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Mycelium material in interior design. Acceptance level amongst future users of new eco-aesthetics

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Abstract

Mycelium-based composites (MBCs) show great potential as a sustainable alternative to conventional biopolymers in the production of environmentally-friendly furniture and interior decor. While these innovative biocomposites have numerous ecological benefits, they pose a new challenge in aesthetics and consumer acceptance. Furniture made from mycelium and lignocellulosic substrates has a porous texture, uneven surface, and unpredictable coloring due to the natural growth patterns of mycelium. Although production methods can be improved and imperfections reduced, the inherent randomness of mycelium growth cannot be eliminated. These factors and the natural provenance of such materials can be a challenge in interior design. For these reasons, it is justified to measure the level of acceptance of such materials as objectively as possible. The article presents and justifies three complementary consumer tests suitable for MBC materials and product acceptance level measuring. The proposed set of consumer tests includes (1) an organoleptic evaluation of the material, using three senses simultaneously, (2) a product acceptance and desirability evaluation, and (3) comparative tests of products with the same function, dimensions, and shape, made of two different materials. The results of these tests are complementary and demonstrate to which extent products made of MBC are potentially acceptable to the public. All of these methods support current and future applications of MBC for manufacturing items where enhanced aesthetics are required.

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Introduction

Interior design and interior decoration mirror *fast fashion*, *a* trend known in the clothing industry. Retail companies specializing in interior design and decoration vigorously promote the vision of often changing collections once or several times during one season (Niinimäki et al., 2020). As in fast fashion in clothing, the environmental costs of fast fashion in interior design are very high (Bick et al., 2018). Consumers are used to permanent purchases, and even the awareness of the problem and negative publicity of fast fashion practices does not always prevail (Roozen and Raedts, 2020). In this situation, the pro-environmental strategy of using environmentally friendly materials could be implemented along with the policy of reducing energy consumption, which is highly reasonable. Following this idea, the authors have begun researching mycelium-based composites (MBCs) in general use. The analysis indicates that MBC could become an alternative to typical materials in sustainable furniture and interior design, despite some known engineering flaws, such as the low ability to transfer tensile forces and high hygroscopicity, resulting in low outdoor durability (Sydor et al., 2022a; 2022b). The use of fungi in the production of MBC usually raises concerns about the health impact, but when compared to MDF, in which formaldehyde or other chemicals are used, MBC seems to be a healthier option.

Using mycelium-based composites (MBCs) to design sustainable furniture and other interior elements raises concerns about aesthetics and acceptance. The question of whether designers and future customers will accept this material is valid and depends on the level of "likeability" of the material (Rifqiya and Nasution, 2016). Even if a material has good physical and economic properties, its lack of acceptance by users can limit its industrial applications (Kwak et al., 2015). This risk is exceptionally high for MBCs, which are difficult to manufacture due to their irregular coloring and surface texture resulting from their natural growth process. Furthermore, the biological origin of MBCs, with both the substrate and the mycelium being biological, can raise concerns among consumers. To successfully introduce new material, it is crucial to ascertain whether potential users are willing to accept MBC for their direct, everyday use, as well as for use in furnishings and other interior design elements. Therefore, research on MBCs should aim to answer these essential questions.

This article aimed to describe potential measurement methods of the level of human acceptance of the new material.

Proposed methods of likeability studies

The research program

Several factors should be considered to assess the organoleptic comfort of new furniture materials. Organoleptic comfort encompasses the sensory experience of a material, including its tactile qualities, aroma, visual appeal, and overall aesthetic appeal. Here are some steps to assess the organoleptic comfort of new furniture materials: sensory testing, evaluating the material's odor, and considering the material's appearance.

Sensory testing evaluates tactile properties, such as texture, softness, and smoothness. This can be done by having individuals touch and feel the material and provide feedback on its comfort. The odor of the material can also impact its overall comfort. To evaluate this factor, individuals can smell the material and provide feedback on its odor and whether it is pleasant. The visual appearance of the material also affects its organoleptic comfort. This includes factors such as color, pattern, and overall aesthetics. Individuals can provide feedback on whether they find the material visually appealing and comfortable. Due to its supraliminal nature, visual perception precedes other sensory experiences when evaluating new objects (Goldstein and Brockmole, 2017). This implies that the visual appearance of a material often exerts a more profound influence on our overall perception of it than other senses, such as touch or smell (Schifferstein and Wastiels, 2014). However, it is crucial to recognize that all senses play a crucial role in our perception of materials and cannot be overlooked in research. Sight provides first impressions; the other senses detail the overall experience and are used in long-term contact with the material. The combined action of several senses gives information complete enough to evaluate the material reliably.

