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Sustainable Materials in Biomimetic Design: A Cobogó Project Utilizing Coconut Endocarp Composite as a Filler in a Polymer Matrix

Materialidade sustentável no design biomimético: projeto de cobogó utilizando compósito formado por endocarpo do coco como carga em matriz polimérica

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Abstract

This exploratory study examines the potential of a composite material consisting of polymer resin reinforced with coconut endocarp within the context of biomimetic design and sustainable materials in design. The research proposes the application of the composite in a biomimetic-inspired cobogó design, based on the observation of the maturation and opening process of the fruit of the pereiro tree (Aspidosperma populifolium), popularly known as "galinha de pereiro." The aesthetics and functionality of the cobogó consider adequate ventilation and lighting, inspired by insights derived from the fruit. The Material Driven Design (MDD) methodology was employed in the project, aiming to integrate sustainability, functionality, and the circular economy to promote eco-efficient design focused on utilizing natural resources. The research highlights the importance of composite materials, especially those utilizing agro-industrial waste, in the search for solutions that have less impact on the environment and can be applied in the fields of design, architecture, and civil construction. The use of coconut waste as a raw material contributes both to mitigating the impacts of the Anthropocene and to opening up new possibilities for a society seeking products with a lower environmental impact. The study demonstrates how the combination of design,

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biomimicry, and exploratory studies on materiality can generate ecologically responsible and functional solutions.
Key Words: Biomimicry; Eco-composite; Cobogó

Resumo
Este estudo com perfil exploratório aborda as potencialidades do compósito formado por resina polimérica com carga do endocarpo do coco no âmbito do design biomimético e da materialidade sustentável no design. A pesquisa propõe a aplicação do compósito em um projeto de cobogó com inspiração biomimética, a partir da observação do processo de maturação e abertura do fruto da árvore pereiro (*Aspidosperma populifolium*) popularmente conhecido como "galinha de pereiro". A estética e funcionamento do cobogó levando em conta a ventilação e a iluminação adequadas, com base nas premissas extraídas do fruto. A *Material Driven Design - MDD* foi empregada como metodologia no projeto buscando integrar aspectos de sustentabilidade, funcionalidade e economia circularpara promoção de design ecoeficiente e voltado para o aproveitamento de recursos naturais. A investigação destaca a importância dos materiais compósitos, especialmente os que utilizam resíduos agroindustriais, na busca por soluções menos impactantes ao meio ambiente e que possam ser aplicados no âmbito do design, da arquitetura e da construção civil. O uso de resíduos do coco como matéria-prima contribui tanto para mitigar ações do antropoceno, quanto na abertura de novas possibilidades para a sociedade que busca um consumo de produtos com menor impacto ambiental. O estudo demonstra como a união de design, biomimética e estudos exploratórios sobre materialidade pode gerar soluções ecologicamente responsáveis e funcionais.
Palavras-chave: Biomimética; Ecocompósito; Cobogó

1 - INTRODUCTION

Manzini (2023) asserts that the designers are not an isolated, omnipotent professional who possesses all knowledge. On the contrary, designers are social beings who must not only explore new knowledge but also collaborate with professionals from different fields. It is essential to consider the various factors that influence a product's outcome and, above all, to meet users' actual needs. This scenario of transdisciplinary practice in design is also addressed by Ashby and Johnson (2010) in their book Materials and Design: Art and Science in the Selection of Materials for Product Design.

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In addition to the composition of the team, another factor that helps determine whether an object is considered high-quality is the number and nature of the functions it fulfills. According to Löbach (2001, pp. 54–66), products are shaped by the functions embedded in them, such as practical, aesthetic, and symbolic functions. Norman (2006, p. 15) states that: "(...). Good designs include all of this—aesthetic pleasure, art, creativity—and at the same time are usable, easy to operate, and enjoyable." However, the contemporary world presents an urgent demand: actions that reduce the impact of the Anthropocene on the environment. Thus, sustainable design translates into an approach that considers the environmental, social, and economic impacts of products and services, aiming to present effective solutions for reducing waste, thereby improving people's quality of life.

