

PIASSAVA AS A PRODUCT WITH GREATER ADDED VALUE: PERSPECTIVES FOR DESIGN

PIAÇAVA COMO PRODUTO DE MAIOR VALOR AGREGADO: PERSPECTIVAS PARA O DESIGN

PIASSAVA COMO PRODUCTO DE MAYOR VALOR AGREGADO: PERSPECTIVAS PARA EL DISEÑO

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ABSTRACT

This article aims to investigate the potential of piassava fibers as higher value-added products (VAAP), highlighting the role of design in increasing their value and expanding their applications. The article discusses the economic and sustainable potential of piassava, as well as the challenges and opportunities related to its use. Furthermore, it emphasizes the importance of design, materials, and sustainability in promoting the value of this resource, reinforcing the relevance of the study for understanding and advancing the topic. The methodology employed involved a review of academic literature and the analysis of public company websites to obtain updated data on the piassava supply chain in Bahia, its current applications, and prospects in the field of design. As a result, practical examples were presented, such as the production of eco-composite from piassava fiber and castor oil plant resin, aiming to increase the value and market potential of this fiber.

KEYWORDS

Piassava fiber eco-composite; sustainable product design; PMVA.

RESUMO

Este artigo tem como objetivo investigar as potencialidades das fibras de piaçava como produtos de maior valor agregado (PMVA), destacando o papel do design na sua valorização e expansão de suas aplicações. Serão discutidos o potencial econômico e sustentável da piaçava, bem como os desafios e oportunidades relacionados ao seu uso. Além disso, enfatizar a importância do design, dos materiais e da sustentabilidade para promover a valorização deste recurso, reforçando a relevância do estudo para o entendimento e o avanço do tema. A metodologia empregada envolveu uma revisão de literatura acadêmica e a análise de sites de empresas públicas, afim de obter dados atualizados sobre a cadeia de piaçava na Bahia, suas aplicações atuais e perspectivas no campo do design. Como resultado, apresentaram-se exemplos práticos, como a confecção de eco-compósito de fibra de piaçava e resina vegetal de mamona, visando ampliar o valor e o potencial de mercado desta fibra.

PALAVRAS-CHAVE

Eco-compósito de Fibra de Piaçava; Design de produto sustentável; PMVA.

RESUMEN

Este artículo tiene como objetivo investigar las potencialidades de las fibras de piassava como productos de mayor valor agregado (PMVA), destacando el papel del diseño en su valorización y en la expansión de sus aplicaciones. Se discutirán el potencial económico y sostenible de la piassava, así como los desafíos y oportunidades relacionados con su uso. Además, se enfatiza la importancia del diseño, de los materiales y de la sostenibilidad para promover la valorización de este recurso, reforzando la relevancia del estudio para la comprensión y el avance del tema. La metodología empleada incluyó una



revisión de literatura académica y el análisis de sitios web de empresas públicas, con el fin de obtener datos actualizados sobre la cadena productiva de la piassava en Bahía, sus aplicaciones actuales y sus perspectivas en el campo del diseño. Como resultado, se presentaron ejemplos prácticos, como la elaboración de un eco-compuesto de fibra de piassava y resina vegetal de ricino, con el objetivo de ampliar el valor y el potencial de mercado de esta fibra..

PALABRAS CLAVE

Eco-compuesto de Fibra de Piassava; Diseño de Producto Sostenible; PMVA.

1. INTRODUCTION

The indiscriminate use of natural resources for industrial production has been the subject of various debates and concerns in society, ranging from environmental, economic and health problems. Individuals and companies have spoken out in favor of awareness and practices that generate alternatives and contributions that reduce the environmental impact generated by the production, consumption and unbridled disposal of products.

Studies show an overexploitation of natural resources for industrial purposes, and to reinforce the current moment, FUNDAJ - Fundação Joaquim Nabuco, a public institution linked to the Ministry of Education, published the article: "What are the consequences of the overexploitation of natural resources?". It draws our attention to the effects of uncontrolled consumption of natural resources, as listed below (FUNDAJ, 2021).

- Environmental: The disappearance of essential habitats for fauna and flora, i.e. the extinction of species. [...]
- Economic: 33% of the planet's soil is degraded to moderate to high levels, according to a report by the Food and Agriculture Organization of the United Nations [...]
- For health: if we don't take care of forests, there will be fewer carbon sinks and therefore more air pollution. According to the World Health Organization (WHO), nine out of ten people in the world breathe air with high levels of pollution and seven million people die every year because of pollution [...]

In this context, designers and researchers are looking for alternatives in new material experimentation in product designs and production processes that generate a lower impact on the environment, improving local quality of life and, above all, solving the problems generated. These alternatives, based on the fundamentals of sustainable design, help society find new solutions with tools and tactics focused on sustainability.

One of the forerunners in the environmental approach, designer, professor and researcher Victor Papanek, published the book "Design for the Real Word: Human Ecology and social Change" in 1971. The author holds designers responsible for their design actions, whether positive or negative, one of which is the possible choice in the control and selection of materials and processes used to develop products

with a lower environmental impact (PAPANEK, 1971). Putting Papanek's concern into practice, one of the alternatives suggested here is the use of piassava fibers in both craft products and design projects. This article presents and recommends the potential application of fibers as the basis for new materials in industrial design projects, transforming them into products with greater added value (PMVA).

