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CONTRIBUTIONS OF IVRI IN VETERINARY VACCINE DEVELOPMENT AND DISEASE ERADICATION IN INDIA

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ABSTRACT

Indian Veterinary Research Institute (IVRI) has made immense contributions to veterinary vaccine development in India. IVRI has made indigenous vaccines at an affordable cost, which are highly efficacious under field conditions and has reduced the disease incidence in India. Further, the veterinary indigenous vaccines developed by IVRI have also substantially reduced the import burden of overseas vaccines and have contributed immensely to the national exchequer. Moreover, IVRI has played a pivotal role in the eradication of nefarious diseases such as Rinderpest and Contagious Bovine Pleuropneumonia (CBPP).

KEYWORDS: Disease eradication, Livestock health management,Veterinary vaccines

CONTRIBUTION OF IVRI IN VETERINARY VACCINE PRODUCTION IN INDIA

1. IMPROVED BOVINE BRUCELLOSIS VACCINE

The deletion of the perosamine synthetase gene (per gene) from the conventional Brucella vaccine, S19 led to the development of *Brucella abortus* S19 Δper vaccine by IVRI scientists. This improved vaccine is highly stable, possesses DIVA capability and provides protection levels similar to S19. By deleting the perosamine synthetase gene, which is integral for LPS biosynthesis and replaced this gene with a kanamycin marker in the S19 backbone, the improved version of the bovine brucellosis vaccine was created.

2. LUMPY SKIN DISEASE (LSD) VACCINE

LSD Vaccine (Lumpi-provac Ind) provides absolute protection against virulent LSDV challenge. LSDV virus formulated in the vaccine was first isolated from LSD infected cattle from Ranchi in 2019. The vero cell line-based LSDV virus attenuated by 50 passages was used as a vaccine. A single dose of the LSD vaccine comprises of $10^{3.5}$ $TCID_{50}$ of live-attenuated LSD virus (LSDV/2019/India/Ranchi).

3. CLASSICAL SWINE FEVER VACCINE

An indigenous live attenuated CSF Cell Culture Vaccine has been developed using an Indian field isolate. The most remarkable feature of this vaccine is its very high titre ($1x10^{9.5}$ $TCID_{50}$/ml). Due to its high titre, a large multitude of vaccine doses (approximately 6 million) can be comfortably produced from only one 75 cm^2 tissue culture flask. The annual requirement of India (22 million doses) can be prepared in just four 75cm^2 tissue culture flasks. This is the most frugal CSF cell culture vaccine available at less than Rs 2/- per dose.

4. INFECTIOUS BURSAL DISEASE SUBVIRAL PARTICLE-BASED VACCINE

SVP-Gumboro Vac is a subviral particle-based IBD vaccine. This recombinant vaccine intended for use against IBD consists of IBDV major capsid protein VP2 expressed in yeast. This sub-viral particle-based vaccine protects day-old broiler chicks in the presence of maternal antibodies. Moreover, this vaccine does not cause immunosuppression, as has been demonstrated by an intact histological architecture of the Bursa of Fabricius in immunized birds.

5. INDIGENOUS PPR VACCINE

PPR vaccine (PPRV/Sungri/96 strain), a Vero cell-based live-attenuated vaccine, was developed at ICAR-IVRI in 2002 and has a shelf-life of 1 year at 4°C in the freeze-dried form. The recommended dose of PPR vaccine is 1.0 ml (containing $10^{2.5}$ $TCID_{50}$ per animal inoculated by subcutaneous route at the mid-neck region. This vaccine technology has been transferred to Hester Biosciences Ltd, Indian Immunologicals Ltd., and Brilliant Bio Pharma Pvt. Ltd and Biomed Pvt. Ltd. Two hundred million doses of PPR vaccine have been produced by the companies after acquiring this technology from ICAR-IVRI.

6. LIVE ATTENUATED VERO CELL-ADAPTED GOATPOX VACCINE

A live attenuated goatpox vaccine, indigenously developed by IVRI, is presently used in the goat population for the immunization against goatpox virus, an egregious viral pathogen of caprines. This vaccine has huge commercial potential for control and possible eradication of goatpox in the endemic regions, which include not only India but countries in Central Asia, the Middle East, Northern and Central Africa. Extensive use of this vaccine will notably reduce the disease incidence, contributing to the augmented small ruminant productivity.