Thus, according to Cavalcanti, Arruda, and Nonato (2017), the integration of design methods with principles of sustainability has been taking place since the 1970s, though this movement gained momentum in the late 20th century. Authors such as Victor Papanek (1971), Ezio Manzini (2002), and Carlo Vezzoli (2024) represent some of the leading voices in the field of design and sustainability, with important studies on the subject.

This article reports on one of the outcomes achieved through the activities and content proposed in the Design and Ecology course of the University's Design program (name omitted for double-blind review), in which the theme of sustainability was explored through readings, reflections, and material experiments. This article presents the experimental development process of a composite material within the scope of the course, using coconut endocarp powder as the raw material, more specifically as a filler in a polymer matrix for the design of a cobogó. The aesthetics and functionality of the artifact were defined based on the observation—considering biomimetic principles—of the ripening and opening process of the fruit of the pereiro tree (Aspidosperma populifolium), popularly known as "galinha de pereiro." As biomimicry is one of the approaches to sustainable design, it constitutes a science that draws inspiration from nature to generate innovative and sustainable solutions to problems faced by society, addressing social,

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environmental, and economic pillars. Thus, this article presents the experimental development process of the composite, studies involving biomimicry, its 3D modeling, and analyses regarding the future performance of the component when constructed and applied in various environments.

2 – THEORETICAL FRAMEWORK

According to Callister and Rethwisch (2007), composites are a distinct class of materials from metals, ceramics, and polymers, as they are designed by combining different materials to achieve properties not found in any of the individual materials. It is an artificially created multiphase material, which requires it's constituting phases to be chemically distinct. They are also formed by at least two phases: one called the matrix phase, which surrounds the other, called the dispersed phase. According to the authors, the properties of the composite material depend on the properties of each of its constituent phases, as well as their respective quantities and the geometry of the material regarding the dispersed phase (filler or reinforcement).

In this regard, the composite developed used the endocarp of the dried coconut—commonly known as coconut husk—as its dispersed phase, which was processed into two different particle sizes: powder and larger endocarp granules. It is important to note that the dispersed phase is currently being treated as a filler, as mechanical tests will still be conducted to determine the composite's strength. As the matrix phase, three types of materials were used: ordinary plaster, Portland cement CP II-E-32, and acrylic resin. These materials were chosen as matrices because they are accessible, provide specific tactile and visual characteristics, and offer the potential for a solution with less environmental impact. Acrylic resin was used in this initial phase of the study to evaluate the composite's tactile and visual properties; however, for the remainder of the research, castor oil-based polyurethane resin will be used, a polymer with a lower environmental impact, according to data from the company PROQUINOR – Produtos Químicos do Nordeste Ltda.

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Taking sustainability principles into account, the dispersed phase of the composite material was not chosen at random. It is important to emphasize that the creation and development of composite materials should be problem-solving oriented, not merely aimed at creating yet another type of material. Thus, the endocarp of the dried coconut was chosen, as it is a solid waste product discarded in large quantities every day in Brazil and around the world.

According to Araújo (2017) and Embrapa – Brazilian Agricultural Research Corporation (2021), Brazil allocates a total of 280,000 hectares for coconut plantations, corresponding to a production equivalent to more than 2 billion coconuts per year, and, consequently, to the solid waste generated after the liquid and pulp have been consumed. According to Araújo (2017) and Silva Junior (2020), the coconut shell accounts for 80% to 85% of the fruit's gross weight and the endocarp for 19% of that same weight, with these parts being discarded and considered waste. The disposal of green coconuts generates a large volume of waste (around 6.7 million tons of husk per year), which is considered an environmental problem, as this volume produces gases such as methane that contribute to the greenhouse effect, one of the causes of global warming. However, this same waste has the potential to be transformed into various other products, such as bioplastics or natural resins, and can also be used in composite formulations of high environmental value (Passos, 2005).

