International Journal of Recent Development in Engineering and Technology
Website: www.ijrdet.com (ISSN 2347-6435 (Online) Volume 15, Issue 11, November 2026)

Plant-Derived Textile Materials for Healthcare Textiles: A Review of Yarn Characterization and Woven Fabric Development

Karpagavalli V.S.[1], Dr. M. Sumithra[2]

[1]Research Scholar, [2]Assistant Professor, Department of Textiles and Apparel Design, Bharathiar University, Coimbatore, India

***Abstract*—Textiles sourced from plants provide several avenues for creating materials suitable for healthcare settings; nevertheless, the botanical source does not determine the fiber's chemical composition, organic certification, or functional efficacy. This narrative study explores aloe vera, banana, corn-derived polylactic acid (PLA), and soya materials by analyzing the interconnected phases of material identification, yarn characterization, pit-loom weaving, and substrate assessment. Literature released post-2010 is examined, focusing on differentiating extracted lignocellulosic fibers, regenerated protein-rich substances, and synthetic bio-based polyester. The data suggests that banana possesses a recorded yarn-to-fabric process, but textiles containing aloe necessitate specific attention to differentiate between a fiber source and a finishing component. Research on soybean composites and altered PLA highlights the significance of fabric design and substrate-specific processing, although fails to ascertain the efficacy of an unnamed commercial yarn. A comparative development approach is provided that records composition, linear density, twist, strength, evenness and weaving conditions before evaluating fabric integrity and comfort. Market and consumer information can drive product selection when validated composition and practical care requirements are provided separately from environmental claims. The major research need is a replicable link between yarn identity, woven structure and service performance. Plant-resource labeling alone cannot prove acceptability for patient clothing, linen or other health care products.**

***Keywords*—aloe vera, banana fibre, health care textiles, pit-loom weaving, plant-derived yarns, polylactic acid, soya textiles**

I. Introduction

The creation of alternative textile materials necessitates substantiation at multiple phases from a renewable resource to a functional result. A plant can provide an extracted fiber, a polymer precursor, or a component applied to an existing textile. These processes yield significantly distinct fabrics. A critique that categorizes them exclusively by botanical nomenclature conceals variations in wet processing, washing, and mechanical performance. According to Morris and Murray [1], the medical textile literature includes goods with varying specifications, ranging from apparel and linens to materials for wound contact and implants.

The application must hence be established prior to evaluating a prospective substrate.

The four resources examined below provide a valuable juxtaposition since they embody distinct processing routes. Banana is linked to the extraction of lignocellulosic fibers; corn-derived PLA is a synthetic polyester; soya can provide protein for regenerated or composite fiber systems; and aloe vera may be explored as a leaf-fiber source or utilized as a finishing component. The comparison is most enlightening when the precise yarn composition and fabric structure are recorded. This evaluation inquires how the characterization of yarn and regulated weaving might enhance the use of these materials as foundations for future healthcare textile innovation.

The ecological impetus is pertinent yet necessitates an analysis at the product level. As discussed by Niinimäki et al. [2], resource use and product lifespans are issues within the textile supply chain. An alternate feedstock could alter a segment of that chain without addressing the repercussions of extraction, spinning, wet processing, or substitution. Consequently, this assessment regards environmental performance as a supplementary inquiry that should be evaluated throughout the material channel, rather than deduced from the source of the plant.

II. Literature Review Methodology And Limitations

This narrative review is concentrated on the compilation of sources gathered for a thesis literature study, enhanced by specific public web inquiries into academic titles, publisher websites, and institutional archives. The choices are limited to publications released post-2010.

Investigations amalgamated the resource titles with terminology such as yarn, fiber extraction, fabric, thermal comfort, natural dye, textile evaluation, and handloom. Fundamental textile research underpins the discourse on observed processing and performance; analyses, publications, and organizational papers offer categorization and wider context. No subscription-based database search, comprehensive retrieval, formal bias risk evaluation, or meta-analysis was conducted.

International Journal of Recent Development in Engineering and Technology
Website: www.ijrdet.com (ISSN 2347-6435 (Online) Volume 15, Issue 11, November 2026)

Evidence is categorized according to material pathways and their significance to woven substrates. Outcomes from composite reinforcement, coated cotton, and knitted mixes are not regarded as metrics for pit-loom-woven textiles derived from the four specified yarn types. The essential synthesis and development framework are suggestions based on the existing literature. They do not provide novel experimental or survey results.

