

# VACCINIA VIRUS

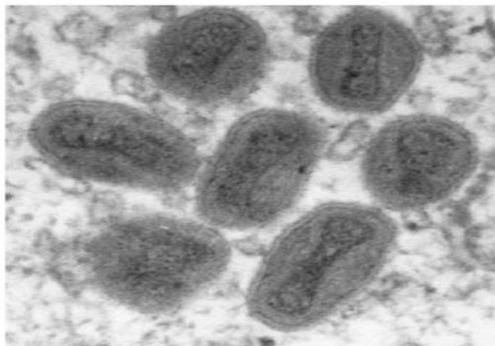
## PATHOGEN SAFETY DATA SHEET - INFECTIOUS SUBSTANCES

### INFECTIOUS AGENT

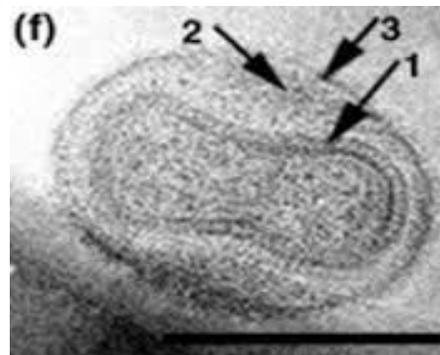
**NAME:** Vaccinia virus

**SYNONYM OR CROSS REFERENCE:** Poxvirus, smallpox vaccine, VACV, VV

**CHARACTERISTICS:** Vaccinia virus is a member of the genus *Orthopoxvirus* in the subfamily *Chordopoxvirinae* of the large family *Poxviridae*, comprising a group of complex animal double stranded DNA viruses. Vaccinia virus is a "brick-shaped" particle 200 to 400 nm long, the external surface of which is ridged in parallel rows. The detailed structure of the particle is not known. Two kinds of particles are known: extracellular forms containing two membranes and intracellular particles having only an inner membrane. The former is believed to be responsible for dissemination. Thin sections in electron microscopy reveal that the outer membrane surrounds the core, which is biconcave (dumbbell-shaped), with two lateral bodies. The core is composed of a tightly compressed nucleoprotein that contains more than 10 enzymes, mostly concerned with transcription and genome replication.



Electron micrograph of thin-sectioned vaccinia virus particles<sup>1)</sup>



Cryo-electron micrograph of a purified intracellular mature vaccinia virion. 1 = core membrane with a clear palisade layer; 2 = lateral bodies; 3 = outer membrane. Bar = 200 nm<sup>2)</sup>

### HAZARD IDENTIFICATION

**PATHOGENICITY/TOXICITY:** Vaccinia virus normally has no serious health effects in humans, although it can cause disease of the skin when used to inoculate against the smallpox virus. Vaccinia virus is usually injected in the dermis where a localized lesion appears (a "take"), and then scabs over and heals in about 10-14 days. The vaccination is accompanied by fever, rash, lymphadenopathy, fatigue, myalgia and headaches in some patients. Accidental infection with the virus can occur through contact between the vaccination lesion

and broken skin (inadvertent inoculation). Serious complications sometimes occur after vaccination. Complications are more serious in immunosuppressed individuals and the smallpox vaccine usually causes one death for every million doses. Contraindications to vaccine are their use in immunocompromised individuals, individuals with certain skin (e.g., eczema) and cardiac diseases, and pregnant women.

**EPIDEMIOLOGY:** Routine vaccination is not recommended due to the eradication of smallpox by 1980. U.S. military and laboratory and health personnel working with the vaccine or other orthopox viruses still receive the vaccine.

**HOST RANGE:** Several mammals, including humans, rabbits, cows and river buffalo have been shown to contain the virus.

**INFECTIOUS DOSE:** Unknown. Vaccine titer is usually  $10^8$  pock-forming units per ml.

**MODE OF TRANSMISSION:** The virus can be spread through the contact of a recently vaccinated individual with an unvaccinated person. Contact of a vaccinia virus lesion and broken skin is the most common mode of transmission between humans, although it has been shown that human-to-cattle and cattle-to-human transmission can occur, usually by touching the cow's teats.

**INCUBATION PERIOD:** As this is an immunizing agent, there is no incubation period; rather the time it takes to become immune is usually 7-14 days after vaccination.

**COMMUNICABILITY:** Vaccinia virus transmission between humans occurs through direct contact. Vaccinee-to-cattle and cattle-to-human transmission has been shown, particularly due to contact with cow's teats.