2. METHODOLOGICAL PROCEDURE

This article aims to identify and present the use of piassava fibers as higher value-added products and the influence of design on their use, using a qualitative approach, which includes a systematic search of the available literature on the subject.

To do this, a literature review was carried out, supported by the collection of data from scientific publications on the internet, mainly on public agency portals, based on the indication of keywords (Severino, 2014).

In the search process, the keywords associated with "piassava fibre", mentioned in Table 01, were analyzed individually and in possible combinations.

Piassava fiber	Keywords found in the search
	Characteristics
	Piassava as NTFP
	Highest Value Added Product
	Applications
	Production chain
	Sustainability
	Piassava product design

Table 1: Accepted keywords.
Source: The Authors, 2024.

3. RESULTS AND DISCUSSIONS
3. 1. Characteristics of the piassava plant

In an overview provided by the Brazilian Forestry Service, the piassava palm has characteristics that give it its own identity, mainly because it produces its long, resistant and waterproof fibers. According to the:

Piassava produces the main fiber from extractivism, if we consider the annual production value. There are three species

of piassava used for extracting fiber: *Attalea funifera*, *Leopoldinia piassaba* and *Aphandra natalia*. The latter two are native to the Amazon biome and the former to the Atlantic Forest. In terms of production value, the northeastern region is the main producer of fiber from the *Attalea funifera* species found in the Northeast (Alagoas, Bahia and Sergipe). The fibers, extracted from the petiole of the leaves, are resistant and impermeable. They are used to make brooms, brushes, nautical cables, ropes and thermal insulation. Piassava fiber is also exported to other countries, where it is used to clear snow accumulated on sidewalks, and is preferred because it is more resistant to friction and the rotation of machinery. Brazilian Forest Service, 2020.

Studies already published by Guimarães and Silva (2012) invite the reader to discover the wealth of details about piassava, with botanical, historical and economic aspects (Figure 1)



Figure 1: Piaçava from Bahia (*Attalea funifera* Martius).

Source: Guimarães e Silva (2012, p. 48).

The authors, quoting the National Institute of Industrial Research (n.d.), comment that an estimated 1,000 to 2,000

types of palm trees produce fibers, whether from their stems, leaves or other parts. However, only two dozen fibers are used on a commercial scale. Another important point presented by the authors in the book is the extraction of the fibers, which takes place manually, in different ways, such as beating the leaves, rubbing them or even putting them in water before extracting the fibers.

3. 2. Piassava as a Non-Timber Forest Product (PFNM)

This topic begins with the definition of a Non-Timber Forest Product (NTFP). To make it easier to understand, Frederico Soares Machado of the Chico Mendes Institute for Biodiversity Conservation (ICMBio), a Brazilian government entity, reports in a publication called “Management of Non-Timber Forest Products: A Manual with Suggestions for Participatory Management in Amazonian Communities” that NTFPs are:

[...] all forest products other than wood, such as: leaves, fruits, flowers, seeds, nuts, palm hearts, roots, bulbs, branches, bark, fibers, essential oils, fixed oils, latex, resins, gums, vines, herbs, bamboos, ornamental plants, fungi and animal products (Machado, 2008).

Using NTFPs, the Fibras do Quilombo group, located in the Southern Bahia Lowlands, creates artifacts from piassava fiber from Bahia. They are organized by associations and family groups of Quilombolas, Indians and other Traditional Communities in Brazil. The website presents the piassava production chain, from its extraction to its processing, indicating, for example, what is extracted and used from the palm, such as fibers and fruits, without having to cut down the tree.

In 2020, the Ministry of Agriculture, Livestock and Supply brought to our attention, through the Brazilian Forestry Service, the report “Bioeconomia da Floresta - A conjuntura da Produção Florestal Não Madeireira no Brasil”, which according to the statistics contained in the material, the main fibers in the distribution of non-timber forest production in Brazil, data recorded by IBGE, are piassava with 70% and Buriti with 11%.

In this sense, the palm tree that generates piassava fiber becomes an NTFP with great potential, making it possible to conserve the forest and for many families and regions the use of fibers and coconuts from the palm tree becomes an economic alternative.

3. 3. Piassava in Bahia: Challenges and opportunities

According to the National Forestry Information System (SNIF), on the Brazilian Federal Government's website, the data on piassava (fiber) production was updated in 2021 with a wealth of information mapped graphically and in videos in the webinar "Bioeconomy of the forest: Challenges and opportunities for the development of the piassava chain in Bahia".

Figure 2 shows the regions in which piassava fibers are produced in Brazil, by year and microregion, from 1994 to 2019. The first image highlights production in 1994 and the second in 2019.

