Investigating physicochemical characteristics of artificial sebum for sustainable cleansing.

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Objective **:** Sebum, a complex mixture of lipids, plays a key role in protecting and lubricating the skin and hair. While sebum acts as a natural barrier against microbes and pollutants, its build-up or contamination can contribute to conditions like acne and dandruff. The aim of this work was to establish an understanding and develop new methods and knowledge about physicochemical properties of artificial sebum (AS) that underpin the cleansing technologies.
Methods **:** A novel micromanipulation method was developed and optimised for mechanical characterisation of AS thin films through scratch testing. The effect of temperature and humidity were evaluated using a combination of Differential Scanning Calorimetry (DSC) and Dynamic Vapour Sorption (DVS). Polarised Optical Microscopy (POM) allowed for evaluating polymorphism of AS.
Results **:** AS upon ageing reduced the cohesive energy from 0.3 mJ on the day of preparation to 0.04 mJ after 72 hours, which is due to the kinetic transformation of more unstable β' to β polymorph. DSC and POM analysis showed a change in crystallinity of AS upon ageing due to the change into the thermodynamically stable polymorphs. The addition of model air pollutants to AS resulted in lower mechanical strength and change in the polymorphism of AS, which made AS more solid-like at skin temperature therefore making it less likely to melt and remove. DVS analysis of polluted sebum after 24 h showed reduction in water sorption upon addition of pollutants suggesting that air pollutants affect water sorption and therefore moisturisation properties of sebum.
Conclusion **:** This work offers an in-depth understanding of the physicochemical characteristics of AS and its interactions with model air pollutants. It was established that the physicochemical properties of AS are dependent on the crystal structure of lipids, which also get affected by the addition of model air pollutants.