By considering these factors and gathering feedback from individuals, it is possible to assess the overall organoleptic comfort of new furniture materials. This information can then be used to determine whether the material is suitable for furniture design and is likely to be accepted by consumers.

Considering the argument presented, we propose three consumer surveys.

- Test A: Assessing organoleptic comfort (sight, touch, and smell) with a 3-degree scale (methodology partially inspired by (Podrekar Loredan et al., 2022)).
- Test B: Assessing a material acceptance level with a 9-degree scale (methodology inspired by (Lim, 2011)).

- Test C: Comparing two products with the same function and form: made of MBC and made of reference materials and identifying consumer preferences (methodology inspired by (Manuel et al., 2015)).

Respondents

When selecting respondents for furniture material research, it is essential to consider the target market and the study's specific objectives. It can be detailed as:

1. The target market must be defined by identifying the demographic characteristics of the population to be studied. This may include age, gender, income level, education level, occupation, and other relevant factors.
2. The research objectives and the information to be gathered should be considered, such as evaluating the acceptance of new material, understanding consumer preferences for specific material characteristics, or identifying potential areas for improvement in current materials.
3. A sampling method should be selected that is appropriate for the research objectives and target market. This can include probability sampling, where each respondent has an equal chance of being selected, or non-probability sampling, where respondents are selected based on specific criteria or convenience.
4. The appropriate sample size should be decided based on the research objectives, budget, and time constraints.
5. Respondents who meet the target market criteria and are willing to participate in the study should be selected.
6. When selecting respondents, diversity should be considered, including a diverse group of participants to ensure that the results represent the larger population.

Considering the purpose of the tested materials, it is justified to research a group of students who will soon be entering the job market as architects and interior designers, making them a crucial group for understanding the emerging design trends that will shape the future of the product market. Second, the age range of the respondents, 19–24 years, is suitable because they belong to Generation Z, the postmillennial cohort. This generation is known for its increased sensitivity to sustainability and environmental issues, making them the best for evaluating sustainable materials for interior furnishing products. Finally, selecting female and male respondents is likely to ensure that gender-based differences in perception are accounted for, which can be essential in understanding how different gender groups perceive sustainable materials

for interior furnishing products. The selected group of respondents should represent a population, ensuring the accuracy and generalizability of the study results.

Tests environment

When material acceptability testing for interior furnishing products is conducted, it is essential to provide three individual sample presentation stands to allow independent evaluation, free from the influence or suggestion of others. Each respondent should only be able to access one stand at a time. The room should be thoroughly ventilated and maintained at a temperature of 22 ±2°C and an air relative humidity of 60 ±5%. The samples should be assessed at a color temperature of 5000K to 10 000K against a neutral, uniform background identical for all the elements presented.

Production of samples

The first stage in producing all MBC samples was to prepare gypsum molds (Fig. 1). The substrate should then be placed in molds with fungus inoculum after five days of growth of the mycelium. After the mycelium has fully colonized the substrate, the molded product is removed and dried. The drying process inactivates the fungus and ensures that the product is stable and durable. The shape and size of the final product are determined by the molds used.

Fig. 1. Wall cladding element before ripening – the form is filled with MBC material (photo by A. Bonenberg)

Fig. 2. Wall cladding element in realization – the panels of chamotte clay (photo by A. Bonenberg)

For example, unglazed and unpainted chamotte clay cladding panels can be used as reference samples. The technology includes: (1) molding into the desired shape and size by extrusion, where the clay is pushed through a die to create a consistent shape, or the clay can be pressed into molds or hand-shaped; (2) drying to remove any excess moisture; (3) firing in a kiln at high temperatures; (4) optionally finishing by glazing or painting, which adds color and protection to the surface. The panels can also be left unglazed for a more natural look. Fig. 2 shows the reference samples prior to firing.

Testing procedure

The first of three consumer tests (test A) was conducted as an organoleptic assessment, requiring using three senses simultaneously. The assessment involved the properties of the test material perceived in the following manner: visual – in terms of color (pleasant, neutral, ugly), olfactory (pleasant, neutral, unpleasant), haptic (pleasant, neutral, unpleasant/hard, difficult to define / warm, neutral, cold).

