SCOBY: CULTIVATING SUSTAINABLE ART IN THE COSMOS

Dina Lestari
Product Design Study Program
Podomoro University
dina.lestari@podomorouniversity.ac.id

Abstrack-The exploration of sustainable materials for artistic endeavors in space has gained significant attention in recent years. This article delves into the potential of SCOBY (Symbiotic Culture of Bacteria and Yeast) as a biomaterial for cultivating sustainable art in the cosmos. Scoby, commonly used in the production of fermented beverages like kombucha, exhibits unique properties that make it an intriguing candidate for artistic expression beyond Earth. This study explores the characteristics of scoby, including its biodegradability, versatility, and potential for customization, which make it an ideal medium for artistic creations in the extraterrestrial environment. Furthermore, the article investigates the challenges such as conducting in-depth research to understand the potential inherent in SCOBY as a sustainable art material, exploring techniques and methods in SCOBY utilization, ensuring sustainability and prolonging the lifespan of SCOBY in the context of art, and exploring SCOBY potential for applications in art, space & science. In conclusion, this research presents a comprehensive overview of the potential of SCOBY as a sustainable biomaterial for artistic creation. It highlights the importance of embracing biomimicry, learning from nature's wisdom, and recognizing the interconnectedness of all living beings and systems. Through this exploration, the article encourages further research and collaboration to unlock the full potential of SCOBY in cultivating sustainable art practices that resonate with both the artistic and scientific communities, ultimately contributing to a more harmonious and sustainable future.

Keywords: scoby, biomaterials, sustainable art, cosmos

INTRODUCTION

In the vast expanse of the cosmos, where art, science, and sustainability intertwine, lies an intriguing avenue of research: exploring the potential of SCOBY (Symbiotic Culture of Bacteria and Yeast) in cultivating sustainable art. This research delves into the captivating world of SCOBY and its profound implications for artistic creation in the context of the cosmos, encompassing the realms of space, art, and science. As Stephen Hawking once said, "To confine our attention to terrestrial matters would be to limit the human spirit." With this sentiment in mind, we embark on a cosmic journey to unravel the potential of SCOBY as a sustainable artistic medium. SCOBY, which stands for Symbiotic Culture of Bacteria and Yeast, is a material that grows as a result of the fermentation process in kombucha tea. It consists of a symbiotic relationship between acetobacter bacteria and yeast microorganisms. The bacteria, in particular, play a crucial role in the production of molecules and synthetic materials, such as dyes for textiles and silk from spider silk (Biofabricate, 2021).

Bacteria, fungi, and algae are living organisms often utilized in the creation of biomaterials. Bacterial-derived materials offer a flexible alternative to animal leather. The fermentation and tissue growth processes can be carried out in static or agitated cultures, with the latter involving machine agitation. It takes about four weeks for a sufficiently thick cellulose layer to form. The growth process is then halted by washing the biomaterial sheets in soapy water (Lee, 2011). Once cleaned, the sheets absorb water and need to be dried before being colored (Lee, 2011). The nutritional composition, choice of organisms, and environmental conditions significantly impact the properties of the final fabricated material, which can resemble paper, plastic, or even, with a certain thickness, mimic leather (Huang et al., 2014; Lee, 2011).

Quoting relevant sources, "Bacterial cellulose, produced by the Acetobacter xylinum strain, is an interesting natural material with unique properties and a wide range of applications" (Huang et al., 2014). Another study states, "Microbial cellulose is a promising biomaterial for tissue engineering due to its excellent mechanical properties, biocompatibility, and controllable degradation rate" (Lee, 2011). The utilization of SCOBY as a biomaterial opens up new possibilities for sustainable and versatile materials that can be applied in various fields, including textiles, biomedicine, and environmental applications. Its unique composition and growth characteristics make it an intriguing material to explore further in order to fully understand its potential and expand its applications.

Biomaterial is a term commonly used in the field of Biodesign (Lee, 2021). Biodesign itself was initially used in the biomedical field. Around 2009, Stanford University published a book titled "Biodesign - The Process of Innovating Medical Technologies," which focused on the innovation of healthcare technologies. The concept of design was first introduced in the early 2000s within the realm of medical technology innovation (Denend, 2015). This term has since been adopted in the design industry, encompassing various fields such as architecture, fashion design, visual arts, graphic design, and product design, with many design projects emerging that are not necessarily related to medical technology.

The definition and understanding of Biodesign have become widely adopted in art and design schools worldwide, covering the study of design and biology with applications in various fields, including advertising, architecture, food, and fashion (Lee, 2021). Similarly to the term biotechnology, which combines the words "biology" and "technology," Biodesign can be understood as the combination of "biology" and "design." Therefore,

it can be concluded that design is a term used to denote design that originates "from," "for," or "with" a connection to biology.

