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The Skin and Textile Interaction and The Future of Fashion as Therapeutics.

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Abstract

Invisible to the naked eye, our bodies play host to millions of microorganisms. Optimal skin conditions depend on the probiotic bacteria or microbes that live on our bodies. Our skin's biome is shaped by our natural environment, and what we put on and next to our skin has a direct impact on our bodies. Cosmetic products and textile finishes on clothing can contain toxic chemicals, which disrupt the diversity of bacteria living on our skin.

'Probiotic Clothing', a collaboration with microbiologist Dr. Callewaert and design researcher Rosie Broadhead, explores the benefits of encapsulating probiotic bacteria into the fibres of clothing. The encapsulated bacteria are associated with reduced body odour, encouraging cell renewal, and improving the skin's immune system. This project not only replaces the need for chemical fabric finishes, but also reduces the need to wash your clothes as frequently. This research aims to use what is natural on our bodies to advance the performance of clothing through microbiome friendly innovation.

Keywords, *Skin Microbiome, Textiles Innovation, Probiotics, Textile Microbiome*

Probiotic Clothing, textile innovation for future fashion therapeutics.

The skin microbiome and more recently the textile microbiome has gained a lot of interest within the scientific community in the last few years. There has been a fundamental shift in our understanding of innate chemistry of the body and the role microbiome plays in shaping it. The emergence of next-generation sequencing has given unprecedented insights into the impact and involvement of microbiota in skin conditions and disease and the surface interaction with our clothing. Textiles are an integral part of our lives, and these insights into bacterial cell communities on our skin has led us to question the clothes we live in and who is living on us, and how this plays a role in our overall health. Between the skin and textile microbiome this interaction between the wearer and clothing is an opportunity for skin bacteria to attach to the textile surface, which can lead to the growth of certain strains[1]. During this process, the absorption of the wearer's sweat, sebum and bacterial metabolites to clothing can contribute to the outgrowth of certain strains [1], [2]. As our clothing is consistently in contact with the human skin; textiles are an important consideration when studying the cutaneous

environment. Thus, textiles and clothing are essential players in the potential causation and treatment of skin diseases.

The microbiome plays a key role in body odour and skin health, and antibacterial fabric finishes on clothing have been designed in an attempt to reduce these issues. In the past decades, innovation has mainly focused on broad-spectrum antimicrobial technologies. Yet, these are associated with many drawbacks, such as antibiotic resistance strains and the environmental and toxicity concerns of these chemicals [3],[4]. This research explores the incorporation of healthy skin commensal bacteria into textiles.

Here we are developing 'Probiotic Clothing', in which beneficial bacteria are incorporated into clothing textiles to prevent malodours. The skin and textile microbiome interact and the two surfaces influence pH, moisture content, odour generation and bacterial and chemical compositions. Thus, embodying the necessity for the co-habitation of human and non-human cells and how the entanglement of these ecologies can work for our benefit. 'Probiotic Clothing' explores the impact of the textile microbiome and points out the direct involvement of particular microbes on malodour development and skin disease. This research is investigating so-called "microbiome-smart" textiles, in which healthy microbes, or their enzymatic potential are applied, as such the microbiome is steered towards non-odour-causing and healthy communities.

The encapsulated healthy skin commensal bacteria are applied to be both durable on the textile, hydrophilic, and pH neutral and non-toxic. The microorganisms are activated in contact with the moisture on the skin, allowing them to dominate other less beneficial bacteria. The non-odour associated strain chosen which resides in the axillary area is applied to the garment and designed to have close contact with this area of the body. The probiotic clothing technology provides an alternative to antibacterial chemicals in clothing and cosmetics and a solution for natural odour management and disease prevention. Designing microbiome-smart textiles can be a novel and alternative way to advance the functionality of clothing and to combat odour development or potential textile-related skin conditions. To make a shift in the effects of the antibacterial ingredients and toxic cosmetics that society has encouraged, the answers may be to look more closely at the skin's living ecosystem and natural skin biome.

Figure 1, Skin II Probiotic Clothing by Rosie Broadhead and Dr Chris Callewaert. Photographed by Tom Mannion

Conclusion

Textile and the textiles microbiome are closely interlinked to the homeostasis of our skin's natural ecology, and therefore the health of the body. An increase in synthetic fibres in textile production has exasperated odour retention in textiles, microbiome disbalance and pathogenic colonisation of bacteria, which can trigger skin diseases. We have seen the rise of a wide array of antimicrobial finishes in clothes, which are not always effective and are sometimes associated with unwanted side-effects, and environmental impacts. The relationship between body odour and skin diseases, textile and the skin microbiome are an emerging field of research.

Microbiome-smart textiles can be a novel and alternative way to advance the functionality of clothing and to combat odour development, maintain skin health or avoid potential textile-related skin conditions. To make a shift from the effects of the antibacterial ingredients and toxic cosmetics that society has encouraged, the answers may be to look more closely at the skin's living ecosystem and natural skin biome. As research digs deeper into the textiles and skin interactions new developments are being established to nurture these relationships with the textile, the skin microbiome, and the body.

Biography

Rosie Broadhead is a Textile Scientist specialising in biomaterials in the fashion industry. Founder of therapeutic clothing brand Skin Series and Textile Specialist at Ghent University. Her current research focuses on the skin microbiome and probiotics therapy as a solution for antibacterial finishes in textile which utilises technology that works in synergy with the body. Rosie is a graduate of Central Saint Martins' MA 'Material Futures'; course and has a background as designer and Head of Sustainability at sportswear brand Perfect Moment and R&D at Rapha. Through her interest in the skin and clothing interaction, her research focuses on how science and technology will influence the future of fashion. More recently she has co-founded Surface Tension, a platform centred around realising the positive potential of materials.

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