Structural analysis of skin (stratum corneum)

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Stratum corneum (SC) is the thin outermost layer of the skin. It protects a living body from chemical and physical stimuli. It also acts as the main barrier diffusion of water and drugs through the skin. It is very important to understand structure and function of SC for dermatological science and cosmetic technology.

We carried out measurements of SC by using of small-angle neutron scattering (SANS). We used a SANS system at SANS-U (C1-2), JRR-3 in JAEA (Tokai).
The SC was obtained from porcine skin through standard preparation methods. The dorsal skin of the pig was soaked in deionized water at 60 degrees C for 1 min. Sheets of epidermis (including the stratum corneum) were then peeled from the skin physically using a spatula. To remove the living cells, the peeled sheets were then floated epidermal side down for 30 min. at 37 degrees C on phosphate-buffered saline containing 0.5% trypsin. The sheets were then washed well with deionized water and dried. For scattering measurements, we prepared stacked-layer samples in 7mm thickness. We measured SANS of SC from the edge direction with the 5mm diameter incident neutron beam.

Fig. 1 shows SANS profiles from dry and wet SC. The dry SC sample was measured under normal room condition (temperature: 27 degrees C, humidity: 42%RH). The wet SC sample was soaked in heavy water (D2O) for more than 5 hours, and then measured in soaked condition at the same temperature.

The dry SC sample does not have deuteriums, so its scattering intensity was low. Its scattering profile was difficult to distinguish peaks in Hi-q region because of incoherent scattering. However, obscure two peaks were observed in scattering profile of dry SC where blue arrows indicate in Fig. 1. More obvious two peaks were observed in scattering profile of wet SC where red arrows indicate also in Fig. 1. The ratio of two peaks are same between dry SC sample and wet SC sample (first peak position / second peak position = ca. 2.3). Consequently, these peaks from dry and wet SC are probably due to same structure. It suggests that these peaks are the same as those which were observed in SAXS measurements, caused by intercellular structure consists of the size of lipid bilayers [1]. It was probably that swelling by D2O in wet condition made peaks clear, i.e., we could measure the SC by using " swelling-visualization " method in SANS. On the other hand, we could not observed other peaks, which have never detected in SAXS measurements, in this experiment within observable scattering scale.

Reference

[1] J. A. Bouwstra, et. al., J. Lipid Res., vol. 36, 496 (1995)

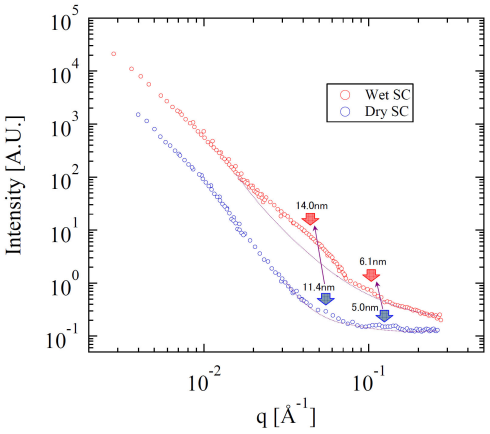

Fig. 1. Fig. 1. SANS scattering profiles from dry and wet porcine SC. Arrows indicate peaks caused by intercellular structure consists of the size of lipid bi-layers. Numbers show spatial scale of peak potions in real space.