According to Figueiredo Sobrinho (2015), the structure of the coconut endocarp consists of lignin, cellulose, and hemicellulose biopolymers, as well as pectins. According to Araújo (2017), lignin stands out because it is present in greater quantities in the endocarp, has good thermal stability, and high resistance to weathering, making it suitable for use in construction materials. In addition to these characteristics, the dried coconut endocarp, as a whole, exhibits high hardness, good acoustic resistance, and resistance to fungal degradation, while also being a non-toxic material that is not easily combustible.

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The composite was created based on DIY (Do It Yourself) concepts—specifically, DIY Materials—which, according to Rognoli (2015), is a practice that allows designers to produce and experiment with materials, seek solutions beyond those provided by the market, and at the same time satisfy future users who are looking for unique products with a lower environmental impact. This approach demonstrates that it is possible to conduct experiments, to a certain extent controlled, using appropriate technologies, which are nothing more than accessible materials and tools. From this perspective, the DIY approach was used to create this material, drawing on the work developed by Prof. Valentina Rognoli (Design – Milan Polytechnic) in conjunction with the Material Driven Design (MDD) method developed by Elvin Karana (2015).

DIY practices served as the foundation and reference points for the independent development of the aforementioned composite material, guiding the initial experiments; upon their completion, the material's application in a cobogó project became apparent, given that its material properties and production process are easily replicable by diverse social communities. The MDD method was used as a guide to steer the entire experimental process for the production of the composite material, requiring a scientific foundation as the basis for the entire process of experimentation and analysis of future applications in products.

Biomimicry, as a design approach, seeks intelligent solutions to human problems in nature by observing biological forms, processes, and systems. In this study, inspiration came from the pear fruit, whose gradual opening as it ripens reveals a structure that balances functional efficiency and aesthetics. The way the fruit splits, strategically, guided the development of the artifact, especially in defining openings and joints that enable ventilation, lighting, and formal expression. In developing the cobogó design, direct reference was drawn from this process of fruit ripening and opening, respecting the principles of natural ventilation and lighting inherent to the cobogó, a non-structural perforated element. The cobogó can be applied in both indoor and outdoor spaces to separate environments and aid in the ventilation and lighting of those spaces.

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The aim was to apply the principles of biomimicry, which, according to Benyus (1997), is the field that studies nature—its morphology, functionality, and relationships—and, based on this analysis, enables the development of innovative solutions, always considering natural organisms as models and mentors to be emulated. In this context, biomimicry was applied through an initial analysis of the shape of the pear fruit, particularly regarding its opening behavior, and applied to the interior of the cobogó. Complementing this approach, recent studies highlight the role of fruits as valuable sources of natural structures and inspiration for the development of innovative products. According to Oliveira, Arruda, and Langella (2021), the skins and structures of fruits such as the pomelo, coconut, and walnut feature sophisticated structures that serve as a reference for the creation of bio-inspired materials and forms. These investigations highlight the potential of biomimicry in the design of functional, sustainable, and adaptive components, with broad applicability in architectural products and systems guided by the logic of nature.

Nature is home to a wide variety of biological structures that perform functions essential to the survival and adaptation of living organisms. Among these, fruits have been studied strategically, with the aim of understanding and translating their functionalities into the development of innovative solutions. Their structures reveal sophisticated strategies for protection, dispersal, and functional efficiency, making them valuable references in the field of biomimicry (Oliveira, Arruda, and Langella, 2024).

3 – METHODOLOGICAL PROCEDURES

Karana (2015), using the MDD method, works on and develops design projects with the material to be used as the starting point. In this method, the constituent phases aim to define and generate material experiences, which, according to Karana, Hekker, and Kandachar (2009), emerge from a comprehensive and complex interaction between the material itself and the. In this context, the