7. LIVE ATTENUATED VERO CELL-ADAPTED SHEEPPOX VACCINE (SPPV)

The exotic RF vaccine strain available presently for preventive vaccination in the Indian sheep population has been replaced by the indigenous sheeppox virus strain [SPPV Srin 38/00] developed by IVRI. This vaccine has been adapted to grow in the Vero cell line.

8. LIVE ATTENUATED VERO CELL-ADAPTED BUFFALO POX VACCINE

A live-attenuated vero cell adapted Buffalopox vaccine has been developed using an indigenous Vij96 strain isolate by 50 passages in Vero cell lines for the control of buffalopox. This vaccine is highly efficacious in the control of buffalo pox infection in endemic areas of India. The indigenous Vij96 strain-based buffalo pox vaccine has been assessed both in-house and at field conditions.

9. INACTIVATED VERO CELL-BASED JAPANESE ENCEPHALITIS VACCINE

The indigenous inactivated vero cell culture-adapted Japanese encephalitis vaccine derived from an Indian JEV isolate (JEV/SW/IVRI/395A/2014) is expected to protect the pigs from the JEV prevalent region in India.

10. LIVE ATTENUATED DUCK PLAGUE VACCINE

A live attenuated cell culture-based duck plague vaccine has been formulated by attenuating an Indian DPV isolate (DPvac/IVRI-19) in Chicken embryo fibroblast

cell culture. The titre of the duck plague vaccine virus is $10^{7.5}$ $TCID_{50}$/ml, and approximately 1.5 lakh doses can be produced utilizing one 75 cm^2 culture flask, which is compliant for industrial-scale mass production as it is cheap and economical.

CONTRIBUTION OF IVRI IN RINDERPEST ERADICATION

The Imperial Bacteriological Laboratory (IBL) was shifted from Pune to Mukteswar in 1893 with Rinderpest as the primary target for its research efforts. Anti-RP serum was developed in 1899 at IVRI, Mukteswar, and this serum was utilized for passive immunization against Rinderpest. J.T. Edward (Director at IBL, Mukteswar) developed the Goat attenuated Rinderpest vaccine by serial passages (600 times) in goats in 1927, and this vaccine provided long-lasting immunity against rinderpest in cattle & buffaloes without any side effects. This Goat Tissue-adapted Virus (GTV) caprinized vaccine conferred life-long immunity to Rinderpest. The GTV vaccine developed by J.T. Edward at IVRI, Mukteswar, was the first vaccine for Rinderpest for the whole world. In 1967, IVRI started the production & supply of Tissue Culture Rinderpest (TCRP) vaccine. The Unveiling of the commemorative “Global Rinderpest Eradication Memorial” at IVRI, Mukteswar, took place in 2012.

CONTRIBUTION OF IVRI IN CBPP ERADICATION IN INDIA

T1/44, a Tanzanian strain which was egg-passaged 44 times, was sufficiently attenuated to protect cattle without post-vaccinal severe reactions was extensively employed to eradicate CBPP in India. To obtain provisional freedom from CBPP decreed by the WOAH, a program was undertaken in 2001 by DAHD in collaboration with IVRI & Department of Veterinary and Animal Husbandry, Government of Assam. Cattle sera and tissue samples were tested for both the antibodies and the bacterial pathogen, which was done together by Mycoplasma Laboratory, IVRI, Izatnagar and by the CBPP laboratory, Khanapara. India was declared provisionally free from the CBPP in October 2003, as no CBPP cases were detected during this investigation. As per OIE resolution number 17, the WOAH declared India free from CBPP infection on 26 May 2007.

CONCLUSION

The significant contributions of IVRI to veterinary vaccine development and disease eradication have made intensive livestock and poultry production possible in India. The combined PPR-Goatpox vaccine in caprines and PPR-Sheeppox vaccine in ovines launched by IVRI is expected to increase the profitability of small ruminant husbandry. Further, IVRI is expected to play a pivotal role in the eradication of nefarious diseases such as Peste des Petits Ruminants (PPR) in line with the ambitious PPR Global Eradication Programme launched by the FAO by 2030.

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