III. Material Identity Before Comparison

Natural, organic, and bio-based are distinct categories that cannot be used interchangeably. Natural refers to a fiber derived from a biological source; bio-based pertains to the origin of biological feedstock; organic necessitates an appropriate production and certification foundation. As specified by Global Standard gemeinnützige GmbH [3], the Global Organic Textile Standard version 7.0 provides a certification framework rather than a catch-all term for plant-based textiles. This is referenced here as a historical framework, not as an assertion that all examined materials had certification.

A fundamental material description must encompass the commercial name, specified composition, method of extraction or regeneration, form as staple or filament, mix ratio, and supplier documentation. This holds significant relevance for aloe and soya fibers. A yarn marketed under a botanical designation may incorporate an alternative fiber or undergo a botanical process. Until composition is established, interpreting its spectroscopy, moisture uptake or strength as an attribute of the listed plant is unreliable.

TABLE I
Material Identity and Evidence Boundaries

Resource	Material pathway to verify	Evidence relevant to textile development	Main interpretation boundary
Aloe vera	Extracted leaf fibre, blend or treated conventional yarn	Fibre-treatment work and aloe-containing textile finishes as reported by Purushothaman et al. [4] and Fiedler et al. [5]	An aloe finish does not establish aloe fibre composition
Banana	Extracted lignocellulosic fibre and any blending	A yarn-to-fabric investigation as reported by Khan et al. [6]	Extraction and spinning conditions affect comparability
Corn-based PLA	Manufactured polyester from bio-based feedstock	Surface modification and natural-dye application as reported by Li et al. [7]	Corn-husk fibre data do not describe PLA
Soya	Regenerated protein-containing fibre or blend	Constructed soybean-blend comfort study as reported by An et al. [8]	Blend and knit results cannot be assigned to pure woven soya

IV. Aloe Vera And Banana Resources

A. Aloe Vera Fibers and Fabrics Incorporating Aloe

As reported by Purushothaman et al. [4], sodium hydroxide treatment affects aloe vera, banana, and corn-husk fibers. This demonstrates that pretreatment alters the properties of retrieved biomass fibers. The presence of maize husk should not be construed as proof of corn-derived PLA. The research underscores the necessity of recording pretreatment for aloe, while the effective spinning and weaving of the provided yarn remains to be validated.

The concluding literature takes an alternative path. As reported by Fiedler et al. [5], aloe microcapsules were applied to cotton nonwoven fabrics. This indicates the integration of aloe components into a pre-existing textile framework, rather than the creation of an aloe-fiber yarn. These two pathways must stay distinct in the procurement of records and claims. An effective development research would initially determine if the yarn incorporates extracted aloe fiber, a composite element, or a topical aloe application, followed by an assessment of its appropriateness for weaving.

When dealing with an unfamiliar aloe-designated yarn, the primary inquiry pertains to its processability under defined conditions. Reports ought to delineate breakages, attainable density, and any necessary sizing, instead of characterizing the final fabric as proof of an indeterminate fiber composition. In instances when a previous botanical finish exists, it should be taken into account when choosing an untreated baseline for future herbal applications.

B. Banana Agricultural Byproducts as Textile Materials

As reported by Khan et al. [6], banana agricultural waste was examined through a yarn-to-fabric textile process.

International Journal of Recent Development in Engineering and Technology
Website: www.ijrdet.com (ISSN 2347-6435 (Online) Volume 15, Issue 11, November 2026)

This is more pertinent to the advancement of woven substrates than research confined to reinforcing fibers. As discussed by Pappu et al. [9], banana-related literature also outlines the broader possibilities of cellulose-rich biomass. The variance in evidence quality is significant: the presence of fibrous remnants, the creation of a spinnable substance, and the adequate performance of the fabric are distinct accomplishments.

A comparative weaving initiative ought to document extraction, purification, fiber preparation, blend formulation, and yarn fabrication. The utilization of residues should not be considered a procedure with no impact; the chemicals, water, and energy employed to produce a functional yarn must be included in the assessment. Similarly, any noticeable enhancement following pretreatment must be evaluated in conjunction with material yield and any reduction in usable fiber.