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form, the aesthetic/sensory characteristics of the material, the manufacturing processes adopted, the users, and the very occasion in which this situation unfolded all influence the experiences with the product and the material. Through these experiences, the designer is able to identify how the material behaves under different conditions and with different users. Through this method, the designer can identify the best material to be used in a given scenario, eliciting meaningful and positive responses from the public. From this perspective, the aim is to understand the material—what it is, how it behaves, what it evokes or signifies—and to observe what people feel or think when they come into contact with it. Through the analysis of these factors, a product is developed that is designed in accordance with the material's characteristics and properties, providing future users with a positive experience. Thus, it is important to note that this method can be applied both to existing and known materials, as well as to materials that are unknown and not yet fully developed. In this context, Karana (2015, pp. 40–41) points out that:

> The MDD method consists of four main sequential steps: (1) Understanding the Material: Technical and Experiential Characterization, (2) Creating Visions of Material Experiences, (3) Manifesting Patterns of Material Experiences, (4) Designing Material/Product Concepts. (…), the MDD process begins with a material (…), and ends with a product or a subsequently developed material.

However, it should be noted that some of the activities comprising these stages were not carried out, as the initial focus was on analyzing the sensory characteristics of this material and its response to certain traditional machining operations such as drilling, cutting, and polishing.

3.1 – Pilot Phase New Subtitle (In English, Times New Roman 14, uppercase, bold, justified alignment)

The coconut endocarp was purchased at the Central Market in the city of Campina Grande (PB), located on Dr. Carlos Agra Street in the Centro neighborhood, where a variety of products and

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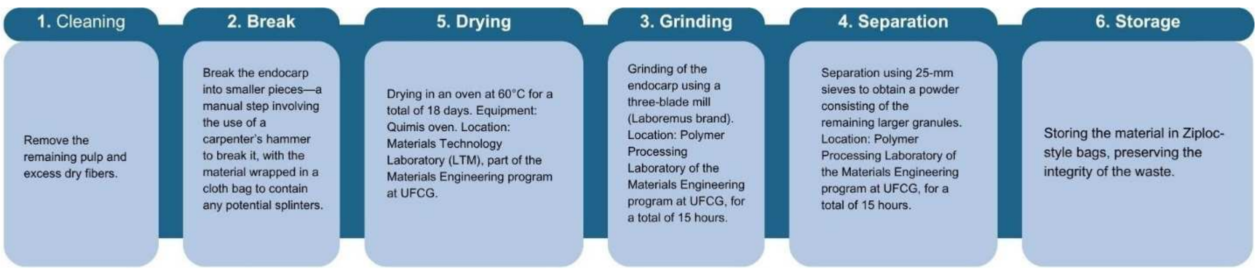
goods are sold, including dried coconuts, from which the water and pulp are extracted on-site, leaving the endocarp to be discarded. From this waste, the equivalent of 15 and a half endocarps was obtained, corresponding to 31 pieces, since the coconut is cut in half to extract the liquid and pulp from the fruit.

After the waste was collected, it had to undergo several steps before it could be used as the dispersed phase in the composite, as shown in Figure 1.

Figure 1 – Steps for obtaining the residue.



Source: Authors, 2025

3.2 – Aesthetic and Structural Rationale for Cobogó

For the cobogó design, factors such as functionality, aesthetics, and the basic principles of how this structure works—which allows for lighting and ventilation without compromising privacy—were taken into account. Consequently, it was decided to study the fruit of the pear tree (Aspidosperma pyrifolium), a plant found in the northeastern semi-arid region, and the ripening process of its fruit. According to Carvalho (2008, p. 448), the Pereiro fruit "is pear-shaped, woody, and brown, with a small palmate or paddle-like structure that, upon dehiscing, splits into two bands, releasing 4 to 5 seeds." Its shape (Figure 2), when open, has an organic form that allows the wind to pass easily between its bands, dispersing the seeds across the ground.

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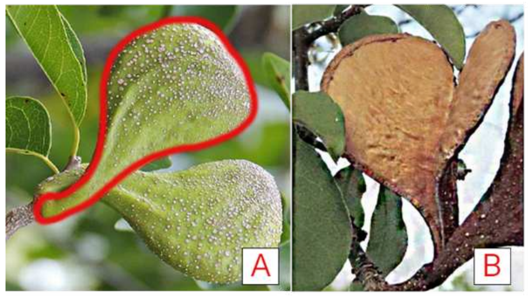
Figure 2 – A green pear (A) and a ripe pear (B).



