Precision Vaccinology Technical Paper

Cambridge Technologies

Key Points:

1. Precision Vaccinology is the combination of Next Generation Diagnostics and state of the art manufacturing.
2. Emerging and changing pathogens require precise diagnostics to ensure vaccines attack new disease challenges.
3. Next Generation Sequencing allows diagnosticians to identify all known and unknown pathogens in a sample, and to characterize and compare isolates for use in a vaccine.
4. Virulence factors, selection of the proper adjuvant and route of administration are all key considerations for developing an autogenous vaccine[5].

Introduction

Precision Vaccinology™ at Cambridge Technologies, combines next generation diagnostics with state of the art manufacturing to create a herd specific, custom vaccine to help veterinarians prevent disease and possibly reduce dependence on antibiotics for bacterial pathogens. Since manufacturing and use of custom vaccines, also known as autogenous vaccines, was allowed with the 1985 amendments to the Virus-Serum-Toxin Act, manufacturers have continued to raise the bar in the areas of diagnostics and vaccine development, building vaccines that are increasingly targeted while maintaining required levels of safety. Precision Vaccinology™ focuses on continuous improvement in herd health by seeking solutions for ongoing and emerging disease challenges.

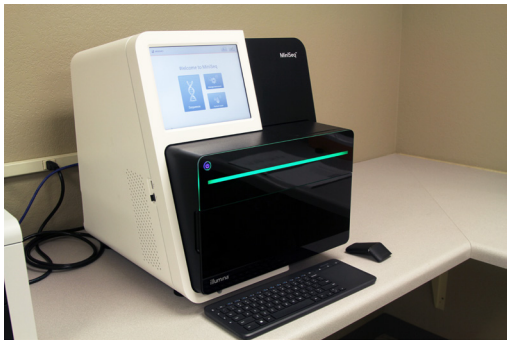
The Role of Autogeneous Vaccines

The AVMA encourages veterinarians using autogenous biologics to apply "sound scientific principles and good veterinary practice" when faced with situations where the autogenous vaccine is the only answer to a challenge or when the commercial vaccine is not effective[2]. For example, diseases caused by *mycoplasma hyosynoviae* in swine, and Influenza D virus in cattle, do not currently have a commercial vaccine available. Bovine Respiratory Disease can evolve from a myriad of pathogenic causes, some of which only a custom vaccine can be built to meet the exact challenge affecting a herd.

Due to the lengthy process involved in developing and licensing a commercial

vaccine, many of those products are built from master seeds that eventually become outdated. For example, Afghah, et al., reported that while commercial vaccines against Porcine Circovirus Type 2 have been effective in reducing clinical signs and improving production, the emergence of new viral variants has continued to increase[1].

Cambridge Technologies' custom vaccines are the result of innovative technology backed by years of experience. These vaccines are based on next generation diagnostic techniques in order to formulate products that are precisely targeted against identified disease pathogens. Precision Vaccinology™ encompasses both diagnostics and manufacturing to provide veterinarians the solutions they need to win against disease.



Diagnostic Technique

The first step in Precision Vaccinology ™ is analyzing a sample in order to identify the disease causing agents present. Next Generation Sequencing technologies such as Metagenomics now allow diagnosticians and researchers to study host-pathogen interactions at a genomic, transcriptomic, or proteomic

level[9]. Metagenomic technology can potentially identify and fully sequence all pathogens present in a sample including novel or emerging viruses or variants. If needed, qPCR can be used to quantify the identified viruses.

"Isolates" are the keystone of autogenous vaccine formulation at Cambridge. A pure bacterial or viral sample must be isolated, and then evaluated for virulence factors. Viruses are commonly isolated via cell culture and bacteria are commonly isolated on agar plates. Innovative techniques such as the use of cocultured cells enable diagnosticians to perform isolation of certain viruses within a 24-hour time frame[4]. Evaluation for and of virulence factors is necessary as potential selection criteria for final choice of isolates used in the vaccine. For example, the many infectious Salmonella strains with differences in vital virulence factors present a challenge in building a cross-protective vaccine[3]. In Precision Vaccinology™, Cambridge Technologies uses a Next Generation Sequencing technique known as Multi Locus Sequence Typing to characterize and compare isolates from a herd to select those with known antigenic or virulence factors.

Vaccine Formulation and Development

In order to work correctly, a vaccine needs to induce an effective immune response that can recognize the intended pathogen and act against it[5]. One key component of Precision Vaccinology™ is the expression of virulence and pathogenic factors during the manufacturing process.

Toxins, proteins, etc., that have been identified as being part of the selected isolate would potentially be ideal to include in an inactivated vaccine in an attempt to selectively target the pathogen[6]. By developing an immune response to key virulence factors via vaccination, the pathogen can be rendered innocuous[5].

Precision Vaccinology™ also considers the adjuvant and route of administration to generate the best immune outcome. Certain adjuvants can enhance the immune response and/or aid in the administration of the antigen. There are multiple options to choose from when deciding on a route of administration, and often they can be chosen based on the preference of the particular farm that the product is being manufactured for. Custom vaccines can be developed for intranasal, intramuscular, intraperitoneally, or subcutaneous administration. Each route has unique advantages and drawbacks, and the relevant localized immune responses can be selectively enhanced based on the selected administration method[5]. Cambridge Technologies technical staff works with the herd veterinarian to select the most appropriate adjuvant and route of administration.

Additionally for bovine, Cambridge can provide a SoliDose® implantable custom vaccine that delivers 2 doses of vaccine in one implant, utilizing proprietary immediate release and prolonged release pellets.

Conclusion

Precision Vaccinology™ raises the bar in the creation of herd specific, custom vaccines. These vaccines are constantly evolving in terms of diagnostics/isolate selection, method and timing of administration, and flexibility. As new challenges evolve and new strains of known diseases are discovered, custom products continue to grow in importance. Backed by science and based on veterinary experience in the field, the next generation of custom vaccines is here and Cambridge Technologies is here to provide them to veterinarians and producers with a fast, flexible and uncomplicated process.

SOURCES

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