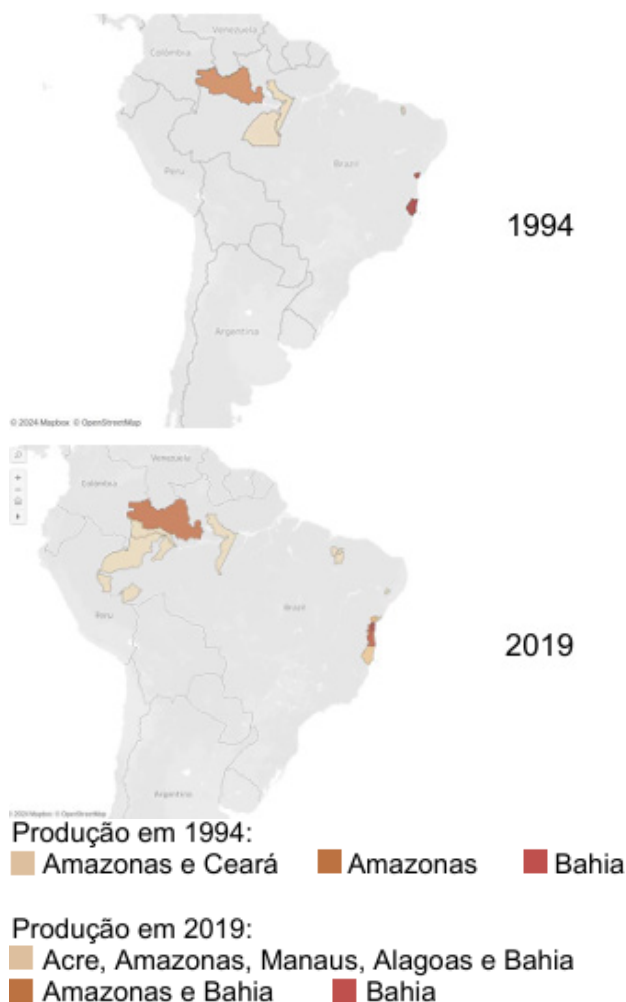


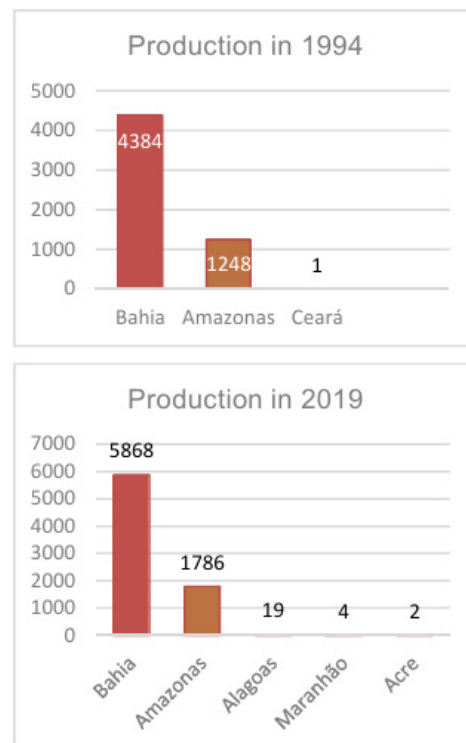
Figure 2: Production of piassava fiber in regions of Brazil.

Source: snif.florestal.gov.br (based on the data PEVS 2019 / IBGE 2020).

In a Brazilian panorama, the figure illustrated above, detailed by the portal, indicates that in 1994 the northern region of the country, signaled as the geographical micro-region of Rio Negro (AM) obtained the amount produced

in plant extraction of 1,218 tons, while in Parintins (AM) the amount was 25 tons, in Madeira (AM) 5 tons and in the Northeast in Ibiapaba (CE) corresponds to 1 ton. Further down, still in the Northeast, the geographical location of Santo Antônio de Jesus (BA) produced 2,112 tons of piassava fiber, while Porto Seguro (BA) produced 2,272 tons.

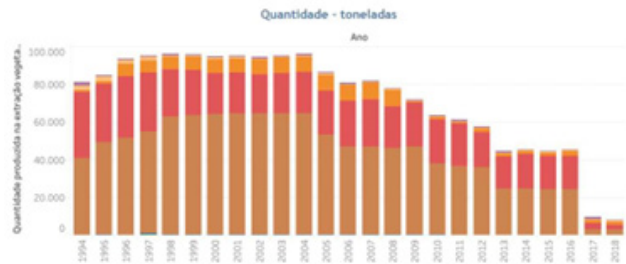
After 25 years, in 2019, the figure above shows the changes taking place, for example the inclusion of new municipalities and the reduction in tons of fiber extracted. According to the data, Rio Negro (AM) now produces 1,780 tons, Parintins (AM) 1 ton, new municipalities such as Japurá (AM) with 2 tons, Tefé (AM) 2 tons, Alto Solimões (AM) 1 ton, Cruzeiro do Sul (AC) 1 ton and Sena Madureira (AC) 1 ton. In the Northeast, production of 1 ton was recorded in Codó (MA), Coelho Neto (MA) 1 ton, Caxias (MA) 2 tons. Geographically, Santana de Ipanema (AL) produced 19 tons in 2019, Salvador (BA) 11 tons, Santo Antônio de Jesus (BA) 696 tons, Valença (BA) 2,685 tons, Ilhéus-Itabuna (BA) 2,129 tons and Porto Seguro (BA) 347 tons. According to the records, if only 1994 and 2019 are taken as a reference, it is understood that there has been a small increase in piassava fiber production in Brazil, represented by production in tons, with Bahia standing out (Graph 1). However, the reality in Brazil during these years was decreasing, and "over the last 20 years the drop in production has been approximately 90%" (Ministério da Agricultura, Pecuária e Abastecimento, 2019).