Source: https://www.flickr.com/photos/pedropabc/18382081201 (A) e
https://www.istockphoto.com/br/foto/belezas-da-caatinga-fruto-do-pereiro-gm898122086-247781923 (B)

Based on this, it was decided to incorporate into the cobogó both the fruit's profile—in a simplified form—and its aerodynamic shape and fluidity; the latter was achieved by rounding the edges and developing a three-dimensional shape based on the fruit's profile, resulting in a conical form. These characteristics are designed to direct the winds, facilitating airflow and air exchange between the spaces.

The functional model and design of the cobogó were created using the 3D modeling software Rhinoceros, with the aim of studying its shape and extracting its dimensions in order to subsequently create the physical mold. Figure 3 illustrates the developed cobogó and the appearance of the material obtained using the acrylic resin polymer matrix; it can be observed that the material has an interesting texture suitable for application in various environments (Figure 4).

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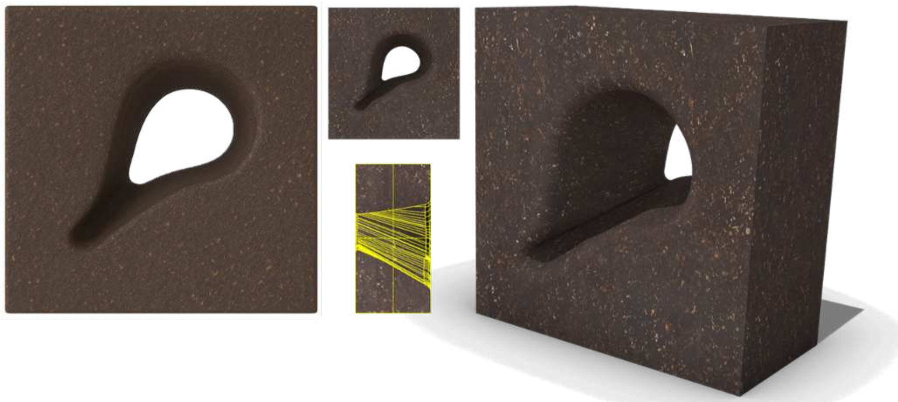
Figure 3 – 3D model.



Source: Authors, 2025

Figure 4 – Rendering of cobogó installed in a setting.

Source: Authors, 2025

3.3 – Making the Patterns

For the purposes of this study, two molds were created: the first for producing the material test specimens, measuring 9 cm × 9 cm × 2 cm; and the second for the cobogó specimens on a 1⁄2 scale,

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measuring 10 cm × 10 cm × 4 cm. The internal structures forming the hollow areas were made of expanded polystyrene for all three molds.

3.4 – Initial samples of cobogós on a reduced scale

The composite preparation process followed a 50/50 ratio, in which 50% of the composite's weight consists of the matrix and the other 50% consists of organic waste. This ratio was used for the three matrices tested (gray cement, plaster, and acrylic resin) to establish a standard comparison among them. It is understood that these ratios may change in the future, particularly with regard to reducing the matrix and increasing the waste content. The following equipment was used to prepare the samples (Figure 5): a household digital scale; clean plastic containers for mixing the components; spatulas; and a release agent.

For the gypsum and endocarp residue composite, a ratio of 106 grams of gypsum to 106 grams of endocarp (66 grams of larger granules and 40 grams of powdered granules) was used. The dry ingredients were mixed, and water was then added to form the mixture and bind the components. The mixture was then compacted on a vibrating table to prevent air bubbles that could weaken the composite. Demolding was performed after 5 days, as humidity in the city of Campina Grande in April was quite high. Complete curing of the cobogó took 4 to 5 weeks.

