Bacterial Cellulose Product Development: Comparing Leather and Leather Alternatives

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Background. Leather making, by simple drying and curing, has been practiced for at least 7,000 years (Britannica, 2018). Worldwide demand for leather often outstrips supply due to the widespread use of the material in shoes and upholstery (Taylor, 2018). Additionally, the processing of animal leather creates waste in several stages due to the use of liming chemicals in the de-hairing and unwanted subcutaneous layers removal procedure (Dayanandan et. al., 2003). The large demand and sustainability concerns led to the pursuit of leather alternatives. Imitation leather, a composite material made of a variety of synthetics such as polyvinyl chloride, offers affordability and availability but lacks an environmentally cleaner production process. Imitation leather also acts to pollute the environment through the use and processing of petroleum based chemicals (Taylor, 2018). Vegan leather made of bacterial cellulose (BC), on the other hand, requires very little land to grow, little water and few chemicals to process.

Product Development Process. The product development process used to guide this project was adapted from May-Plumlee & Little, 1999 and Davis & Sanders, 2014. *Market Definition and Research.* According to The Vegan Society, "veganism is a way of living which seeks to exclude, as far as is possible and practicable, all forms of exploitation of, and cruelty to, animals for food, clothing or any other purpose (The Vegan Society, 2019)." The number of global consumers who identify as vegan has grown 61% from 2014 to 2017 (Global Data, 2018). *Merchandising.* In this step, the assortment of goods was planned. A gender neutral interior piece was decided. To understand the differences in production, these pieces were made from traditional leather, imitation leather and bacterial cellulose vegan leather. *Design and Development.* The color white was decided on for all products to remove the possibility of color bias influencing judgment of the materials. Keeping in mind the properties of BC, ottomans that could be covered with the largest possible piece of grown material were sought. Using flat pattern techniques, ottoman covers were modified in order to accommodate the BC. A pure BC strain was cultivated in standard Hestrin Schramm media with mannitol to promote enhanced growth. Media was sterilized and bacteria were transferred into the containers with the media to grow for 3 weeks at 32 degrees Celsius. The mats were disinfected with a 1 % NaOH soak for 24 hours at room temperature. Then, the mats were further disinfected in a 4% glycerol, 1% germeben solution at room temperature for 24 hours. Mats were whitened with a 10% bleach and deionized water solution at room temperature for 24 hours, and then treated again with the glycerol and Germaben soak. After these treatments, all materials were rinsed and dried in an incubator at 32 degrees Celsius, stretched every other day in both directions. Products were constructed with heavyweight and polyester thread, sewn with a leather sewing needle on a domestic machine. BC was brushed with tragacanth and backed to a stabilizer with leather and suede glue.

Prototypes.

Traditional *Imitation* *Vegan* *All 3*

Development Considerations. Preliminary pricing estimates put the BC ottoman at approximately twice the price of the traditional leather ottoman and eight times that of the imitation leather. No sewing issues were noted with either the imitation leather or bacterial cellulose vegan leather, indicating that this material would be able to be sewn on a standard domestic sewing machine. However, the material suffers the same alteration limitation as the other two leathers, with a needle puncture remaining visible should a seam be removed. Uniquely beneficial, such punctures can be made significantly less noticeable if the material is rewetted, pressed and dried. The pattern for the BC covered ottoman did need to be altered in order to be smaller, with a smaller main top piece and seam allowances. The reason for this alternation being that the largest container available that could undergo the processes necessary for standard static BC growth still resulted in a main top piece smaller than an ottoman frame by approximately 1/2". As can be seen in the above photo, the BC ottoman also resulted in more texture on the surface of the material. Additionally, the interaction of the glycerol and low heat in the drying process imparted a slight tint to the material that was unable to be removed with commercial bleach.

Conclusion. The sew-ability of the BC material was comparable to imitation leather and better than traditional leather. For this reason, additional product development may explore alternatives in BC growing in order to reduce cost. However, the price to produce the vegan leather was considerably higher than that of the other leathers. Additionally, it would be difficult to produce large enough pieces of the raw material to accommodate most interior patterns using the standard cultivation method.

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