

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



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 into 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 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 advanced 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 our S/O nano dispersion technique 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.

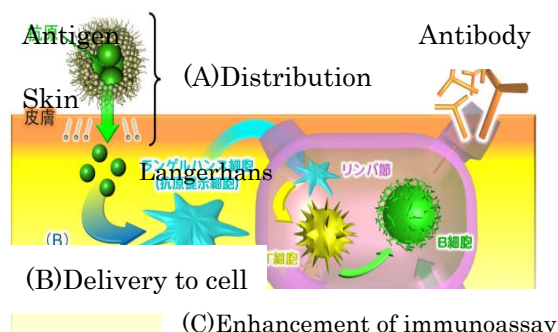


Figure 1 Immunization mechanism in this study

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

The surfactant-antigen complexes in which

antigen proteins are coated with hydrophobic surfactant molecules can be dispersed in an oil of interest, and the nanodispersion 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). In this study, we are focused on the development of transcutaneous cancer and pollen vaccines using S/O technology.

【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 transcutaneous approach has a great promise for constructing effective vaccination or immunotherapy. It will contribute the paradigm shift from medical care to prevention.

【Publications Relevant to the Project】

- Y. Hirakawa, R. Wakabayashi, A. Naritomi, N. Kamiya, M. Goto, 'Transcutaneous immunization against cancer using solid-in-oil nanodispersions' *Med. Chem. Commun.*, 6, 1387-1392 (2015).
- M. Kitaoka, N. Kamiya, M. Goto 'Transdermal Immunization using Solid-in-oil Nanodispersion with CpG Oligodeoxynucleotide Adjuvants', *Pharm. Res.*, 32(4), 1486-1492 (2015).

【Term of Project】 FY2016-2020

【Budget Allocation】 128,500 Thousand Yen

【Homepage Address and Other Contact Information】

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