For the second cobogó, the same dimensions used in the first sample were applied, but with a Portland cement matrix. The compaction process was the same as before. The curing time required before demolding was 6 days, due to local weather conditions, and 3 to 4 weeks for complete curing.

For the third cobogó, a syringe was additionally used to withdraw the exact amounts of resin and solvent, with acrylic resin serving as the matrix. The measurements for the endocarp were the same

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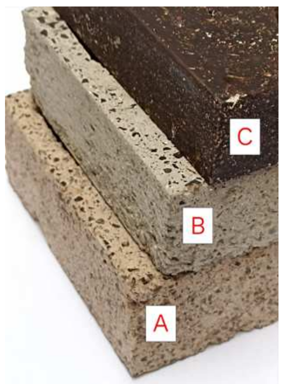
as those for the two previous samples. Regarding the measurements used in the polymer matrix, 75 ml of resin was used, equivalent to 79 grams, and 25 ml of catalyst, corresponding to 26 grams, totaling 100 ml of resin equivalent to 105 grams in all. The curing process took place within 6 hours.

Figure 5 – Examples of test specimens prepared for technical and sensory analysis, namely: A (plaster matrix); B (cement matrix); and C (resin matrix).



Source: Authors, 2025

3.5.1 – Traditional Machining Tests

The following items were used: a hammer, three nails (one larger [7x9] and two smaller [6x6]), a Bosch drill, a screwdriver, and a flat-head self-tapping screw (4.2x19).

In the nail penetration tests (Figure 6), it was observed that the nails initially penetrated the material only superficially, and only after some time—following a series of hammer blows—did they bend. Despite the impacts, the material did not undergo significant deformation and showed no cracks around the holes (Figure 7). Because the nails were unable to penetrate the material deeply, they were easily pulled out, making the use of a hammer unnecessary for this action.

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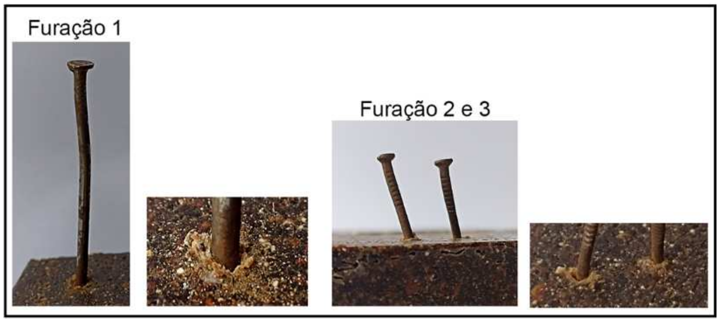
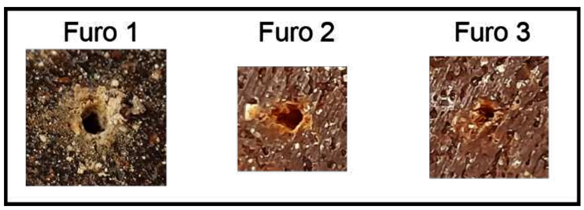
Figure 6 – Drilling with nails.



Source: Authors, 2025

Figure 7 – Absence of cracks in the material.



Source: Authors, 2025

In the screw drilling tests, two drill holes were made using the same screw. The material remained firm and solid throughout the continuous drilling process, showing no cracks. Drilling was easy using a metal drill bit, and there was little vibration during the tests. Insertion and removal of the screw occurred easily, with no cracks or fissures observed around the holes (Figure 8).

Figure 8 – Drilling with screws and material free of cracks.

