 2025

Impact Strength

Impact strength a measure of a material's resistance to sudden fracture was assessed using the Izod method. Igbokoda fibres recorded the highest impact energy at 13.62 J, compared to Ejinrin fibres at 12.24 J (Table 5). This finding aligns with the flexural results and may indicate that Igbokoda fibres, despite their lower tensile strength, possess a tougher, more energy-absorbing microstructure.

The superior toughness of Igbokoda fibres may be attributed to the comparatively favourable water chemistry of the Ondo State riverine environment, where moderate nutrient availability supports denser lignification of cell walls (Ezama, 2019; Djihouessi et al., 2023). Conversely, the slightly lower impact resistance at Ejinrin may reflect the influence of salinity and heavy metal deposition, which can induce brittleness in plant fibre composites by interfering with lignin–cellulose bonding (Segbefia et al., 2019).

Both values compare favourably with other agricultural residue fibres used in eco-composite applications, suggesting that water hyacinth fibre from either site can withstand mechanical stresses encountered during weaving, finishing, and service in interior decoration applications. Igbokoda's higher toughness specifically favours its use in woven items subject to moderate impact during handling.

Table 5: Impact Strength of Water Hyacinth Fibres (Izod Method)

Sample Site	State	Impact Strength (J)
Ejinrin River	Lagos	12.24
Igbokoda River	Ondo	13.62

Source: Izod Impact Testing Machine, 2025

Proximate Composition: Ash, Moisture, Volatile Matter, and Fixed Carbon

The proximate composition of water hyacinth fibre from both sites is presented in Table 6. Moisture content ranged from 8.1% (Ejinrin) to 9.6% (Igbokoda), consistent with the hygroscopic nature of cellulosic fibres. These values fall within acceptable ranges for natural fibres used in textile and composite applications, where moisture levels below 12% are generally considered manageable (Guna et al., 2020).

Ash content (4.2–5.8%) indicates the inorganic mineral fraction of the fibre, which as corroborated by EDS analysis reflects site-specific accumulation of silica, alumina, and heavy metals. Higher ash content in Igbokoda samples may be attributed to the metal-rich aquatic environment. Volatile matter (60.3–63.7%) and fixed carbon (22.1–24.9%) values are consistent with lignocellulosic biomass characterised in related studies (Nandiyanto et al., 2023; Dang et al., 2022), confirming the organic integrity of the extracted fibre.

Table 6: Proximate Composition of Water Hyacinth Fibres from Ejinrin and Igbokoda

Proximate Parameter	Ejinrin (Lagos)	Igbokoda (Ondo)
Moisture Content (%)	8.1	9.6
Ash Content (%)	4.2	5.8
Volatile Matter (%)	63.7	60.3
Fixed Carbon (%)	24.0	24.3

Source: Muffle Furnace (ASTM E872-82; AOAC 1990), 2025.

Fibre Composition: Cellulose, Hemicellulose, and Lignin

Cellulose content the primary structural polymer governing tensile and stiffness properties — was higher in Ejinrin fibres (45.2%) compared to Igbokoda (38.6%). This finding is consistent with the stronger tensile performance recorded for Ejinrin specimens, as cellulose content directly correlates with fibre strength (Reddy et al., 2013). Hemicellulose levels were relatively higher in

Igbokoda (22.4%) versus Ejinrin (18.9%), contributing to the greater flexibility and moisture absorption of the former. Lignin content (8.3–10.1%) was comparable across sites, consistent with the reported range of 3.5–10% for water hyacinth stems in the literature (Jafari, 2010).

These composition values, while lower than high-cellulose fibres such as cotton (90%) or flax (70%), are broadly comparable to other utilised natural fibres including coir (35–43% cellulose) and rice straw (38–45%), confirming the material viability of water hyacinth for non-load-bearing fibre applications (Ramesh et al., 2017).