In the creation of products, design, and material are crucial factors that determine the success and usefulness of a product. Design can be interpreted as human efforts to meet needs and solve problems through planning and conceptualization processes. According to Bruce Archer in his article "Systematic Method for Designers," design can also be seen as problem-solving with clear targets (Archer, 1965). Meanwhile, according to Alexander, C. (1963) in "Notes on the Synthesis of Form," design is the most objective form of physical innovation. It can also be understood as the activity of constructing human creations (Jones, 1970)

Traditionally, the making of wayang kulit puppets in Indonesia utilizes animal skin, predominantly from cows and buffaloes. However, there is potential to explore biomaterials as alternatives to replace traditional animal skins in the production of wayang kulit puppets. Other animal skins, such as goats, sheep, and rabbits, are also viable options (Widagdo, 2018). While cow and buffalo skins are preferred by artisans due to their availability, the utilization of biomaterials presents an opportunity to address environmental concerns and promote sustainability in the art form. Exploring biomaterials as a substitute for traditional animal skins in wayang kulit production could potentially contribute to reducing the demand for animal-derived materials, supporting ethical practices, and preserving the cultural heritage of wayang kulit. The utilization of biomaterials as a substitute for cowhide in handicrafts or artwork is of significant importance, considering the environmental impact of the cattle industry.

Research conducted by the research and development team at Mycotech, a mushroom-based biomaterial manufacturer, has revealed compelling data on the potential benefits. It was found that replacing cowhide with mushroom-based biomaterial can significantly reduce environmental damage caused by the livestock industry. While it takes approximately two years for a cow to reach the stage where its hide can be utilized, mushroom-based biomaterial only requires 60 days, resulting in substantial savings in feed and water consumption, up to 77,500 liters, and a reduced carbon footprint, including methane gas emissions. Quoting from the research team at Mycotech, "The utilization of mushroom-based biomaterials can provide a more sustainable alternative to cowhide, significantly reducing resource consumption and environmental impact associated with the cattle industry.

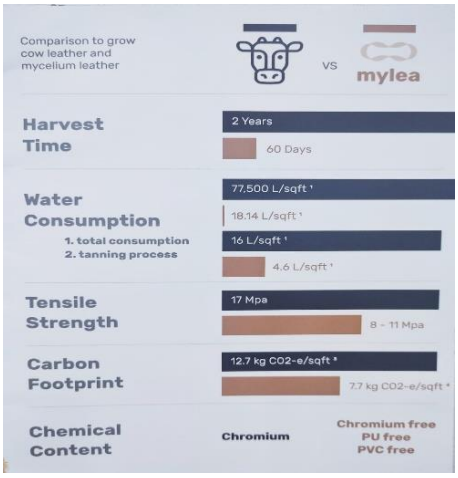

Fig.1 Graphic comparison of fungi biomaterials with cow leather (source: mycotech Catalogue 2021)

As the research team at Mycotech highlights, the utilization of these biomaterials not only offers a more environmentally friendly option but also significantly reduces resource consumption and the ecological impact associated with the cattle industry. By aligning our artistic endeavors with the cosmic forces and embracing nature's ingenuity, we aim to harmonize human creativity with the sustainable principles embedded within the very fabric of the universe. Inspired by the visionary words of Carl Sagan, who remarked, "We are made of star stuff," we recognize the interconnectedness of the universe and seek to channel its creative energy into our artistic endeavors. Janine Benyus, a prominent advocate for biomimicry, encourages us to learn from nature's wisdom and apply it to our human-made systems. In the case of SCOBY, we could embrace the teachings of Paul Stamets, a renowned mycologist, who reminds us that fungi are the architects of ecosystems, adept at decomposition, regeneration, and transformation. With this understanding, we can reimagine our approach to sustainable art, drawing inspiration from the resilient and adaptive nature of fungi.

By exploring the cosmos, guided by the wise words of Neil de Grasse Tyson, who implores us to "embrace the cosmos as our collective home," we might recognize the potential for SCOBY to transcend earthly boundaries and create art that resonates with the grandeur of the universe. Through this research, we explore how SCOBY can serve as a conduit, bridging the realms of art, science, and sustainability, inspiring us to question the possibilities that lie beyond our planet.

With the cosmos as inspiration, this research aims to unlock the transformative power of SCOBY in artistic creation. Through a multidisciplinary approach, incorporating scientific exploration, artistic expression, and sustainable principles, this research goal is to strive to cultivate a new paradigm of sustainable art in the cosmos.

Identifying and Researching the Potential of SCOBY:

One of the key challenges in this field is conducting in-depth research to understand the potential inherent in SCOBY as a sustainable art material. This entails gaining

a comprehensive understanding of SCOBY's physical, chemical, and biological properties, as well as its ability to transform into captivating and durable works of art.

