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Bacterial Ghost: A Novel Vaccine Delivery System in Aquaculture

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INTRODUCTION

The most commonly used aquaculture vaccines are killed microorganisms, inactivated either by heat, irradiation or chemical treatment. Unfortunately, during this inactivation process most of the essential structural components of the bacterial cell wall are denatured, resulting in impaired function and non-efficient immune response [1]. The application of new strategies to develop vaccine is essential in modern aquaculture systems. The bacterial ghost system is a novel vaccine delivery system endowed with adjuvant properties. Bacterial ghost (BG) are non-living gram negative bacterial cell envelope devoid of cytoplasmic contents while maintaining their cellular morphology and the native surface antigenic structures including bio adhesive properties. Extended recombinant ghost systems are needed to develop alternative platform technologies which in the end create better qualities of combination vaccines [2].The extended recombinant ghost system is currently evaluated to combining as many as possible candidate vaccines which are stable without the requirement of a cold chain and do not need any adjuvant. In the end, the vaccine candidates should be easily administered and should be effective early in life [1].

USE IN DISEASE MANAGEMENT

Aquaculture has been growing inimportance, in particular fish farming and has experienced an industrial boom due to an increased demand for marine food in the nutrition market. The majority of industrial food animal, including fish, suffer from physical stress because of their growth in environment which is usually over crowded. These stress full conditions make them more prone to bacterial infections such as Edwardseilosis and vibrosis, which in most cases result in massive economic losses. Continuous treatment of these diseases with antibiotics leads to the development of antibiotic resistance bacterial strains. Recently there has been a growing concern among end consumers regarding drug residues in the meat of industrial farm animal including fish [3].

USE FOR IMMUNIZATION

*E. trada*is a Gram negative bacterium causing Edwardseilosis in both fresh and marine fish (e.g. cat fish, tilapia and Chinook salmon). This disease is characterized by septicemia with extensive skin lesion and leads to massive economic losses. So far, there is no effective vaccine available against this disease owing to the wide range of *E.trada* serotypes [4]. BGs prepared from *E. trada*re present a novel potential system for the design.

Intraperitoneal immunization of tilapia fish (*Oreochromis mosambicus*) with *E.trada* BGs provided a higher degree of protection against Edwardseilosis compared with the group injected with formalin killed *E.trada*[47]. Furthermore, *E.trada* BGs administered orally to Olive flounder (*Paralichthysolivaceus*) proved to be an ideal vaccine candidate eliciting both systemic and mucosal immune responses. Moreover, both studies confirmed that immunization with BGs is simple and less stressful to vaccinate fish of any size [5-7].

Recently BG from another fish pathogen, *V.anguilarum*, was produced for the future animal studiesto counter the most serious fish disease named Vibrosis [8] Furthermore, the BG system has been used to design a novel type of attenuated fish vaccine by combining live- attenuated *V.anguilarm*. This was successfully used to induce cross protective immunity against Vibrio pathogens through the use of BG technology.

BGs AS ADJUVANT

BGs production process does not denature the bacterial envelop or surface protein and preserve pathogen- associated molecular patterns (PAMPs) [9]. These PAMPs induces the generation of cellular and humoral response in an experimental animal [10].The fusion of antigen to BGs through recombinant technology helps in delivery of antigen to target system [11]. This fusion of antigen to membrane (BGs) did not affect the proper folding of enzymes. Hence, the Bacterial ghost is a novel vaccine delivery system and it provides excellent natural intrinsic adjuvant properties with versatile carrier functions for foreign antigens.

BGs AS ANTIGEN DELIVERY VEHICLES

In this novel approach, the attenuated bacteria carrying an in vivo inducible lysis*gene E* will be administered orally to the target fish population; this will lead to the production of BGs from attenuated bacteria in vivo. This new vaccine system provides two major benefits. First the BG technology applied to the selected attenuated pathogen will guarantee no reversal to the native pathogenic form and second the target expression of foreign recombinant antigens in the cytoplasm or their incorporation in to the membrane of the host pathogen selected for immunization might serve as a multivalent vaccine and stimulate immune responses against both delivered antigen and the pathogen. These results indicate the future exploitable potential of the novel vaccination system combining the features of the BG technology and live bacterial vectors [3].

CONCLUSION

Although the exponential rate of discovery of new antigens and DNA vaccines resulting from modern molecular biology, the lack of effective delivery technology is a major limiting factor in their application. Bacterial ghosts are very worthwhile non-living carriers as they can carry foreign antigens, nucleic acid and drugs in one or more cellular locations. Their ease of production and the fact that they can be stored and processed without the need for refrigeration and their outstanding safety profile-even when administered at high doses-are important consideration for a broad spectrum of application. The identical surface receptors of the bacterial ghost and their living counterparts are being exploited for specific cellular and tissue targeting.BG also delivers natural adjuvant property, easy manufacturing, low production costs, and excellent safety profile. Hence, it is a auspicious technology for the development of more efficient vaccine in aquaculture practices.

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