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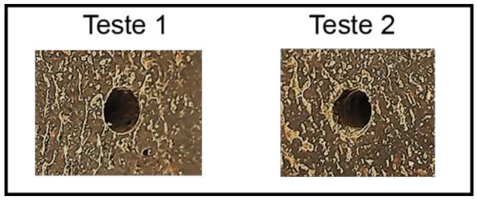

Source: Authors, 2025

3.5.2 – Sanding/polishing

To conduct the sanding/polishing tests, four grades of sandpaper—P180, P240, and P400—were used dry, while P600 sandpaper was used with water to achieve a higher polish. Throughout this process, it was observed that the material offered greater resistance when using P180 sandpaper, requiring more manual force; however, it should be noted that this was the first polishing step and that there were surface irregularities that could have created obstacles. The subsequent tests performed with the other sandpapers were easier and faster, since the sample no longer offered as much resistance. Additionally, it was observed that using P600 sandpaper with water made the process easier, as the material had already undergone sanding stages. For this test, four manual sandpapers of different grits, water, a tempered glass plate, cloth, a blower, and a caliper were used.

Finally, it was observed that there was no significant loss of material after the polishing test, as the cobogó sample initially had a thickness of 27 mm and, after polishing, measured 26 mm, with these measurements taken using a caliper. The authors acknowledge that for this step, a precision scale would be necessary to weigh the material before and after sanding. However, since the facility did not have such equipment, the authors resorted to using a caliper. After the polishing stages, it was observed that the material presented a polished and satin-finished surface, with an interesting texture suitable for application in various industrial design products, provided that technical tests are conducted to validate this observation.

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4 - SENSORY ANALYSIS

This article focused on a composite material developed from the organic waste of dried coconut endocarp, based on “Do It Yourself” (DIY) practices aimed at experimenting with and creating materials from a more accessible perspective. In this context, advanced resources are not used; instead, accessible, everyday tools and technologies are employed in spaces such as the 3D modeling workshops found in design programs in Brazil, utilizing the minimal set of tools described above.

Because the selected waste material has high hardness and the climate in the city of Campina Grande, from April to June 2024, is characterized by instability and high humidity—typical of the season and location—it was necessary to use two technologies to enable the production of the composite: an oven set at 60°C and a three-blade mill. Even with the use of these technologies, the experimental nature of the DIY project remained unchanged, as they were accessible because they are part of the Materials Engineering program at UFCG.

The article did not aim, at this stage, to gather technical data on the composite, but rather its sensory data, taking into account DIY practices that align with the objectives of the Material Driven Design method. The fabrication of a 1:2 scale model of a cobogó using the composite material created and tested demonstrates that designers can not only design products but also conduct experiments with materials and, based on the results obtained, suggest applications for products. These designers who experiment with and design materials are considered “new materiologists,” according to Lefteri (2017, p.60).

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The purpose of this study was to develop this material as an alternative use for the large quantity of dried coconut endocarps discarded each year; the goal is for this composite to replace certain materials currently on the market that do not degrade properly.

Cobogó was chosen as the product resulting from this study because it is a non-structural artifact with cultural significance that is well-suited to the climate of the Northeast and other regions of Brazil. It is important to emphasize the need for subsequent stages of technical studies (tests for tensile strength, flexural strength, abrasion resistance, density, moisture content, among others) since the characteristics and technical properties of the composite are unknown. Consequently, the study focused its efforts on analyzing the sensory data of the created material, considering three of the five human senses—touch, sight, and smell—as outlined in Table 1.

Table 1 – Sensory data on cobogós, based on touch, sight, and smell

Headquarters	Tactile	Visual	Fragrance
Plaster	Rough Lacks flexibility Stiff Heavy/light at 257g Earth-like, stone-like appearance	Opaque Matte finish (with a polished surface pattern) Matte (in sunlight) Appears light and porous Less saturated brown color Resembles a granite surface	It has a scent reminiscent of coconut or wood
Cement	Rough Lacks flexibility Stiff Heavy/light at 229g Chalk-like, wall-like, and stone-like appearance	Opaque Matte finish (polished surface mold) Matte (in sunlight) Appears heavier Gray color Resembles a granite surface	It brings to mind the smell of concrete

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Acrylic resin	Smooth No flexibility Rigid Heavy/light at 196g Appearance of polished ceramic tiles, polished/varnished wood	Opaque Glossy (polished surface finish) Satin (post-finishing with P180, P240, P400, and P600 sandpaper) Satin (in sunlight) Appears heavy/compact Resembles the surface of granite, Silestone, coffee, or chocolate.	The scent of the resin itself

Source: prepared by the author(s).