In this research, several students from the Product Design program at Podomoro University are actively involved in the experimentation process conducted in the laboratory. Their work focuses on exploring and developing the potential of SCOBY as a material for creating artwork. Under the guidance of experienced researchers, these students engage in hands-on experimentation, investigating the properties, characteristics, and artistic possibilities of SCOBY.

Fig.2 Students experimenting & exploring scoby materials (Source: Dina 2022)

The students begin by conducting preliminary research to understand the fundamental principles of SCOBY and its applications in sustainable art. They delve into scientific literature, attend workshops, and collaborate with experts in the field to expand their knowledge base. Equipped with this understanding, they proceed to the experimental phase, where they explore various techniques to manipulate and transform SCOBY into artistic forms. Working closely with the research team, the students employ techniques such as molding, shaping, drying, and coloring to create unique textures, shapes, and visual effects. They experiment with different combinations of materials, pigments, and processes to enhance SCOBY's artistic potential while ensuring its sustainability and durability. Throughout this process, the students document their findings, record observations, and engage in critical discussions, allowing for continuous learning and refinement of their experimental approaches.

The involvement of these students from Podomoro University adds a dynamic element to the research, as their fresh perspectives and creative insights contribute to the exploration of SCOBY's artistic possibilities. This collaborative approach not only fosters interdisciplinary learning but also nurtures a new generation of artists and designers who prioritize sustainability and innovative materials in their creative practices.

To explore SCOBY's potential, researchers delve into its unique characteristics, such as its gelatinous texture, porous structure, and ability to adapt to different environmental conditions. Understanding SCOBY's physical properties, such as its flexibility, strength, and translucency, allows artists to experiment with various artistic techniques and forms. Furthermore, delving into the chemical composition of SCOBY enables researchers to analyze its natural pigments, texture modifiers, and potential interactions with other materials. This knowledge is crucial for artists seeking to incorporate SCOBY into their artistic practice, as it allows for the exploration of new aesthetic possibilities and the development of sustainable art techniques.

Fig.3 Exploring scoby materials textures & colors (Source: Dina 2022)

In addition to physical and chemical properties, researchers also investigate SCOBY's biological aspects, such as its growth patterns, reproduction, and response to different cultivation methods. This knowledge informs artists about SCOBY's life cycle, providing insights into its sustainable sourcing, cultivation, and potential for continuous artistic exploration. By comprehensively studying SCOBY's properties and its transformative capabilities, researchers and artists can unlock its full potential as a sustainable art material. This deep understanding paves the way for innovative applications, pushing the boundaries of artistic creation while promoting environmental consciousness and longevity in the art world.

Exploring Techniques and Methods in SCOBY Utilization:

To leverage SCOBY as an artistic medium involves the exploration of effective techniques and methods. It encompasses research on the processing, manipulation, and treatment of SCOBY to achieve desired outcomes in the art context while considering sustainability factors and the feasibility of using this material in artworks. Researchers and artists experiment with various processing techniques to enhance SCOBY's malleability, texture, and visual appeal. This includes methods such as drying, pressing, cutting, and layering SCOBY sheets to create desired shapes and forms. Additionally, artists explore ways to incorporate pigments, dyes, and natural materials into SCOBY, enabling the creation of vibrant colors and visual effects. As sustainability is a key consideration, researchers investigate environmentally friendly preservation methods and explore the potential of SCOBY as a biodegradable material in the art-making process. They explore innovative techniques to enhance SCOBY's durability, resistance to moisture, and overall longevity as an art medium.

Fig.4 Experimenting with scoby biomaterial forms & shapes
(Source: Dina 2023)

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By addressing these sustainability concerns, artists and researchers aim to extend the lifespan of SCOBY as an art medium while minimizing its environmental impact. The pursuit of innovative preservation techniques and responsible sourcing practices allows for the creation of SCOBY artworks that are not only visually captivating but also ecologically conscious, harmonizing artistry with environmental stewardship.

Expanding Understanding and Acceptance of Sustainable Art:

This challenge is related to broadening the understanding and acceptance of sustainable art that utilizes SCOBY as a medium. It involves raising awareness and providing education about the concept of sustainable art, as well as efforts to create spaces for discussion and appreciation of artworks produced from this research.

To address this challenge, researchers and artists engage in outreach activities, such as workshops, exhibitions, and public talks, to disseminate knowledge and foster dialogue about sustainable art practices. They aim to bridge the gap between artists, researchers, and the general public, promoting a deeper understanding of the environmental implications and creative potential of SCOBY-based artworks.