Test B assesses acceptance and desirability using a 9-point hedonic scale. In this test, respondents should be presented with samples of authentic products with various shapes, flat, convex, and concave, made of mycelium-based composite (MBC) that they could touch, see, and smell. Respondents could be asked: *Would you accept the*

Fig. 3. Test stands for the A, B, and C tests (photo by A. Bonenberg)

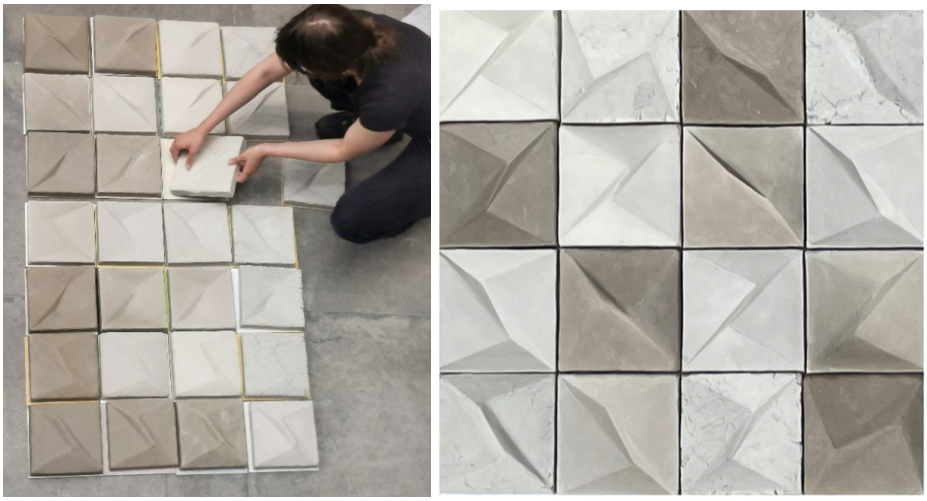

Fig. 4. Evaluation of material acceptance and comparison of wall cladding panels made of MBC and made of chamotte clay (photo by A. Bonenberg)

material in interior design elements in your home? *Would you accept the material in interior design elements in a home that you design with an ecological aesthetic*? The first question concerns a personal opinion on the material, with positive answers indicating a significant positive reception. The second question concerned the respondent's general opinion regarding using the material in interiors.

Test C compares the two products with the same function, shape, and size. It can be a wall cladding made of MBC and alternatively made of chamotte clay, fired and unglazed. This differential, pairwise comparison method tests the solution's potential competitiveness on the market and determines whether the new material would gain consumer acceptance and whether it is 'likable' compared to other solutions.

This testing procedure aims to determine the hedonic quality resulting from evaluations of sensory experience in terms of subjective emotions, both raw materials and end products. Fig. 3 shows the exemplary test stands for the A, B, and C tests.

Fig. 4 shows the pairwise comparison of the exemplary products during the C test.

Fig. 5 shows sample products made of MBC that can be used in consumer tests.

During all the test, the respondents could not influence each other's responses.

Fig. 5. Sample products made of MBC (photo by A. Bonenberg)

Conclusions

Studying the material properties of manufactured products in the context of introducing new materials and applying this knowledge to industrial design is a challenge in product design (Petiot and Yannou, 2004). Due to the subjectivity and different nature of user needs, it is difficult to assess and quantify these characteristics accurately. In this article, the authors relied on usability testing and used traditional marketing and decision-making theory methods, i.e., two one-step consumer tests and pairwise comparison. This approach has provided data that helps to understand and identify the requirements of future users.

Using the proposed methodology enables:

1. A better understanding of consumer needs and preferences by gaining a more detailed understanding of how consumers perceive and interpret product semantics, which can inform decisions related to product design and development.
2. Improving product specifications by providing a framework for specifying product attributes and characteristics based on consumer perceptions can improve product specifications' accuracy and relevance.

3. Enhancing product evaluation by a more precise and comprehensive evaluation of product performance and user experience can improve product quality and consumer satisfaction.
4. Increasing competitiveness by incorporating consumer perceptions into the design process, companies can develop products that better meet consumer needs and preferences, potentially resulting in a competitive advantage in the market.

The potentially positive evaluation of the mycelium-based composite (MBC) among respondents will demonstrate that the continued development of the material in question could yield good commercialization results in the coming years (Sydor et al., 2022a; 2022b). Working with this and other biomaterials can lead to a paradigm shift in aesthetics in which the design mainstream has hitherto been defined by high technology and highly sophisticated design and production methods, which will perhaps soon take on a more casual, nature-like form.

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