Graphic 1: Piassava fiber production in Brazil at two points in time.

Source: Adapted from the author, 2024.

Over the years, the IBGE has shown that there was a significant increase from 1994 to 1998 and it remained stable until 2004. From 2005 onwards, the data shows a drop in the amount of piassava fibers produced in 2017, a sharp downturn. The figure below (Graph 2) shows an annual scenario of the most and least prominent producing micro-regions, highlighting the three main ones.



Caption: ■ Valença (BA) ■ Ilhéus – Itabuna (BA)
■ Rio Negro (AM)

Graphic 2: Annual quantity scenario - tons.
Source: SNIF, 2021.

In terms of tons per year, three municipalities stand out in terms of piassava fiber production: Valença (BA), Ilhéus - Itabuna (BA) and Rio Negro (AM). In this order, their production indicators follow, where we have Valença with its highest level in 2004 totaling 63,940 t and in 2019 the municipality reached 2,685 t, then Ilhéus - Itabuna with 34,638 in 1994, while in 2019 there was a considerable drop, leaving its production with 2,129 t. Lastly, Rio Negro, which had its highest production in 2008 at 8,957 tons, fell to 933 tons in 2009 and continued with ups and downs in production until it reached 1,780 tons in 2019.

Another important piece of data is the relationship between Quantity (tons) X Average price (R\$/ton) of piassava fiber over the years. The highest average price for fiber extraction occurred in 1994, reaching R\$3,545/ton, and in 2019 this price was already at R\$1231/ton.

If you look at the graphs above, you can see that even with a considerable reduction in the piassava production chain, the state of Bahia is still the leading producer. According to the information provided by the responsible bodies and the literature, many communities depend on the income generated by piassava, even if it is lower than in previous decades.

An analysis of the production, handling and marketing of piassava fiber in Bahia allows us to identify challenges and possibilities in its production chain, as well as adding value to the material.

Table 2 suggests challenges and opportunities, based on readings in the field of fiber research and use.

Challenges	Opportunities
Preserving sustainable management methods;	Market for ecological products;
Competition with syntactic fibers;	Design and innovation
Lack of knowledge about the capacity of piassava fiber;	Higher added value
Investment in research	Ecological certifications

Table 2: Challenges and opportunities in the production and use of piassava fiber.
Source: The Authors, 2024.

3. 4. Piassava economic, social and sustainable potential

By examining the information collected, the potential of piassava fiber, especially *Attalea funifera*, is clear, from its characteristics to the way it is used. Thus, we can recognize or even propose, albeit from an initial observation, some of its potential in the economic, social and sustainable sector:

- Economic potential - the fiber has the potential to be used as a raw material in alternative materials for the manufacture of new products, both in industry and in the market, in addition to its traditional application, resulting in appreciation and income generation;
- Social potential - cooperation between community members to plant and sell piassava;
- Sustainable potential - low environmental impact alternative, sustainable extraction and preservation of the ecosystem and regional biodiversity.

3. 5. Uses of piassava in traditional products

Embrapa (Brazilian Agricultural Research Corporation) - recently made public the study “Sustainable management and ecology of piassava in Bahia”, written by Madeiros, Moser and Chacel (2024). This research provides relevant data about the palm, including characteristics, use of the palm's components, addressing characteristics, production, appropriate management practices, among other aspects. The diagram below (Figure 3) illustrates the products that can be produced from the piassava palm (*Attalea funifera*). It represents the products derived from the leaf, fruit, seed, stipe and cap of this palm tree.

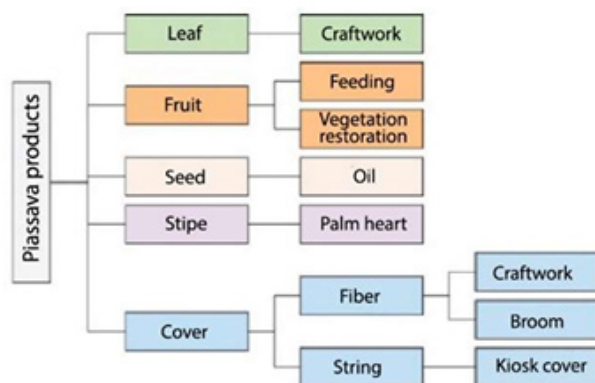


Figure 3: *Attalea funifera* palm products.
Source: Embrapa, 2024 (our translation).

The products mentioned by Embrapa (2024) are derived from the palm tree. The leaves are used for handicrafts, the fruit for food and restoring vegetation, the seed for oil production, and the palm heart is extracted from the stipe. The fiber is used to make brooms and handicrafts, while the ribbon is used to cover kiosks.

Guimarães and Silva (2012), mentioning Voeks (1987), explain that piassava fiber began to be used to make brooms and brushes after a certain period, since it had previously been used as a raw material for the production of ship ropes. The authors, based on Voeks, then summarize the history of piassava exploitation in three stages: The first stage runs from 1500 to 1840, the fibers were harvested used to make ship ropes. The second stage, from 1840 to 1930, was a period in which the fiber began to be used in the production of brushes and brooms. The third stage, from 1930 onwards, is the transition period between piassava exports and its domestic use (Guimarães; Silva, 2012).

