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Carmen W.E. Embregts, Maria Forlenza

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Oral vaccination of fish: successes, challenges and future perspectives

Carmen W.E. Embregts and Maria Forlenza*

Cell Biology and Immunology Group, Department of Animal Sciences, Wageningen University, Wageningen, The Netherlands

*Address correspondence to Maria Forlenza: maria.forlenza@wur.nl

Abstract

The limited number of oral vaccines currently approved for use in humans and veterinary species clearly illustrates that development of efficacious and safe oral vaccines has been a challenge not only for fish immunologists. The insufficient efficacy of oral vaccines is partly due to antigen breakdown in the harsh gastric environment, but also to the high tolerogenic gut environment and to inadequate vaccine design. In this review we discuss current approaches used to develop oral vaccines for mass vaccination of farmed fish species. Furthermore, using various examples from the human and veterinary vaccine development, we propose additional approaches to fish vaccine design also considering recent advances in fish mucosal immunology and novel molecular tools. Finally, we discuss the pros and cons of using the zebrafish as a pre-screening animal model to potentially speed up vaccine design and testing for aquaculture fish species.

Keywords:Live vaccines; adenoviruses; encapsulation; M-like cells; adjuvants; zebrafish

Abbreviations: TLR: Toll-like receptor, NLR: NOD-like receptor, RLR: RIG-like receptor

Highlights

- The current status on fish oral vaccine development is summarized and discussed
- Approaches using novel live vaccine vehicles are discussed
- Targeting of M-like cells or antigen presenting cells in the gut is discussed
- The use and selection of strong mucosal adjuvants is discussed
- The zebrafish as pre-screening animal model for aquaculture species is discussed

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