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Virucidal Potential of Gamma Radiation

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Enteric viruses are a major cause of human water and foodborne diseases. These type of viruses primarily infect the intestinal tract through ingestion of contaminated water or food. Enteric viruses, like norovirus (NoV) and adenovirus (AdV), can enter the environment through the discharge of waste materials from infected individuals and be transmitted back to susceptible individuals. The stability of these viruses and their presence in waters and food can thus cause serious implications on public health. In this scenario, gamma irradiation could be an efficient technology to achieve elimination of viral pathogens.
The goal of this study was to investigate the inactivation by gamma irradiation of murine norovirus type 1 (MNV-1), as a NoV surrogate, and human adenovirus type 5 (AdV-5) in six different aqueous substrates and two types of fresh berry fruits.
Phosphate Buffer Saline (PBS), demineralized water, tap water, Fetal Bovine Serum (FBS) and aqueous solutions of 10% and 50% FBS as well as fresh strawberries and raspberries, were inoculated either individually with MNV-1 and AdV-5 or with a viral pool of both viruses. The spiked samples were irradiated in a Co-60 chamber at several doses 0.87 up to 11.35 kGy at a dose rate of 1.6 kGy/h. For fresh berries samples, the viruses were recovered from spiked samples and then purified and concentrated by low speed centrifugation. The infectivity of viral particles of MNV-1 and AdV-5 was tested by plaque assay using Raw 264.7 and A549 cells, respectively. D10 values and virucidal efficiency of gamma irradiation were estimated for each virus and substrate.
A reduction on MNV and AdV titers of 4 log10 PFU/ml was achieved after irradiation at 3 kGy on PBS, demineralized and tap water suspensions. However, it was found that MNV-1 and AdV-5 were approximately 3 times more resistant to gamma radiation when irradiated in FBS suspensions. Concerning the obtained results for fresh berries, a reduction on MNV-1 and AdV-5 titers of 2 log10 PFU/g was achieved after irradiation at a dose of 4 kGy. Non-linear inactivation survival curves were obtained for both virus in fresh berries, leading to the detection of infective viral particles at a dose of 11 kGy.
MNV and AdV indicated to have the same radioresistance when irradiated in a viral pool or in individual viral suspension for all tested matrices.
The viral inactivation by gamma radiation was found to strongly depend on the substrate where the viruses are suspended. The study of viral behavior in different substrates could open new insights on the inactivation mechanism caused by gamma irradiation. The selection of the gamma radiation dose for the disinfection treatment of berry fruits, must achieve the balance to guarantee food safety and preserve food quality. The irradiation process presented virucidal potential. This technology can be an effective virus mitigation tool to treat polluted waters, which are the major vehicle of contamination for minimally processed food products.

Country/Organization invited to participate

Portugal

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