

Ultrapure soft water reduces growth of *Staphylococcus aureus* adopted on skins of the barrier-disrupted animal model

Background: Atopic dermatitis (AD) is a common chronic inflammatory skin disease that has increased in prevalence these years. Dysfunction in the skin barrier system that has been suggested in patients with AD is one of the credible explanations for their susceptibility to cutaneous pathogens such as *Staphylococcus aureus* (*S. aureus*). We demonstrated that ultrapure soft water (UPSW) excluding both calcium (Ca^{++}) and magnesium (Mg^{++}) provided beneficial effect on dry skins in subjects with atopic dermatitis. Since mineral salts have been reported to associate with the growth of certain bacteria as nutrient and metal chelation inhibited *S. aureus* growth, we investigated whether UPSW has suppressive ability to bacterial growth on the barrier-disrupted skins.

Methods: Male hairless HR-1 mice at 6-7 weeks of age were maintained in the isolation chambers with free access to water and food. The barrier-disrupted model was made by repeated tape-stripping of dorsal skins of HR-1 mice. Transepidermal water loss (TEWL) of HR-1 mice was measured before and after tape-stripping, and mice with high TEWL (around $30 \text{ g/m}^2/\text{hr}$) were used for this study. After the barrier-disrupted mice were pre-treated with UPSW or city water for 5 minutes, *S. aureus* was applied onto affected skins. Bacteria increased on affected skins were swabbed off and numbers of collected *S. aureus* were counted.

Results: On skins of the barrier-disrupted mice, applied *S. aureus* was increased its number, on the other hand, *S. aureus* was rarely isolated on normal skins of HR-1 mice. Growth of *S. aureus* was significantly reduced on skins of UPSW-treated skins when compared to that on skins treated with city water. In *in vitro* experiments, necessity of Mg^{++} on growth of *S. aureus* was confirmed.

Conclusion: By chelation of Ca^{++} and Mg^{++} in medium, growth of *S. aureus* was reduced. Particularly, we found the importance of Mg^{++} for growth of *S. aureus*. UPSW treatment protected skins from *S. aureus* infection possibly because of the absence of metal ions that may be served as nutrient for bacteria. Use of UPSW may be useful for skin care of patients with atopic dermatitis by preventing growth of *S. aureus* on the barrier-disrupted skins.