

Healthy Environment



Virus Guide



Inactivating Viruses with Heat

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While viruses are not considered living organisms, they depend upon living cells to replicate. The structure of the virus includes an envelope constituted by proteins and genetic material of DNA or RNA. All of these components are thermo-sensitive. The genetic material and the proteins have complex structures regulating their function, and change in this structure may result in a loss of function known as denaturizing. There are two basic means by which denaturing occurs: a change in PH or temperature.



Some examples: viruses and heat inactivation

Numerous studies have focused on virus inactivation through heat application. For example, HIV virus in the blood will die when exposed to 77 degrees Celsius¹ for as little as 0.006 seconds¹. In another study, parvovirus and phage phiX174 were completely inactivated when exposed to 103 degrees Celsius for 90 seconds². In the case of the Herpes virus, high

temperatures inhibit the release of proteins necessary for the success of the infection³.

Airborne viruses are no different. One study of respiratory syncytial virus (the major cause of wheezing in children less than 2 years old) showed that when the virus is exposed to 65 degrees Celsius for 45 minutes, the infection capacity is diminished and conformational proteins are transformed, resulting in a reduction of substances responsible for the inflammation, hyper-responsiveness and damage to airpassages⁴. The SARS virus (causative agent of severe acute respiratory syndrome) has thermo-sensible proteins in its envelope, which can be totally denaturated at 55 degrees Celsius, the same temperature at which SARS virus was also reported to be inactivated⁵. The influenza virus contains proteins essential for infectious transmission that are sensible to variations of pH and temperature between 55-70 degrees Celsius⁶.

The avian flu

The virus, responsible for the bird flu, can be spread from the poultry to humans and up to now, about 20 million chickens have been slaughtered in order to control the spread of the virus¹⁰. Since 1997, it has been reported that more than 100 cases of the disease in humans, resulted in over 50 deaths⁸. Experts are very concerned about the rise of a new pandemic strain of the virus because of the mixing between avian and human viruses. It's predicted that the virus could infect someone who is already infected with a human flu virus like A, resulting in genetic rearrangement and a new pathogen that could be highly infectious¹¹ and easily transmitted from human-to-human¹³.



Transmission and symptoms

All birds are susceptible to the avian virus and some types of wild birds are natural carriers of influenza type A virus. They have a large amount of avian virus in their secretion, saliva and feces that can contaminate domestic poultry when in contact. Furthermore, their dropping or saliva may contaminate water, rivers, feed and even our own shoes⁸. Infected droplets may settle on conjunctival, nasopharyngeal or other respiratory mucosal epithelium in humans¹² leading to symptoms ranged from typical influenza-like symptoms (e.g., fever, cough, sore throat, and muscle aches) to eye infections (conjunctivitis), pneumonia, acute respiratory distress, viral pneumonia, and other severe and life-threatening complications¹³.

Avian Flu characteristics and their heat instability

The avian virus, H5N1, is a negative-sense, single-stranded RNA virus¹², which has two types of proteins in its surface: hemagglutinin (HA) and neuraminidase (NA)¹³. It is documented that the virus can be inactivated by 56°C in 3 hours and 60°C in 30 minutes⁸. Thus, only four degrees of temperature elevation reduced the time of inactivation by about 85%.

Airfree® and its TSS™ Ceramic Core

Here, we have listed only a few examples of virus inactivation by heating and in all those cases the temperatures were below the Airfree's TSS™ ceramic core internal temperature of 200 degrees Celsius. Since 1977, studies have shown that the higher the temperature, the faster the proteins get denatured⁷. Therefore, we may infer that the Airfree purifier may be efficient inactivating virus proteins in most cases, resulting in lack of infection ability.

Airfree® Products

Efficient: Airfree was tested in real inhabited working environments by credible ISO 17025 independent laboratories and universities in several countries. Airfree destroys microorganisms such as mold spores, bacteria, viruses, and dust mite allergens when passing through its patented and highly efficient thermodynamic sterilizing system known as TSS™ technology, regardless of how hazardous and small these contaminants might be.