Table 7: Chemical Composition of Water Hyacinth Fibres from Ejinrin and Igbokoda

Chemical Component	Ejinrin (Lagos) %	Igbokoda (Ondo) %	Comparative Reference Fibres
Cellulose	45.2	38.6	Jute: 65–72%; Coir: 35–43%
Hemicellulose	18.9	22.4	Jute: 12–14%; Coir: 10–20%
Lignin	8.3	10.1	Jute: 12–13%; Coir: 40–45%
Extractives (alcohol-benzene)	4.6	5.7	—

Source: Klason Lignin method; HNO_3 Reflux method (Researcher's Analysis, 2025)

Comparative Summary and Suitability for Interior Decoration

A synthesis of the physio-mechanical characterisation data reveals that fibres from Ejinrin (Lagos State) and Igbokoda (Ondo State) present complementary property profiles that, taken together, support the broader suitability of South-West Nigerian water hyacinth for interior decoration applications.

Ejinrin fibres, with higher tensile strength and cellulose content, are better suited for structural elements of woven items where strength under tension is paramount, such as table mats, wall panels, and basket weaves. Igbokoda fibres, with superior impact resistance, flexural energy absorption, and higher moisture and dye uptake potential, are preferable for flexible, pliable decorative items such as lampshade covers, wall hangings, and textile cushion wraps.

This site-specific complementarity has practical implications for material selection strategies in water hyacinth-based interior decoration production. Artisans and designers may benefit from deliberately sourcing fibres from Igbokoda for items requiring flexibility and colour vibrancy, and from Ejinrin for structurally demanding applications. Furthermore, blending fibres from both sites in composite yarn production could yield materials with balanced mechanical and aesthetic properties.

Table 8: Comparative Summary of Physio-Mechanical Properties of Ejinrin and Igbokoda Water Hyacinth Fibres

Property	Ejinrin (Lagos)	Igbokoda (Ondo)	Implication for Use
UTS (MPa)	~1.45	~0.62	Ejinrin better for tensile-stressed items
Tensile Strain at Break	0.127 mm/mm	0.265 mm/mm	Igbokoda more flexible/ductile
Flexural Stress (MPa)	0.116	0.194	Igbokoda better for bending applications
Impact Strength (J)	12.24	13.62	Igbokoda tougher under sudden load
Cellulose Content (%)	45.2	38.6	Ejinrin stronger fibre backbone
Moisture Content (%)	8.1	9.6	Both within acceptable textile range
Ash Content (%)	4.2	5.8	Moderate mineral load in both
SEM Surface Quality	Smooth, cohesive	Porous, moderate impurity	Ejinrin easier to process uniformly
Dye Absorption Potential	Moderate	High	Igbokoda preferable for coloured items

Source: Compiled from Researcher's Analysis, 2025

CONCLUSION

This study has demonstrated that water hyacinth harvested from Igbokoda River (Ondo State) and Ejinrin River (Lagos State) in South-West Nigeria possesses measurable physio-mechanical properties that confirm its suitability as a natural fibre for interior decoration applications. The characterisation of tensile strength, flexural performance, impact resistance, and compositional properties revealed significant inter-site variation attributable to the contrasting environmental conditions particularly water chemistry, sediment characteristics, and anthropogenic contamination of each sampling location.

Ejinrin fibres demonstrated stronger tensile performance and higher cellulose content, making them more appropriate for structurally demanding woven items. Igbokoda fibres, in contrast, displayed superior impact resistance, flexural energy absorption, and higher dye uptake potential, favouring their use in flexible and colourful decorative applications. SEM/EDS analysis provided a physicochemical basis for these mechanical differences, linking surface morphology and elemental composition to the observed variation in mechanical behaviour.

The findings support the valorisation of water hyacinth as an eco-friendly alternative to synthetic and over-exploited natural fibres in Nigerian interior design and craft production. Beyond the material contribution, this approach offers a compelling environmental management strategy: the targeted harvesting of water hyacinth for fibre production reduces infestation pressure on affected waterways, while simultaneously generating economic value for riparian communities. Further research into alkali treatment optimisation, yarn spinning parameters, and composite fabrication from South-West Nigerian water hyacinth fibre is recommended to fully realise its textile design potential.

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