Zugaib and Costa have already observed that there are few industries working with piassava fiber to produce brooms and brushes in the Northeast, and that they are generally small. The main broom factories are in the Southeast, mainly in the states of Rio de Janeiro and São Paulo (Zugaib; Costa, 1988 apud Guimarães; Silva, 2012).

As mentioned, and especially in the southeast, piassava fiber from Bahia is still widely used in the production of brooms and brushes, as illustrated in Figure 4, with a strong association of this fiber with these household products. However, there are studies and experiments that show the potential for use in new products and material bases.



Figure 4: Piassava broom and brush.
Source: The Authors, 2024.

A quick search for “piassava broom factories” and “piassava brooms” on google maps on October 25, 2024 reveals a large number of companies in the southeast region, including distributors and factories (Figure 5).



Figure 5: Broom factories on google maps.
Source: The Authors, 2024.

3. 6. Piassava as a Product with Greater Added Value (PMVA)

As an option to replace wood in projects, especially in the case of rare and endangered species, the piassava palm provides mainly fiber and coconut. These materials, whether waste or not, are used in addition to a single product, such as a broom. This has been the subject

of studies into the development of new composite materials and the manufacture of handicraft items. This can be a crucial factor in conservation and reducing environmental impact.

In this scenario, the material is re-signified, giving new meaning to its use and generating value for what is proposed, which is essential for innovation and sustainability. SEBRAE (Brazilian Support Service for Micro and Small Businesses) makes this easier to understand by pointing out that added value goes beyond its functional characteristics.

Added value refers to the extra benefit that a product or service offers the consumer [...]. This value can manifest itself in various ways: through superior quality, innovation, customer support, personalization or even the emotional impact that the brand generates in its consumers. More than price or functionality, added value is related to what makes the product or service special and worthy of the customer's preference (SEBRAE, 2024)

The market indicates an increase in the green products sector, which values socio-biodiversity, cultural and environmental values, and reduces, for example, a harmful effect on nature caused by the exploitation of non-renewable natural resources, irresponsible consumption and disposal. Therefore, piassava fiber, extracted by traditional communities in the Southern Bahia Lowlands, has a little-explored market in the green markets sector (Embrapa, 2024).

Embrapa recognizes that there are some gaps in the piassava fiber market. In order to improve its market, it is necessary to increase the value of the fiber; establish and consolidate cooperatives; and integrate the products into the green market. In this way, options emerge for its expansion (Embrapa, 2024).

To elucidate piassava as a product with greater added value, in 2019, the Ministry of Agriculture, Livestock and Supply in a report published "Bioeconomy of the Forest", informs that the commercialization of piassava fiber in Bahia occurs throughout the year and that the longest harvest period is from March to September, and that the purchase and resale of fibers occurs mainly for the installation of artisanal broom manufacturing units and/or broom factories and the "alternative for obtaining added value from production refers to the manufacture of piassava 'combs', which are wood and fiber structures used in roofing in civil construction" (Ministry of Agriculture, Livestock and Supply, 2019). Figure 6 illustrates combs made from wooden slats with straw, also known as piassava dregs, which are widely used in kiosks.



Figure 6: Details of the roof of a kiosk made from piassava sludge.

Source: Guimarães e Silva, 2012.

Other opportunities, from the higher quality fibers, usually combed for the sale of brooms, are also value-added alternatives for handicrafts and design (Figure 7).



Figure 7: Piassava products (from left to right): pot, bag and pot holder.

Source: <https://www.gov.br/siscomex/pt-br/arquivos-e-imagens/2021/10/IMG-0010-BA-Jose-Roque-A-Assuncao-Porta-Panela-Pote-Fibroso-Bolsa-de-Fibra-de-Piassava-800x.jpg/view>

In its various species, the piassava palm not only produces the fiber, which is the main extraction, but also the piassava coconut, as already mentioned and shown in Figure 8. The fruit appears in a bunch on the palm tree and is then cut off.



Figure 8: Palm trees with coconut bunches and the coconut cut in half.

Source: <https://fibrasdoquilombo.com.br>

In the same way that the broom is not the only product made from the fibers, there is a range of possibilities arising from skilled and creative hands (Cf. Rosa; Villas Boas; Oliveira, 2020). As an example, the use of coconuts is publicized by the Regional Development and Action Company (CAR), of the Secretariat for Rural Development, Government of the State of Bahia, which published the article “Bahia piassava coconut gains international prominence as raw material for Egyptian rosaries” in 2023.

The CAR also reports that the Baixo Sul Family Farmers' Cooperative (Coopafbsul), in the municipality of Ituberá, had already exported 400 tons by June 2023 and in the weeks afterwards sent 10 containers, each with 28,550 kilos of coconut, to Egypt to make rosaries (Figure 9).



Figure 9: Rosary made from piassava coconut.