V. Corn-Based PLA And Soya Systems

A. PLA Processing and Surface Modification

Corn-derived PLA is classified within the produced bio-based fiber sector. Its polyester composition differs from the lignocellulosic framework of maize husk. According to Hussain et al. [10], PLA dyeing requires substrate-specific processing considerations. A standard finishing bath utilized on four textiles therefore forms a comparison study; it does not confirm that a singular treatment regimen or bath condition is similarly suitable for all substrates.

As reported by Li et al. [7], hydrophilic modification of PLA fibers was examined alongside natural-dye application. The research emphasizes the importance of surface condition in assessing wetness and coloration. It does not forecast how an indeterminate herbal blend will adhere to a commercial PLA yarn. The beneficial research avenue involves linking substrate preparation with supplementary components, material integrity, and retention within a defined framework.

The source of feedstock should be distinguished from disposal practices. As discussed by Ali et al. [11], PLA synthesis and environmental degradation are separate concerns. A healthcare application may additionally entail frequent cleaning, separated waste, or disposal methods, in contrast to industrial composting. A prospective environmental assessment has to utilize the real product and service context, instead of presuming that the polymer vanishes innocuously under any circumstance.

B. Soy-Derived Fibers and Fabric Comfort

As reviewed by Tahir et al. [12], soy-protein fibers require consideration of regeneration, processability, and modification of the resulting material. The pertinent identity is hence the ultimate fibre system, encompassing any blending or auxiliary polymer. A soy classification by itself does not indicate which element controls wet strength or absorption of a finishing solution.

As reported by An et al. [8], organic cotton, bamboo-blended, and soybean-blended knitted textiles were investigated for thermal and sensory attributes. This provides fabric-level evidence; however, its numerical findings cannot be applied to a pit-loom woven soya textile. In woven development, the methodological implication is that comfort should be assessed at the fabric level, while the composition, structure, and finishing history must be discernible.

VI. Yarn Evaluation As A Development Stage

Yarn evaluation must occur before weaving, as it can indicate if variations later ascribed to botanical source originated during yarn fabrication. Linear density, twist, tensile characteristics, irregularity, and hairiness address many inquiries. No individual metric offers a comprehensive assessment of loom appropriateness. As specified by ISO [13], ISO 2061:2015 concerns direct measurement of yarn twist; as specified by ISO [14], ISO 16549:2021 concerns capacitance-based assessment of unevenness. Their significance does not confirm that these techniques were employed in any specific experiment; the executed procedure and any variations must be documented.

As reported by Fidan and Kireçci [15], single, plied, and sirospun yarns were compared with their corresponding woven fabrics. This illustrates the rationale for incorporating yarn architecture into fabric interpretation. A differentiation among the four resource categories should so separate fiber identification from ply, spinning method, and twist. When comparable standards are unattainable, the research must document the discrepancies and refine its conclusions accordingly.

The suggested reporting architecture aims to evaluate each yarn batch under specified conditions, maintain batch identifiers throughout the weaving process, and summarize both central tendency and variability. Tensile outcomes must specify gauge length, testing velocity, and whether strength is represented as force or tenacity.

International Journal of Recent Development in Engineering and Technology
Website: www.ijrdet.com (ISSN 2347-6435 (Online) Volume 15, Issue 11, November 2026)

Hairiness must specify the tool and measurement. Evident parity in nominal quantity is inadequate when genuine linear density and structure vary.

VII. PIT-Loom Fabrication And Construction Control

A pit loom provides a method for fabric creation that requires the recording of its operational parameters. As documented by the Ministry of Textiles, Government of India [16], handloom production has a wider institutional framework, although it fails to demonstrate a performance superiority for innovative textiles. The scientific input arises from the regulated interaction between yarn inputs, weaving parameters, and the resultant fabric.

For a comparison analysis, the loom description must encompass weave design, warp and weft distribution, reed and sett specifications, target density, size, quantifiable weaving tension, and finishing or desizing prior to testing. Documentation of operator actions and interruptions is necessary when they impact construction. These documents enable a reader to differentiate between deliberate organization and procedural fluctuation.