Researchers and artists explore strategies to prolong the lifespan of SCOBY artworks while minimizing their environmental impact. This involves developing methods for preserving SCOBY, such as proper storage techniques, controlling humidity levels, and protecting artworks from degradation.

Furthermore, artists and researchers collaborate to develop best practices for working with SCOBY, including guidelines for handling, storage, and display of SCOBY artworks. These guidelines ensure that SCOBY-based artworks maintain their integrity and sustainability throughout their lifespan. Through continuous experimentation and refinement of techniques and methods, researchers and artists aim to unlock the full potential of SCOBY as a versatile and sustainable medium for artistic expression. By developing effective techniques and approaches, they pave the way for a new wave of SCOBY-based artworks that showcase the unique aesthetic and environmental benefits of this fascinating material.

Ensuring Sustainability and Prolonging the Lifespan of SCOBY in the Context of Art:

SCOBY, as an artistic medium, in the long run, has many challenges, one of them revolves around maintaining sustainability. Questions arise regarding the care and preservation of SCOBY, extending its usability, and ensuring the alignment between ecological sustainability and the quality of the resulting artworks.

Implementing these practices, SCOBY artworks can retain their structural integrity and visual appeal over extended periods.

Fig.5. Applying scoby as materials for artwork (Source, Dina 2023)

Additionally, artists consider the ecological footprint of SCOBY-based artworks. They strive to source SCOBY sustainably, exploring alternatives such as home cultivation or collaborations with local kombucha producers. By establishing responsible sourcing practices, artists can ensure the continued availability of SCOBY as a renewable and eco-friendly art material. Furthermore, the question of balancing ecological sustainability and artistic quality arises. Artists experiment with different preservation methods and coatings to protect SCOBY artworks without compromising their visual appeal or natural qualities. They explore options for reinforcing SCOBY structures, enhancing their resistance to environmental factors, and maintaining their vibrant colors and textures over time.

Fig.6. Scoby decorating workshops to promote sustainable art to the public (Source: Dina, 2022)

Collaborations with art institutions, galleries, and cultural organizations provide platforms for showcasing SCOBY artworks and initiating conversations about sustainable art. By actively engaging with diverse audiences, researchers and artists seek to challenge traditional notions of art and promote the adoption of more sustainable and eco-conscious practices within the art community.

Fig.7. Collaborating with LIP IFI Galleries to exhibit & promote sustainable art (Source: Dina 2023)

Furthermore, educational initiatives play a vital role in nurturing appreciation and acceptance of sustainable art. By integrating sustainable art concepts into curricula and organizing educational programs, researchers and artists inspire the younger generation to embrace sustainable artistic practices and become agents of change in the art world. Through these collective efforts, the goal is to create a supportive ecosystem that fosters understanding, acceptance, and appreciation of SCOBY-based sustainable art. By encouraging dialogue, education, and exposure, the research aims to shift perspectives and ignite a broader movement toward sustainable art practices that reflect our growing awareness of environmental responsibility and artistic innovation.

SCOBY Potential for Applications in Art, Space & Science

Based on the challenges discussed earlier, SCOBY holds great potential for applications in art, space, and science, including:

Art: SCOBY offers unique artistic possibilities both on Earth and in space. Its malleability, translucency, and ability to incorporate pigments make it a versatile medium for creating visually captivating artwork. In space, SCOBY's adaptability to different environmental conditions and its potential to be grown sustainably make it an intriguing material for artistic expression. SCOBY's organic nature and sustainable sourcing align with the growing interest in eco-conscious art practices, providing artists with an innovative and environmentally friendly medium for their creations.

Space: SCOBY shows promise as a potential material for space exploration and colonization. Its biodegradable nature aligns with the principles of sustainability in long-duration space missions. SCOBY's ability to act as a nutrient-rich food source and as a natural habitat for microbial life makes it an interesting candidate for bio-regenerative life support systems in space. Furthermore, SCOBY's use in biofabrication and biomaterial engineering holds potential for the development of sustainable materials and technologies needed for future space missions.

Science: SCOBY presents exciting opportunities for scientific research and development. Its composition and growth characteristics make it an intriguing subject for studying microbial ecosystems, fermentation processes, and biomaterial production. SCOBY's unique properties can be leveraged in the development of biodegradable packaging materials, medical scaffolds, and environmental sensors. Its potential as a platform for studying microbial interactions, bioengineering, and biotechnological applications can contribute to advancements in various scientific fields.

CONCLUSION

Exploring the potential of SCOBY in art, space, and science opens up new frontiers for sustainable materials and innovative applications. Further multidisciplinary collaboration, research, and experimentation are needed to fully unlock and harness the capabilities of SCOBY, paving the way for its integration in diverse contexts, both on Earth and beyond.

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