Source: <https://www.car.ba.gov.br/noticias/coco-de-piaca-da-bahia-ganha-destaque-internacional-como-materia-prima-para-rosarios>

3. 7. Design, Materials and Sustainability

The researchers and writers of “Materials and Design: The Art and Science of Material Selection in Product Design”, Michael Ashby and Kara Johnson, establish a relationship between design and materials, as when they state that “we interact with materials through products” (Ashby and Johnson, 2011). It is understood that, without understanding the initial production process and the relationship with the raw materials used, the consumer is restricted to an experience. On the other hand, when they discover that the product they bought was produced with “X or Y” material, new emotions and bonds emerge. With regard to piassava fiber, many consumers interact with the broom product and its plant-based fibers. However, by integrating this fiber into another product, a new bond and emotions are established, as well as tangible and visual characteristics, such as those mentioned by Ashby and Johnson (2011).

The use of piassava plant fibers as raw material for new products, whether through extraction and use of the fibers in a specific project, or even the use of waste from a production stage that uses the fiber, paves the way for industrial and sustainable design. In the book “The development of sustainable products”, written by Ezio Manzini and Carlo Vezzoli, the writers draw attention to a shift towards sustainability, which will be “[...] a large and articulated process of social, cultural and technological innovation, within which there will be room for a multiplicity of options that correspond to different sensitivities and diverse opportunities.” (Manzini & Vezzoli, 2011).

Thus, the next topic, which deals with products made from renewable sources, designed with piassava fiber, moves towards sustainability, presenting examples of a process of social innovation (including the creation of jobs and income for communities), cultural (design, art and crafts) and technological (sustainability, innovation in materials, Research and Development), which illustrate objects created by artisans and designers and generate opportunities, as proposed by Manzini.

3. 7. 1. Trends and artifacts with piassava

In January 2024, the Brazilian magazine “exame.” published on its website the “15 design trends that will impact brands' marketing strategies”. The year 2024 presented three trends related to the environment. “Basics reimagined” is the first focus, which features

material innovation through circular models in efficient production. The second, “extended lifespan”, refers to responsible consumption, in which a product's value is defined by its longevity, reparability and sustainability. In contrast, the third focus is linked to the “ancestral future”, with its traditions, wisdom and practices that play a crucial role in the search for sustainable solutions.

On the website promoting the Sete Lagoas Design Biennial, which took place in December 2024, some design trends are highlighted. The event encompasses various themes, with “regenerative and sustainable design” being one of the trends. It discusses topics such as “biodegradable and renewable materials” and “closed production cycles”, with the main aim of reducing environmental impact through products and processes that benefit the environment.

There are trends that explore innovation in the design of products made with piassava, such as the work of Brazilian designer Sérgio Matos, in partnership with riverside communities in the Amazon. He uses piassava fiber to produce products such as the Buriti Piassava Fiber Baré Ethnic Group centerpiece (Figure 10) and the Vitória Régia fruit bowl (Figure 11).



Figure 10: Piassava table centerpiece.

Source: https://www.leroymerlin.com.br/centro-de-mesa-buriti-fibra-de-piassava-etnia-bare-40cm_1570963278



Figure 11: Vitória Régia fruit bowl.

Source: <https://sergiojmatos.blogspot.com/2017/02/>

RETROBEL, a store specializing in handmade products and exclusive design, is known for selling lamps and decorative items made from plant fibres such as carnauba straw, cattail, cotton, piassava, among others.

The products shown below use piassava straw, giving the material a new use and investing in authorial design (Figure 12)



Figure 12: Piassava straw lamps.

Source: <https://retobel.com.br/collections/luminarias-de-palha-de-piassava>

We can see that the variety of artifacts made with fiber surpasses that of piassava coconut when we look. However, there are still products made by hand, either due to lack of stock or almost exclusively to order. The wooden salad tongs and piassava coconut in Figure 13 are sold by Zuzula Raposo, who explains that they are various types of wood that come from parts that fall naturally from trees, which are reused and used by the indigenous people of the Pataxó reserve, who turn them into beautiful utensils for the home. Not only the potholder, but also the napkin holder cut from piassava coconut is also available (Figure 14).



Figure 13: Wooden handle and piassava coconut.

Source: <https://www.guarirobaloja.com.br/produtos/pegador-de-salada-em-madeiras-varias-e-coco-de-piacava/>



Figure 14: Piassava coconut napkin ring.

Source: <https://zuzularaposo.com.br/products/porta-guardanapo-de-coco-de-piacava-lapidado>

3.7.2. Material experience as a starting point in Design

Ashby and Johnson highlight the deep connection between design and materials, challenging readers to explore new possibilities. They state that "science reveals new technologies; from these, new materials and processes emerge. These, in turn, stimulate new opportunities for product design" (Ashby; Johnson, 2014), as illustrated in Figure 15.