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Ozone Reduction: No other air purifying device matches Airfree's exclusive TSS™ technology which reduces ozone, while simultaneously destroying microorganisms.

Economic: : Airfree's electric consumption equals a 50W light bulb. No replacement parts, such as filters that may cost hundreds of Dollars a year, are required.

Easy Installation: : Just place Airfree on the floor and plug it into the nearest electric outlet. No need for maintenance or special cleaning.



Bibliographical References:

- 1- Charm SE, Landau S, Williams B, Horowitz B, Prince AM, Pascual D. High-temperature short-time heat inactivation of HIV and other viruses in human blood plasma. *Vox Sang*. 1992;62(1):12-20.
- 2- Lelie PN, Reesink HW, Lucas CJ. Inactivation of 12 viruses by heating steps applied during manufacture of a hepatitis B vaccine. *J Med Virol*. 1987 Nov;23(3):297-301.
- 3- Morrison EE, Wang YF, Meredith DM. Phosphorylation of structural components promotes dissociation of the herpes simplex virus type 1 tegument. *J Virol*. 1998 Sep;72(9):7108-14.
- 4- Jaovisidha P, Peebles ME, Brees AA, Carpenter LR, Moy JN. Respiratory syncytial virus stimulates neutrophil degranulation and chemokine release. *J Immunol*. 1999 Sep 1;163(5):2816-20.
- 5- Wang Y, Wu X, Wang Y, Li B, Zhou H, Yuan G, Fu Y, Luo Y. Low stability of nucleocapsid protein in SARS virus. *Biochemistry*. 2004 Aug 31;43(34):11103-8.
- 6- Eppand RM, Eppand RF. The Thermal Denaturation of Influenza Virus and its Relationship to Membrane Fusion. *Biochemical Journal Immediate Publication*. Published on 7 May 2002 as manuscript BJ20020290.
- 7- Palumbo SA, Smith JL, Kissinger JC. Destruction of *Staphylococcus aureus* During Frankfurter Processing. *Applied and environmental microbiology*. 1977;40:744.
- 8- Shih-Wen Hung, I-Yin Lin, Tzong-Luen Wang. *Emerging Infectious Disease* (1): Avian Influenza. *Med*. 2005;3 Suppl 2:S40-S46
- 9- Fleck, F. Avian flu virus could evolve into dangerous human pathogen, experts fear. *Bull World Health Organ*, mar. 2004; 82 (3):236-237. ISSN 0042-9686.
- 10- Abolt A., Pearson H. Fear of human pandemic grows as bird flu sweeps through Asia. *Nature*, Febr 2004; (427): 472-73.
- 11- Andersen M. Avian flu: WHO prepares for the worst. *CMAJ*. 2004 March 2;170(5):777.
- 12- KY Yuen, SSY Wong. Human infection by avian influenza A H5N1. *Hong Kong Med J* 2005;11:189-99
- 13- Center for Disease Control and Prevention. Avian Influenza Infection in Humans. October 17, 2005. <http://www.cdc.gov/flu/avian/gen-info/avian-flu-humans.htm>

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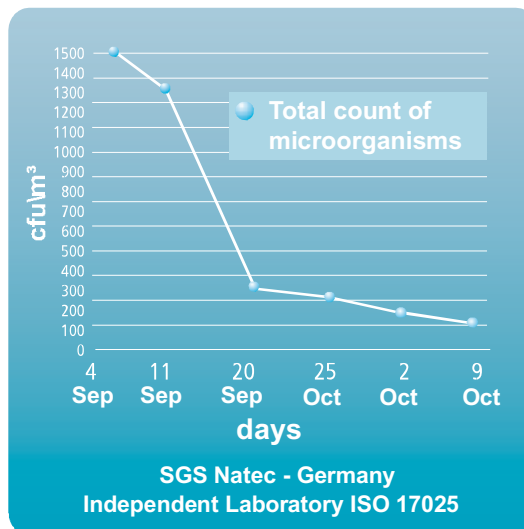


Environment **without** Airfree



*test made in two separate closed chambers

Efficiency Test: microorganism reduction



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This guide had Cristiane Minussi's collaboration, USP biologist professional responsible for the microbiological nature information.

