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Sustainable Eco-Friendly Vegan Bioleather

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Abstract: *Most leather produced across the globe is made from the skins of a variety of animals like cattle, sheep, tiger, goats, snakes, fish, leopard and many others. These animals are hunted and killed specifically for their skins. Extensive rearing of livestock can cause severe environmental impacts such as deforestation, water and land overuse. The Leather industry in India accounts for around 12.9% of the world's leather production of hides/skins and handles a robust annual production of about 3 bn sq. ft. of leather. This gave us the first motivation to work on this aspect. It was decided to work and find an alternative to produce leather which can remove slaughtering of animals and is a low cost process. This project deals with the development of common used material i.e. Leather using Biomaterials like Medusomyces gisevii (Kombucha) and Gossypium (Cotton). Cotton is used as a composite material to infuse with the base material made from Kombucha scoby. This project was conducted at Research Innovation Incubation Design Laboratory without any high end biological equipment for a period of 1 year. It was observed that the composite material was less brittle and more flexible than a normal material made of only Kombucha scoby.*

Keywords: Composite, Sustainable, Eco-Friendly, Biomaterial, Kombucha, Low Cost

I. INTRODUCTION

The Leather industry in India accounts for around 12.9% of the world's leather production of hides/skins and handles a robust annual production of about 3 bn sq. ft. of leather. The drawback of manufacturing conventional leather is the need of toxic metals and chemicals as well as slaughtering of animals. Not only is the leather industry one of India's most significant sectors, but is also considered as one of the most harmful to the environment. There is a huge volume of wastewater discharged, which consists of salts, solvents and chrome tanning agents.

Kombucha leather is a type of bacterial cellulose and a sustainable film made from a byproduct of kombucha tea, which is considered as a new material for clothing, shoes, or handbags. The main component of Kombucha is SCOBY: Symbiotic Culture of Bacteria and Yeast. The paper on the "Kombucha bacterial cellulose for sustainable fashion" by Jurgita Domskiene, Florentina Sederaviciute and Judita Simonaityte (Faculty of Mechanical Engineering and Design, Kauno Technologijos Universitetas, Kaunas, Lithuania) is published in International Journal of Clothing Science and Technology - June 2019 issue. Kombucha leather solved the problem of slaughtering animals and has a zero use of toxic metals and chemicals, but there needs more improvements in terms of flexibility, elasticity, color dying and color fastness for daily use applications. This gave us the first motivation to work on this aspect. It was decided to work and find a better way to produce leather which can increase the sustainability of material in a vegan way.

There is an emerging trend within the fashion industry concerning the eco-friendliness and sustainability of the fabric production in using biomaterials with properties that can ensure commercial viability. The concept of self-grown fabric materials from natural resources such as bacterial cellulose, fungi and mycelium, has increased collaborative efforts between fashion designers and researchers to explore the applications of these natural green materials in textiles.

Through the research, the endeavour was to experiment if a composite material can be developed with Kombucha scoby for better tensile strength.

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II. MATERIALS AND METHODS

This study was carried out over a period of 1 year at Research Innovation Incubation Design Laboratory.

Table 1: Materials

Sr. No.	Item	Quantity
1	Green Tea bags	6
2	SCOBY culture	1 g
3	Sugar	10 g
4	Water	1 L
5	Vinegar	100 mL

III. METHODOLOGY

- Step 1: Brew green tea with 6 green tea bags and sugar in 1 L of water.
- Step 2: Keep it for steeping for 15 minutes.

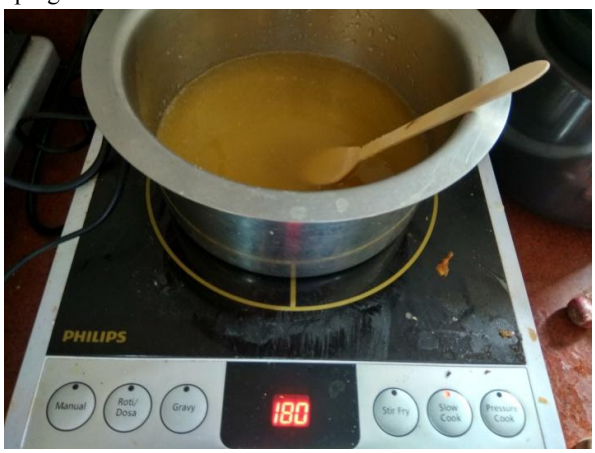

Figure 1: Brewing of Green Tea

- Step 3: Pour the mixture into a flat base container.
- Step 4: Add 100 mL vinegar into 1 L of brewed tea.
- Step 5: Add a small piece of SCOBY culture in the container.