The perception of these inherent sensory properties may may appear insignificant if their potential applications are not understood. However, at first, not knowing the technical properties at this stage is the goal. In general, technical properties are valued and emphasized more than sensory ones. Designers are professionals who do more than just design products in an automatic and mechanical way; they seek to think from the users' perspective. To do this, they need both technical and sensory information, aiming to provide quality products that work and are aesthetically and sensorially pleasing to the public, offering different types of material experiences. For this, more than just technical qualities are necessary.

According to Karana, Hekkert, and Kandachar (2009), the nature of the interaction between the user and the product depends on the materials used in its construction and the manufacturing processes that transform the initial concept into a tangible physical object. This process influences the outcome and how the user behaves toward the artifact, as it is through their senses that they will provide a positive or negative response regarding the user experience. In short, it is not enough to develop merely functional products. When a design professional creates a design, they must keep in mind that users, consciously or unconsciously, will use their senses to evaluate the products, and it is during the course and execution of a project that sensory data can and does play a pivotal role.

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4 – ANALYSIS OF RESULTS

This article presented the development process of a composite whose dispersed phase is the endocarp of dried coconut, applied to three different matrices: gypsum, Portland cement, and acrylic resin. The creation process was guided by "Do It Yourself" (DIY) practices and the Material Driven Design (MDD) method, developed by Karana, Barati, Rognoli, and Laan (2015), which provided the framework and foundation for developing the material experimentally.

As a result, it was observed that, in both the tactile and visual senses, there are some sensory characteristics shared among the materials. Of the three senses, it was observed that only the sense of smell provided distinct sensations for each sample. Furthermore, among the three cobogós, the polymer matrix sample presented the most distinct results across all three senses analyzed. Thus, even though they share similarities, each sample provides specific sensations that distinguish them. It is these sensory data—unique and inherent to each material—that aid and influence the design process, without disregarding technical information. Furthermore, among the three samples, it was observed that the one using a polymer matrix has a more interesting appearance and texture, with a color similar to that found in the fruit of the pear tree.

Regarding the machining tests performed on the resin sample, it was initially observed that this material possesses considerable hardness, a characteristic noted in the nail-drilling tests, in which the nails were unable to penetrate the material. The holes showed no cracks around them.

In contrast, drilling the material with a drill, using a metal drill bit, was easy and quick, with little vibration during the process. Furthermore, the holes drilled showed no cracks, deformations, or fissures. In other words, laboratory tests and trials are necessary to establish the material's technical properties, with the aim of understanding it and determining the products in which it could be best applied.

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Based on the grinding tests, it became clear that a larger number of samples was needed, which will allow for a comparison of the differences between the various finishes, as well as the material loss after each polishing cycle. However, based on the initial machining tests, the material did not show significant wear during polishing.

4 - FINAL CONSIDERATIONS

This article aimed to develop a composite using dried coconut endocarp as a filler in three different matrices, from a sustainable perspective, given that large volumes of this organic waste are discarded every year across the country's five regions, with the goal of providing a potential alternative use for this material. The research activities were conducted using DIY practices, which emphasize accessible experimentation by utilizing common, everyday materials, technologies, and tools. Attention was also paid to the principles of the MDD method, which guided the entire experimentation process, providing theoretical support and allowing for an initial sensory observation of the material before proposing physical strength tests. Consequently, future work will be conducted using a polyurethane matrix derived from castor oil, as it is a less environmentally harmful and non-toxic polymer, in order to compare it with the acrylic resin sample. In addition, the material will now undergo mechanical and physical testing to gather technical data on the developed composite, followed by a more comprehensive and detailed sensory analysis. In short, the material still needs to be studied and understood in depth from both a technical and sensory perspective so that we can determine, for example, its applicability, to what extent this material can be considered eco-friendly, and whether it can replace another material that has a greater environmental impact—that is, information that will only be known and established through a more careful analysis.

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