## DISSEMINATION

**RESERVOIR:** Vaccinated humans.

**ZOOZOSIS:** Occurs by contact with broken skin, from cattle to humans and vice-versa.

**VECTORS:** None

## STABILITY AND VIABILITY

**DRUG SUSCEPTIBILITY:** None known.

**SUSCEPTIBILITY TO DISINFECTANTS:** Susceptible to 0.02% sodium hypochlorite, 30% isopropanol, 40% ethanol, 0.02% glutaraldehyde, 0.01% benzalkonium chloride, 0.0075% iodine, 30% Sanytex and 0.12% ortho phenylphenol. The virus is however resistant to solvent/detergent combinations (Tri(n-butyl)phosphate (TNBP)/Triton X-100 and TNBP/Tween 80) and longer incubation periods (between 10 minutes and 24h depending on the solvent/detergent used) are necessary to inactivate the virus.

**PHYSICAL INACTIVATION:** The virus is inactivated by dry heat at 95 °C for 2 hours. The heat-sensitive fraction of the virus is inactivated by moist heat at 60 °C while the heat-

resistant fraction may take higher temperatures to fully inactivate it. The virus in its aerosol form is also sensitive to UV light (254 nm).

**SURVIVAL OUTSIDE HOST:** The dried virus can survive up to 39 weeks at 6.7% moisture and 4°C.

## FIRST AID / MEDICAL

**SURVEILLANCE:** Monitor for symptoms and confirm using polymerase chain reaction (PCR), electron microscopy and histology.

**FIRST AID/TREATMENT:** Vaccinia immune globulin and cidofovir can be used to treat more serious complications such as eczema vaccinatum and progressive vaccinia. Supportive care should be given to patients with postvaccinial central nervous system (CNS) disease.

**IMMUNIZATION:** A recent (10 years) smallpox vaccination is required for laboratory personnel working with the vaccinia virus (the smallpox vaccine and tissues, materials or animals that may be infected) or other orthopoxviruses because the virus can be spread to non-vaccinated individuals who are susceptible to complications.

**PROPHYLAXIS:** None

## LABORATORY HAZARDS

**LABORATORY-ACQUIRED INFECTIONS:** 9 laboratory acquired infections were reported between 1986 and 2005.

**SOURCES/SPECIMENS:** Lesion fluids or crusts, respiratory secretions and infected tissues containing the virus.

**PRIMARY HAZARDS:** Ingestion, parenteral inoculation, droplet or aerosol exposure to mucous membranes, and exposure to broken skin are the primary hazards when working with this agent.

**SPECIAL HAZARDS:** Certain poxviruses are stable at ambient temperature when dried.

## EXPOSURE CONTROLS / PERSONAL PROTECTION

**RISK GROUP CLASSIFICATION:** Risk group 2.

**CONTAINMENT REQUIREMENTS:** Containment Level 2 facilities, equipment, and operational practices are recommended when working with the vaccine. Viable materials should be manipulated in a biological safety cabinet (BSC).

**PROTECTIVE CLOTHING:** Lab coat. Gloves when direct skin contact with infected materials or animals is unavoidable. Eye protection must be used where there is a known or potential risk of exposure to splashes.

**OTHER PRECAUTIONS:** All procedures that may produce aerosols, or involve high concentrations or large volumes should be conducted in a BSC. The use of needles, syringes,

and other sharp objects should be strictly limited. Additional precautions should be considered with work involving animals or large scale activities. Laboratory personnel working with the agent should consider up-to-date vaccination.

## **HANDLING AND STORAGE**

**SPILLS:** Allow aerosols to settle and, wearing protective clothing, gently cover spill with paper towels and apply an appropriate disinfectant, starting at the perimeter and working towards the centre. Allow sufficient contact time before clean up.

**DISPOSAL:** Decontaminate all wastes that contain or have come in contact with the infectious organism by autoclave, chemical disinfection, gamma irradiation, or incineration before disposing.

**STORAGE:** The infectious agent should be stored in leak-proof containers that are appropriately labeled.

## **REFERENCE**

Pathogen Safety Data Sheet (PSDS) for vaccinia virus has been modified from the ones produced by the Public Health Agency of Canada as educational and informational resources for laboratory personnel working with infectious substances.

- 1) Picture from [what-when-how.com](http://what-when-how.com)
- 2) Picture from [schaechler.asmblog.org](http://schaechler.asmblog.org)