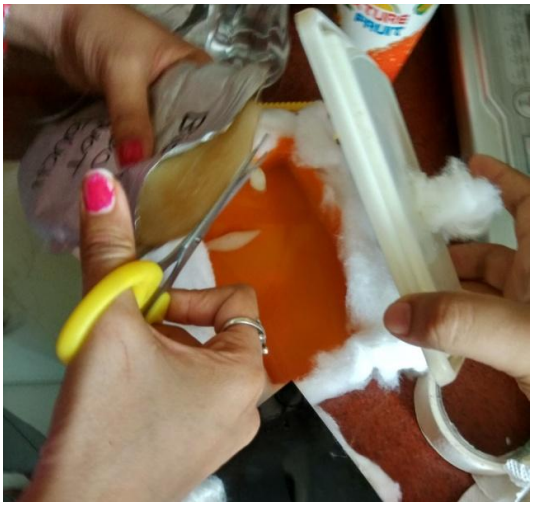

Figure 2: Adding of SCOBY in the mixture

- Step 6: Make a hole in the center of a lid and cover the container using the lid. Put cotton in the hole.

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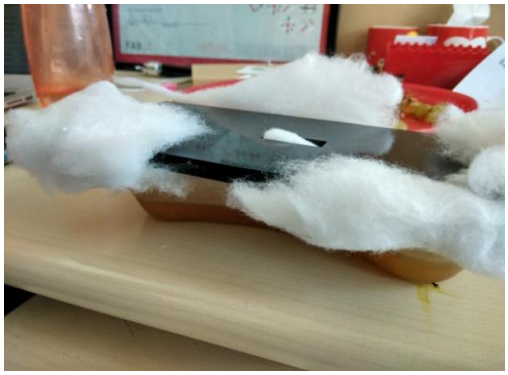

Figure 3: Covering the mixture in the container

- Step 7.1: Incubate the container for a minimum of 7 days and can be extended based on the desired thickness in a dark room.

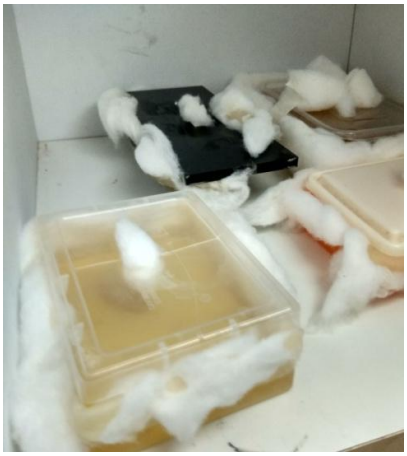

Figure 4: Storing the container in dark

- Step 7.2: If the color is to be added, it needs to be added in the tea mixture itself. The cotton fibres are to be spread after the first layer of mixture is thickened [the thickened mixture refers to a new material].
- Step 8: Once the material in the container reaches the desired thickness, it is removed from the container and washed properly and sun dried.

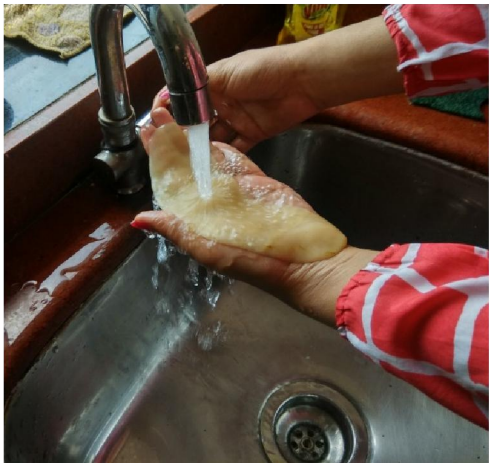

Figure 5: Washing the material

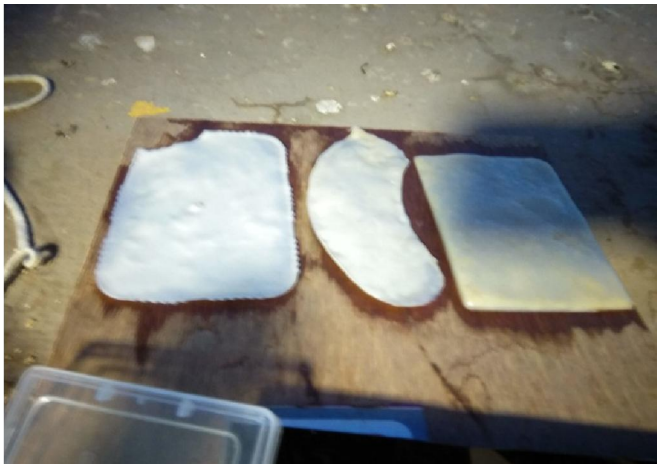

Figure 6: Sun Drying the material

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IV. Results and Discussion

On experimentation of Trial 1, we formed a brittle material as shown in Figure 7.(a) and Figure 7.(b) without the Cotton fibres.

