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Letter to the Editor

Efficacy of heat against the vaccinia virus, variola virus and monkeypox virus



Sir,

The number of new human monkeypox virus infections is currently increasing in many countries worldwide [1]. Orthopoxviruses may stay infectious on inanimate surfaces at room temperature under laboratory conditions for up to 42 days at very low relative air humidity (1%–10%) [2]. Inactivation of infectious virus, e.g. by heat, may be relevant in the surrounding of confirmed cases to reduce the potential for viral spread via contaminated surfaces or objects. That is why published data were reviewed to find out which temperatures and exposure times are necessary for the inactivation of orthopoxviruses.

A Medline search was done on 13th June 2022. The following terms were used, always in combination with “inactivation” and „heat”: vaccinia virus (72 hits), poxvirus (65 hits), orthopoxvirus (51 hits), and monkeypox virus (0 hits). Publications

were included and results were extracted given they provided original data on any type of orthopoxvirus including vaccinia virus, variola virus or monkeypox virus and their inactivation by various temperatures used for thermal disinfection. Reviews were not included but screened for any information within the scope of this review.

A total of seven studies with original data were found. Vaccinia viruses and variola virus were inactivated in suspension tests within 30 min at temperatures between 55 °C and 65 °C (Table I). Copper, cobalt and iron supplemented to the suspending medium inactivated vaccinia virus at 55 °C and 60 °C rapidly [3]. At 50 °C the necessary exposure time to achieve at least a 4 log₁₀ reduction in suspension tests was 90 min (Table I). The inactivation rates could be increased at 50 °C in the presence of Mg⁺⁺ or Ca⁺⁺ whereas Na⁺ protected vaccinia virus from inactivation [4]. On artificially contaminated stainless steel coupons a laboratory strain of the vaccinia virus was inactivated by more than 4.6 log₁₀ steps at 70 °C and 80 °C in 10 min and at 90 °C in 1 min [5]. No original data were found with the monkeypox virus.

The susceptibility of orthopoxviruses to heat were similar to the different coronaviruses which were inactivated to a similar extent at 60 °C within 30 min [6], suggesting similar inactivation kinetics by heat. The loss of viral infectivity by heat is

Table I

Reduction of viral infectivity in suspension tests obtained with vaccinia viruses or variola virus at different temperatures

Type of virus	Suspended in	Temperature	Expoure time	Log ₁₀ -reduction	Reference
Vaccinia virus (strain Guarani P2)	Milk	65 °C	30 min	4.0	[10]
Vaccinia virus (Lister institute strain)	Mcllvaine buffer	60 °C	10 min	6.2	[11]
Vaccinia virus (strain Lederle)	Mcllvaine buffer	60 °C	15 min	3.4–4.0	[12]
			30 min	4.7–5.0	
Vaccinia virus (Lister institute strain)	Mcllvaine buffer	55 °C	10 min	3.7	[11]
			20 min	5.7	
Variola virus (Yamada strain)	Phosphate buffered saline	55 °C	30 min	5.0	[13]
Vaccinia virus (Lister institute strain)	Mcllvaine buffer	52.5 °C	20 min	3.7	[11]
			30 min	4.2	
			60 min	5.1	
Vaccinia virus (Lister institute strain)	Mcllvaine buffer	50 °C	60 min	3.0	[11]
			90 min	4.0	
			120 min	4.6	
Vaccinia virus (strain Lederle)	Mcllvaine buffer	50 °C	30 min	3.0–3.2	[12]
			45 min	3.9–4.1	
			60 min	4.8–5.2	
Variola virus (Yamada strain)	Phosphate buffered saline	50 °C	30 min	2.4*	[13]
Variola virus (Yamada strain)	Phosphate buffered saline	45 °C	60 min	2.6	[13]

* effect is impaired in the presence of 10% skim milk or heart infusion broth.

explained by a general decline in the activities of a number of particle functions [7]. The results obtained with vaccinia viruses are probably suitable to describe the efficacy of heat against the monkeypox virus. A direct comparison of the antiviral activity of copper against a vaccinia virus and a monkeypox virus indicated a similar susceptibility of both viruses towards the biocidal agent [8]. In addition, a comparable susceptibility of vaccinia virus and modified vaccinia virus Ankara (MVA) to four commercially available disinfectants used in veterinary medicine was shown by Hartnack *et al.* [9]. Although a direct comparison of the susceptibility of different orthopoxviruses towards heat was not found it is likely that monkeypox virus is also inactivated by at least 4 log₁₀ steps in 30 min at 60 °C. A limitation is that the majority of data described here were obtained with test virus in suspension (buffer solution or milk; temperatures between 45 °C and 65 °C). It is therefore possible that the results with dried virus on surfaces or objects may be different at these temperatures.

Conflict of interest statement

The author has received honoraria from Schülke & Mayr, Germany, outside the submitted work. The views expressed here are those of the author and do not necessarily reflect those of the university he is affiliated with.

Funding sources

None.

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Available online 18 June 2022