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Popular Article

Insights into the role and applications of mucosal adjuvants

Yashpal Singh¹, Ankur Adhikari², Anjani Saxena³, Mumtesh Kumar Saxena¹

¹Department of Animal Genetics and Breeding, College of Veterinary and Animal Sciences

²Department of Biochemistry, College of Basic Sciences and Humanities

³Department of Veterinary Pharmacology & Toxicology, College of Veterinary & Animal Sciences
G.B. Pant University of Agriculture and Technology, Pantnagar, Uttarakhand, India

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Abstract

A majority of pathogens admit in the body through the mucosal surfaces. Mucosal vaccination is considered as an efficient and emerging strategy against mucosal infections. There are numerous merits of mucosal vaccination in comparison to the other routes of vaccination such as cost-effective, ease of immunization and low risk of spreading of other blood related diseases. Despite of several advantages, very small number of mucosal vaccines have been developed utilizing whole microbes and permitted for use in human beings. Researchers have reported that antigens need a safe and efficient molecule (adjuvants) for enhancing the immune response and may facilitate safe vaccine delivery. Adjuvants are significant part of vaccines, which play an important role in enhancing and inducing strong immune response. Hence in this article, we have made an effort to throw a light upon the current insights into the novel adjuvants for effective, safe and efficient production of mucosal vaccines.

Keywords: Mucosal adjuvants, Mucosal vaccines, Immune response

Introduction

Mucosal adjuvants are generally classified into two categories: vaccine carriers and immunomodulatory molecules. Adjuvants like chitosan can act as delivery vehicle as well as immune-boosters. Many studies have reported that mucosal adjuvants have potential to produce an effective Th1 and Th2 immune response against infections (Lycke *et al.*, 2012; Nedrud *et al.*, 2013). In addition, some of the mucosal adjuvants have a significant role in defense mechanism against

various infections (Gallichan *et al.*, 2001; McCluskie *et al.*, 1998). These adjuvants are strong enhancers of immunity against different tumors (Ko *et al.*, 2005). Adjuvants derived from bacterial enterotoxins and Toll-like receptor (TLR) ligands are very effective and safe for mucosal vaccines production (Nedrud *et al.*, 2013). The conventional vaccines are less effective and produce poor immune response against mucosal infectious diseases such as tuberculosis, AIDS, ulcers, pneumonia and sexually transmitted diseases, which are the major causes of illness among humans and are also an important economic public health concern and burden in many developing as well as some developed countries. On the other hand, mucosal vaccines have potential to produce both mucosal as well as systemic immune response. The development of mucosal vaccines is a very complicated task as the antigen is having less immunogenicity and may also cause serious adverse effects in some cases. Therefore, novel, strong and safe mucosal adjuvants are the need of the hour for the development of effective and safe mucosal vaccines.

Assessment of the safety of mucosal adjuvants

Extensive research is required to confirm the safety of mucosal adjuvants. Till date the use of mucosal adjuvants in human and animal vaccines is uncertain. Though many researchers are focusing on the safety evaluation of mucosal adjuvants. Presently, the non-availability of standardized assessment methods, no authentic assessment strategy and lack of specific delivery routes are the major aspects responsible for the safety of these adjuvants. The evaluation of safety of mucosal adjuvants on animal system is the most prevalent methodology. Although a mucosal adjuvant is confirmed safe in an evaluation model further, it has to be tested again for the safety in different assessment model. Therefore, there is an emergent requirement of effective safety assessment strategies of mucosal adjuvants.

Role of mucosal adjuvants

The potential of mucosal adjuvants to enhance the immunogenicity of the vaccine antigens is considered very important for successful mucosal vaccination (Neutra *et al.*, 2006). Several adjuvants have been utilized as enhancers in different mucosal vaccines (Srivastava *et al.*, 2015). Studies have reported that chitosan may be used as effective mucosal adjuvants as they are relatively safe and effective immunostimulants (van der Lubben *et al.*, 2001). The effective targeting capacity of mucosal adjuvants is important for proficient mucosal vaccination. Many mucosal adjuvants have been recognized by researchers but very few have been reported safe for application in human



vaccines. The safety and efficacy of mucosal adjuvants are correlated, which indicates that effective adjuvants with non-toxic nature are very hard to develop. The storage of mucosal adjuvants relies on the cold chain system, making it a complicated task in developing nations. The application of adjuvants in vaccine is a critical step. The improper mixture ratio of adjuvants and vaccine may lead to worthless and unproductive effects. Hence the interaction of adjuvants with antigen should also be considered along with the nature and properties of the selected adjuvant. It is a major assignment for the researchers to understand and reveal the mechanism of action of mucosal adjuvants in order to achieve effective immune response with mucosal vaccines.

Conclusion and Future Perspectives

Presently, the recent COVID 19 pandemic has revolutionized the field of vaccines. The extensive research in vaccine development for deadly viral infections has produced effective mucosal mRNA vaccines. There are vital advantages of using mucosal vaccines as they trigger the immunity through lymphocytes (CD4⁺ and CD8⁺ T cells). Though a breakthrough is not yet achieved in developing an injectable mucosal vaccine comprised of mucosal adjuvants but it is likely to be produced in the upcoming future along with the better understanding of antigen-adjuvant interactions as well as novel mucosal vaccines development.

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