This leather removed the process of slaughtering of animals and had zero use of toxic metals and chemicals.

But, this material is less elastic and less flexible in nature. Also, it will be affected by color dying and fastness. It needs more improvement for daily use applications.

Figure 7(a): Kombucha Leather

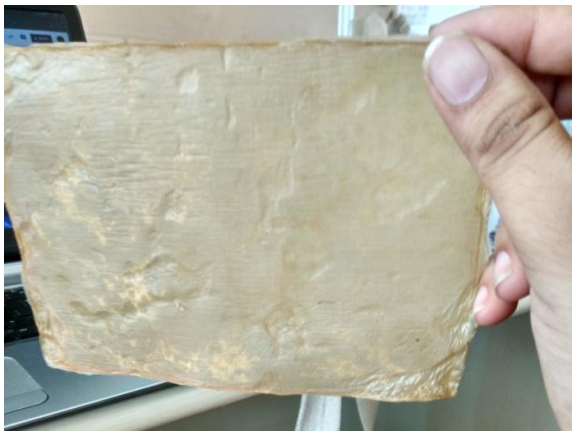

Figure 7(b): Kombucha Leather

Further, we experimented to create another set of trials, Trial 2, to produce Composite Leather. For the same, we spreaded Cotton fibres over the first layer of mixture which is thickened i.e. in the mixture of Kombucha, as Cotton has the properties of color dying and is a good absorber of color.

We also attempted to change the composition of the ingredients so the material is not brittle and is more flexible. As a result, the Cotton got integrated into the Kombucha material and we got a dark brown shaded Composite Leather as shown in Figure 8.(a) and Figure 8.(b).

Figure 8(a): Composite Leather

Figure 8(b): Composite Leather

Compared to the industry available leather, the texture as well as flexibility of the composite bioleather seems to match with the industry available leather as shown in Figure 9.(a) and Figure 9.(b).

This gives the positive insight that composite leather can be promising and can sustain a harsh environment like any other textile. The future scope includes testing of all the parameters from a certified laboratory such as flexibility and elasticity of the material, effect of water, heat, freezing, allergenic and many similar parameters to be tested. Also, adding more polishing and finishing needs for this composite leather.

One of the applications we explored was for the fashion industry where we trained designers to make Biomaterials including Kombucha leather and use it as decor on clothes to participate in India's first ever Bio Fashion Show. With the aim of maintaining a co-existence of environment and fashion, there can be a possible way into an alternative future for the apparel industry.

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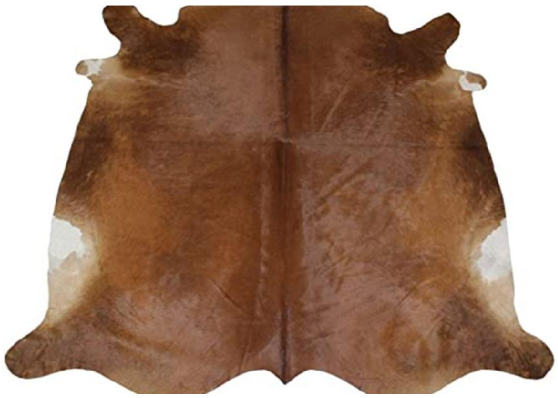

Figure 9(a) Industry available Leather

Figure 9(b) Industry available Leather

More applications can be explored using this composite kombucha leather.

Parameters	Standard Kombucha Leather	Composite Kombucha Leather
Color Fastness	Yes	No, due to addition of Cotton fibres
Flexibility	Brittle	Flexible
Thickness	Thin	Thick
Strength	More fragile	More strong
Transparency	Opaque	Translucent

Note: The parameters are not tested through certified lab tests, this is in the future scope. Currently, the parameters are observed manually and observations are articulated.

V. Conclusion

This composite leather looks very promising and can sustain a harsh environment like any other textile in the market. It can reduce the slaughtering rate of animals to a significant extent and will give a good alternate option for leather. Kombucha has set an exemplary model of a product that could match the growing needs for sustainability and green fashion. Several materials have been experimented with on an industry level to replace the conventional leather, from mycelium based materials to Kombucha based, out of which we have been focusing on Kombucha based material and its composites.

The possibility of producing flexible and color resistant material through the Kombucha composites was validated here. Though other parameters testing through lab certifications needs to be done to ensure it matches and is a better alternative to industry available leather.

Acknowledgements

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