Two designs address distinct inquiries. A matched-construction design seeks to standardize yarn density and fabric structure among resources, facilitating a more concentrated material analysis. A design tailored to unique materials modifies construction to create a functional fabric from each yarn, focusing on practicality and practical product advancement. Both positions are reasonable, however they lead to divergent results. Table II illustrates the suggested order of evidence.

TABLE II
Proposed Records Linking Yarns With Woven Substrates

Stage	Core records	Question supported
Material identification	Composition, supplier, blend, process route and batch	What material is actually being compared
Yarn characterisation	Count, twist, tensile response, variability and hairiness	Is the yarn reproducible and suitable for the intended loom conditions
Weaving	Weave, density, allocation, sizing and production observations	What construction was achieved from the tested yarn
Fabric baseline	Conditioned mass, thickness, density, tensile and comfort properties	What performance existed before herbal finishing
Product selection	Care scenario, handling needs and user preferences	Which substrate merits application-specific development

VIII. Textile Substrates And Consumer Benefit

The woven baseline must be assessed following a specified preparatory sequence. Construction, mass and thickness are crucial background for tensile and comfort results. Measuring before and after desizing helps identify removal of a transient processing assistance from later herbal deposition. As reported by Krupincová and Militký [17], fabric hairiness was evaluated at production and finishing stages, indicating the requirement to record the stage at which a surface quality is measured.

Consumer and market investigation can steer development without replacing laboratory evidence. As reported by Harris et al. [18], practical limitations can influence sustainable clothing consumption alongside environmental concern. For these yarn groups, a market survey should identify vendor claims from composition and certification information. A consumer study should distinguish awareness of a botanical name from experience of wearing or caring for the cloth. The cost, accessibility, and maintenance needs might thereafter be analyzed about a suggested item.

Utility is application-specific. Attire for patients may necessitate appropriate handling and moisture control; washable linens demand dependable sanitation and structural integrity. Neither application is inherently derived from a botanical designation. A design guided by survey data ought to ascertain the specific care environment and thereafter determine the requisite assessments for that application, instead of gathering broad preferences and attributing them to an ambiguous healthcare sector.

IX. Research Priorities And Limitations

The examined evidence exhibits variability in fiber composition, textile structure, and processing background. It fails to substantiate a global hierarchy of the four resources. Its primary contribution lies in pinpointing the records essential for a reliable comparison. Emphasis ought to be placed on authenticated commercial yarn composition, consistent yarn batches, replicable weaving, and a quantified untreated fabric baseline.

Subsequent research ought to differentiate the impact of resource provenance from the influences of yarn structure and fabric density. In instances where construction is intentionally altered, statistical models must incorporate those characteristics, or the analysis should be confined to the unique goods generated. Service efficacy ought to be evaluated within a specified care context, succeeded by an environmental analysis based on the functional lifespan of the product. The suggested framework is a compilation rather than a confirmed predictive model, and the focused literature method can exclude pertinent research.

X. Conclusion

Aloe vera, banana, corn-derived PLA, and soya offer several pathways to textile substrates. The literature advocates for examining their development; nonetheless, botanical nomenclature cannot replace composition, yarn characterization, or production documentation.

Pit-loom weaving can facilitate a consistent substrate-development process when its operational parameters and resultant fabric structure are documented. The subsequent beneficial progression is a comprehensive evaluation of authenticated yarns, regulated woven standards, and performance tailored to specific applications. Such evidence would furnish a more robust foundation for the choosing of herbal finishing and health care products than mere resource labels.

REFERENCES

[1] Morris, H., & Murray, R. (2020). Medical textiles. *Textile Progress*, 52(1–2), 1–127. https://doi.org/10.1080/00405167.2020.1824468

[2] Niinimäki, K., Peters, G., Dahlbo, H., Perry, P., Rissanen, T., & Gwilt, A. (2020). The environmental price of fast fashion. *Nature Reviews Earth & Environment*, 1(4), 189–200. https://doi.org/10.1038/s43017-020-0039-9

[3] Global Standard gemeinnützige GmbH. (2023). *Global Organic Textile Standard version 7.0*. https://global-standard.org/images/resource-library/documents/standard-and-manual/GOTS_7.0_ENG_signed.pdf