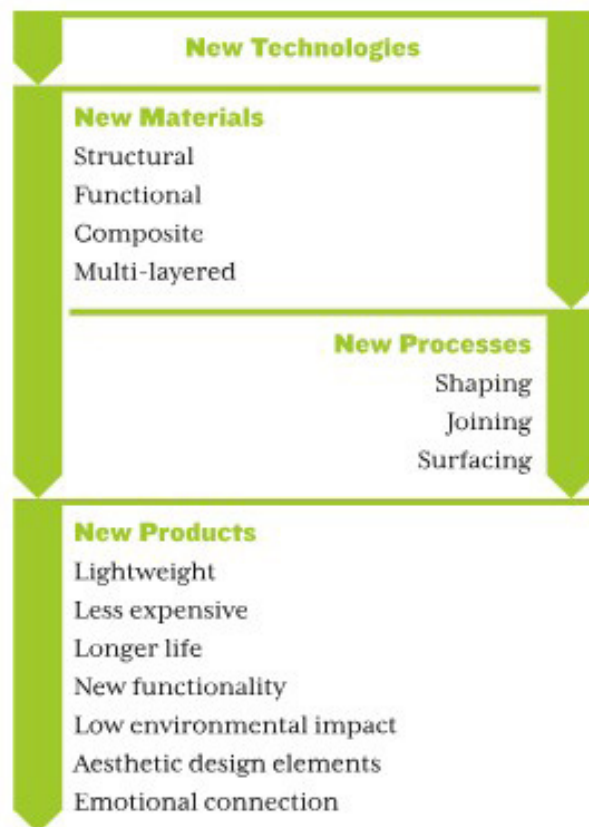


Figure 15: The role of science in new technologies.

Source: Ashby and Johnson (2014, p. 15).

The relationship between design and materials drives the development of innovative technologies, such as composites. According to Callister (2002), composites are formed by combining two or more distinct materials to obtain more efficient properties adapted to the desired applications. In this context, this article presents an excerpt from the ongoing PhD research in Design (UERJ/ESDI), in the area of Technology, Product, and Innovation. This work explores piassava (*Attalea funifera*) and bacina (*Aphandra natalia*) fibers, traditionally used in the manufacture of brooms. The study focuses on utilizing the waste generated in

this process, which is then ground and mixed with castor oil-based polyurethane resin (Figure 16) in varying proportions. The goal has been to obtain more effective combinations that can be tested for workability and produced via heated compression molding, a method that stimulates innovation in industrial design. The result is eco-composites, which offer superior environmental and ecological benefits to conventional composites, incorporating natural fibers or natural polymers (Souza Filho, 2015).

For future product applications to be well-directed, experience with the materials (piassava and castor oil) and their characteristics is crucial. This is where the Material Driven Design (MDD) method becomes relevant. Prioritizing material experience is the starting point in the product creation process. According to Karana et al. (2015), it is essential to qualify the material "not only for what it is, but also for what it does, what it expresses to us, what it provokes in us, and what it makes us do." (our translation).

The MDD method, as identified by the authors, follows four main steps (Figure 16):

"(1) Understanding the material: technical and experimental characterization, (2) Creating a vision of the material experience, (3) Manifesting patterns of the material experience, (4) Designing material/product concepts."

In this context, when seeking to add value to the piassava material, the sensory and emotional experiences and the meaning attributed to it become fundamental as the basis for the following experiment. This phase was conducted at the Laboratory of Sustainable Materials and Technologies (LabMaTs), part of the Federal Technological University of Paraná (UTFPR), on the Centro campus in Curitiba.

During the laboratory visit, a new phase in the production of the ground piassava eco-composite began, using 200g of fiber, which is 86g more than in the experiment conducted for the author's own master's dissertation in 2020. Two experiments were conducted with the two-component polyurethane resin derived from castor oil. In the first experiment, 20% resin was used, while in the second, 30%, both amounts significantly lower than the 60% used in the previous study. After mixing the materials, the resin was poured over the fiber layer. Using four hands, the mixture was rubbed together while pouring the resin for five minutes to prevent lumps from forming (Figure 17).



Figure 16: Ground piassava (A) and castor bean resin (B).

Source: The Authors, 2023.



Figure 17: Addition of resin (A) and rubbing of materials (B)

Source: The Authors, 2023.

After combining the fiber with the resin and checking its uniformity, the eco-composite material was poured into a hollow container made of 19cm x 19cm marine plywood, supported by a thin MDF board with a Teflon blanket as a support. The mold lid was then manually pressed to compact the material, as illustrated in Figure 18.



Figure 18: Material poured (A) and pressed (B).
Source: The Authors, 2023.

After applying gentle manual pressure to accommodate the material, the cast mold was removed. At this point, the eco-composite plate reached a height of 2 cm above the Teflon blanket, a material often used in barbecue grills due to its durability and resistance to high temperatures, according to the manufacturers (Figure 19). The plate was then carefully transported to the benchtop hydraulic press, positioned on the Teflon blanket. It was then pressed for 10 minutes at 100°C, with a compression load of 3 tons, using a Marconi MA 098/A model, as illustrated in Figure 20. The literature indicates that a temperature of 100°C is used due to the need to transfer heat to the interior of the composite, promoting the curing of the thermosetting resin (Figure 20). Although this value may vary in other processes, it is considered a common reference, also used in the curing of MDF panels, for example. Furthermore, the pressing cycle can be adjusted by varying the time, temperature, and pressure.

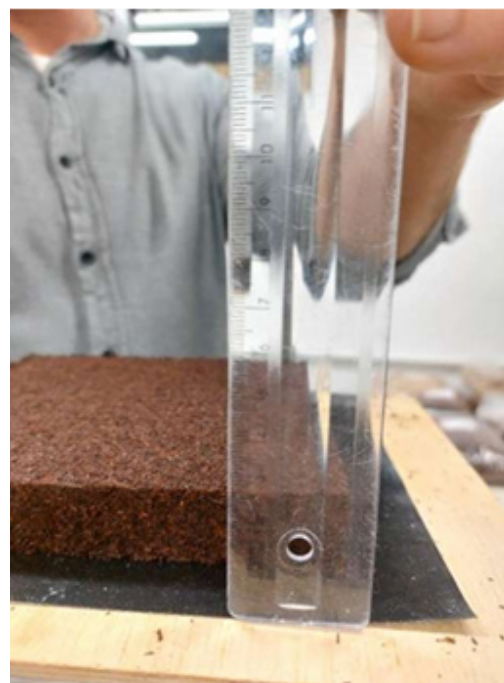


Figure 19: Manually compacted plate.
Source: The Authors, 2023.



