-A REVIEW

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Alum as an adjuvant for human vaccination

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In field of vaccination, to get better immune response, alum is the sole adjuvant approved for human vaccination. Alum is able to induce a good antibody (Th2) response, but it is not effective to stimulate cellular (Th1) immune response, which is so important for protection against many pathogens. Although alum has been used extensively in vaccines for over 70 years, the exact mechanism by which they enhance immune response have not been fully elucidated, which is important for better knowledge of the adjuvants and immune response. In addition alum has the potential to cause severe local and systemic side-effects including sterile abscesses, redness, sub-cutaneous nodules, and some allergic responses, although fortunately most of the more serious side-effects are relatively rare. There is also community concern regarding the possible role of aluminium in neurodegenerative disease such as Alzheimer's disease. This paper reviews the importance of alum adjuvant in human vaccination, explores future directions of adjuvants development and examines some of the impediments and barriers to development and registration of new human adjuvants.

Key words : Alum, Human vaccination

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INTRODUCTION

Adjuvant is derived from latin word adjuvare means to aid. Adjuvant added to vaccine to stimulate the immune system is response to the target antigen but do not in themselves improve the immunity (Gupta and Siber, 1995; Kenney and Edelman, 2004). Aluminium based mineral salts (alum) are the most widely used adjuvants for human vaccination.

The use of adjuvant first introduced by Ramon in 1925, who demonstrated that immune responses of diphtheria and tetanus toxoid could be enhanced by injection of other compounds such as agar, tapioca, lecithin, starch oil, saponin, and bread crumbs (Brewer *et al.*, 1996). The selection of appropriate adjuvant has to be made based on the type of immune response desired or that is necessary for providing protection.

Alum adjuvant:

Alum is a salt with the combination of an alkali metal such as sodium, pottasium, ammonium and a trivalent metal such as aluminium, iron and chromium. Alum can be used in the form of potash alum, soda alum, ammonium alum, chrome alum, selanate containing alum, aluminium sulphate alum, in which potassium aluminium sulphate or potash alum, hydrated potassium aluminium sulphate with the formula KAI $(SO_4)_2$.12H₂O is the most common form that has been used in food processing also.

Alum was first introduced as an adjuvant in 1926 and continues to be the only FDA approved adjuvant for routine human vaccination in US (Ulanova *et al.*, 2010). It has been used widely and proven effective for enhancing humoral immune responses. Alum is a weak adjuvant for mediating cellular immunity and is associated with generating the production of immunoglobulin E associated with allergic reactions (Brewer *et al.*, 1999; Gupta, 1998; Schyms, 2000).

Adjuvant and adaptive immune response:

Adjuvants are essential for enhancing and directing the adaptive immune response to vaccine antigens. This response is mediated by two main types of lymphocyte and T cells. Upon activation by cytokines, B cells differentiate in to memory B cells (long-lived antigen-specific B cells) or plasma B cells (effector B cells that secrete large quantities of antibodies). Most antigens activate B cells using activated T helper cells