[4] Purushothaman, R., Balaji, A., & Swaminathan, J. (2024). Influence of NaOH treatment on physical, chemical, thermal, and morphological behavior of Aloe vera, banana, and corn husk fiber. *Biomass Conversion and Biorefinery*, 14(14), 16743–16754. https://doi.org/10.1007/s13399-024-05740-w

[5] Fiedler, J. O., Carmona, Ó. G., Carmona, C. G., Lis, M. J., Plath, A. M. S., Samulewski, R. B., & Bezerra, F. M. (2020). Application of Aloe vera microcapsules in cotton nonwovens to obtain biofunctional textiles. *The Journal of The Textile Institute*, 111(1), 68–74. https://doi.org/10.1080/00405000.2019.1625607

[6] Khan, A., Iftikhar, K., Mohsin, M., Ubaidullah, M., Ali, M., & Mueen, A. (2022). Banana agro-waste as an alternative to cotton fibre in textile applications. Yarn to fabric: An ecofriendly approach. *Industrial Crops and Products*, 189, Article 115687. https://doi.org/10.1016/j.indcrop.2022.115687

[7] Li, W., Yang, Y., Xi, X., & Feng, J. (2024). Hydrophilic modification of polylactic acid fiber and the usage of natural dye for multi-levered improvement of the fabric staining depth and the stability effect. *Langmuir*, 40(7), 3859–3872. https://doi.org/10.1021/acs.langmuir.3c03721

[8] An, S. K., Gam, H. J., & Cao, H. (2013). Evaluating thermal and sensorial performance of organic cotton, bamboo-blended, and soybean-blended fabrics. *Clothing and Textiles Research Journal*, 31(3), 157–166. https://doi.org/10.1177/0887302x13490069

[9] Pappu, A., Patil, V., Jain, S., Mahindrakar, A., Haque, R., & Thakur, V. K. (2015). Advances in industrial prospective of cellulosic macromolecules enriched banana biofibre resources: A review. *International Journal of Biological Macromolecules*, 79, 449–458. https://doi.org/10.1016/j.ijbiomac.2015.05.013

[10] Hussain, T., Tausif, M., & Ashraf, M. (2015). A review of progress in the dyeing of eco-friendly aliphatic polyester-based polylactic acid fabrics. *Journal of Cleaner Production*, 108, 476–483. https://doi.org/10.1016/j.jclepro.2015.05.126

[11] Ali, W., Ali, H., Gillani, S., Zinck, P., & Souissi, S. (2023). Polylactic acid synthesis, biodegradability, conversion to microplastics and toxicity: A review. *Environmental Chemistry Letters*, 21(3), 1761–1786. https://doi.org/10.1007/s10311-023-01564-8

[12] Tahir, M., Li, A., Moore, M., Ford, E., Theyson, T., & Seyam, A. F. M. (2024). Development of eco-friendly soy protein fiber: A comprehensive critical review and prospects. *Fibers*, 12(4), Article 31. https://doi.org/10.3390/fib12040031

[13] International Organization for Standardization. (2015). *Textiles — Determination of twist in yarns — Direct counting method*. (ISO Standard No. 2061:2015). https://www.iso.org/standard/65146.html

[14] International Organization for Standardization. (2021). *Textiles — Unevenness of textile strands — Capacitance method*. (ISO Standard No. 16549:2021). https://www.iso.org/standard/80024.html

[15] Fidan, G., & Kireçci, A. (2018). Comparison of quality parameters of single, plied and sirospun yarns and fabrics woven by these yarns. *Textile and Apparel*, 28(2), 98–106. https://dergipark.org.tr/en/pub/tekstilvekonfeksiyon/article/439301

[16] Ministry of Textiles, Government of India. (2019). *Fourth All India Handloom Census 2019–20*. https://handlooms.nic.in/assets/img/Statistics/3736.pdf

[17] Krupincová, G., & Militký, J. (2025). Changes in hairiness of woven fabrics at the production and finishing stages. *Scientific Reports*, 15(1), Article 2930. https://doi.org/10.1038/s41598-025-86610-x

[18] Harris, F., Roby, H., & Dibb, S. (2016). Sustainable clothing: Challenges, barriers and interventions for encouraging more sustainable consumer behaviour. *International Journal of Consumer Studies*, 40(3), 309–318. https://doi.org/10.1111/ijcs.12257