Figure 20: Hydraulic press.
Source: The Authors, 2023.

Upon removing the plates from the hydraulic press, the initial visual and tactile observation reveals that the plate with 20% resin has a lighter laydown and, with its edges still untrimmed, releases loose fibers when touched on its sides. On the other hand, the second plate, containing 30% resin, has a darker color and demonstrated greater resistance to physical contact, leaving no traces of loose

fibers in the environment. The amount of resin used is crucial, as it can vary depending on the intended use of the composite. Even without physical and mechanical testing, it is initially believed that the 30% resin formulation is better suited for non-structural applications that require greater strength and durability when handled.

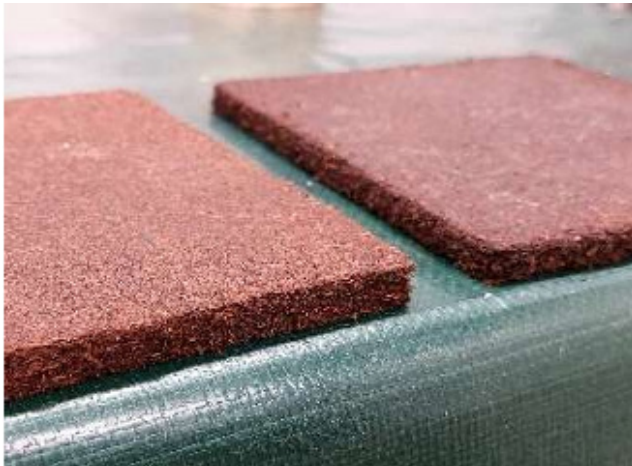


Figure 21: Eco-composite boards.

Source: The Authors, 2023.

The figure below (Figure 22) shows the material after trimming the sides, measuring 18 cm x 18 cm. The uniformity of the fibers on the inside of the board is noticeable. Weighing 267 g and with an average thickness of 10.5 mm, the eco-composite board offers tactile and visual satisfaction due to its smooth texture, attractive color, and light handling.



Figure 22: Appearance of the plate with 30% resin.

Source: The Authors, 2025.

From this perspective, the premise is established that the application of piassava fiber and castor oil resin eco-composites in design objects is a viable option, especially in sustainable consumer products. These products aim to minimize environmental impacts throughout their life cycle and maximize the use of renewable natural resources. The production of this material can serve as a basis for trends and innovations in the design of piassava products, adding value to the fiber-based product. As Ashby and Johnson state, "new materials are often the starting point for designers—they inspire and can be manipulated to achieve products that never before seemed possible" (Ashby & Johnson, 2014).

4. FINAL CONSIDERATIONS

The research explores the sustainable use of piassava—a plant fiber traditionally associated with broom production—with an innovative focus on its potential as a raw material for industrial design. The work was conducted through a systematic literature review and practical experiments, with the goal of developing an eco-composite based on piassava fibers and castor bean resin. The manufacturing process involved heated pressing, a manufacturing method that seeks to expand the application possibilities of this combination of materials beyond their traditional uses.

The results highlight piassava's potential as a sustainable and innovative material, encouraging designers to explore new possibilities for this fiber. The analysis suggests that piassava can meet the growing demand for eco-friendly materials in design, offering alternatives for sustainable solutions in various areas of industrial design. Thus, the research indicates practical ways for piassava to move beyond being merely a traditional raw material and become a component of higher-value-added proposals in product development.

In addition to expanding the use of piassava, the study promotes the appreciation of often underutilized natural materials in the development of new products. In this sense, it contributes to a market increasingly interested in environmentally responsible solutions and reinforces the trend in design toward integrating natural and sustainable raw materials aligned with contemporary needs for reducing environmental impact. Thus, the work offers concrete perspectives for design to incorporate sustainability and innovation as core elements of added value.

These practical and conceptual contributions are in line with the United Nations Sustainable Development Goals; therefore, based on the research presented in this article, it is possible to relate the investigation to some of the SDGs (Figure 23):



Figure 23: Research-related SDGs.

Source: <https://brasil.un.org/pt-br/sdgs>

- SDG 8 – Decent Work and Economic Growth: Recognizes the economic potential of piassava and the job opportunities it offers local communities.
- SDG 9 – Industry, Innovation, and Infrastructure: Highlights the importance of innovation in creating new uses for piassava and eco-composites.
- SDG 12 – Responsible Consumption and Production: Reinforces the need for responsible consumption and production patterns, promoting piassava as an alternative to less sustainable materials.
- SDG 15 – Life on Land: Involves the preservation of biodiversity and sustainable practices in piassava harvesting.

These links highlight how the study not only increases the added value of piassava in design, but also contributes to broader social and environmental goals.

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