

【Grant-in-Aid for Scientific Research(S)】
Science and Engineering (Engineering II)



**Title of Project : Creation of Transdermal Drug Delivery Systems
Using Solid-in-oil Nano-dispersion Technique**

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Research Area : Process engineering, Biochemical engineering

Keyword : Drug delivery system(DDS)

【Purpose and Background of the Research】

Transcutaneous immunization is a novel vaccination strategy that delivers the vaccine antigens onto the intact skin topically to induce protective immune responses. Needle-free vaccination approach has a global priority due to the risk-reduction of needle prone accidents or diseases associated with the re-use or improper disposal of needles, and the injection-related pain or angst. Since a transcutaneous vaccination is a simple and non-invasive procedure, it provides a viable, easy and cost-effective strategy for disease prevention not only in the developed countries but also in the developing countries. Therefore, transcutaneous immunization might be the best-accepted vaccination method by all patients. In this study, we challenge to apply the S/O nanodispersion to transcutaneous immunization in order to enhance the penetration of antigenic proteins and increase the antigen-specific and robust immune responses.

【Research Methods】

Figure 1 shows the transdermal immunization mechanism in this study. There are three important steps to construct an effective immunization system.

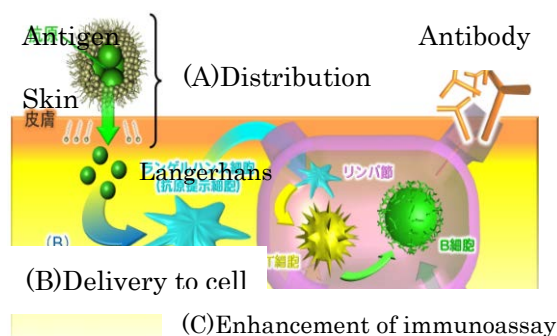


Figure 1 Immunization mechanism in this study

- (1) Distribution of antigen to the skin (A)
- (2) Transfer of antigen to Langerhans cells (B)
- (3) Enhancement of immune assay (C)

The surfactant-protein complexes in which proteins are coated with hydrophobic surfactant

molecules can be dispersed in an oil of interest, and the dispersion of the surfactant-protein complex in the oil phase as a nano-order particle makes the proteins permeable into the skin without any physical enhancements or pre-treatments if a suitable oil with the properties of a chemical penetration enhancer is selected. An adjuvant also will be effective for enhancing the immunization in the step (3).

【Expected Research Achievements and Scientific Significance】

The transcutaneous immunization by S/O nanodispersion is able to enhance the antigen-specific antibody creation without any destruction or removal of the surface of skin. The vaccine formulation comprises the safe-to-use materials such as the edible sugar ester surfactant and penetration enhancer oil. These findings indicate that this oil-based unique transcutaneous approach has a great promise for effective vaccination or immunotherapy in the near future. It will contribute the paradigm shift from medical care to prevention.

【Publications Relevant to the Project】

- Y. Tahara, K. Namatsu, N. Kamiya, S. Kamiya, M. Arakawa, M. Goto, "Transcutaneous immunization by a solid-in-oil nanodispersion", *Chem. Comm.* 46. 1452-1454 (2010).
- Y. Tahara, S. Honda, N. Kamiya, M Goto, "A solid-in-oil nanodispersion for transcutaneous protein delivery", *J. Control. Release*, 131, 14-18 (2008).

【Term of Project】 FY2012-2016

【Budget Allocation】 138,400 Thousand Yen

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