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Conclusions

This study demonstrates the effect of cold nebulized H_2O_2 on murine norovirus (MNV) on fruit and vegetable surfaces and shows the potential for the food industry. Infective MNV were reduced by approximately 4 log_{10} on smooth surfaces (apples, blueberries). Treatment of artificially contaminated cucumbers resulted in lower virucidal efficiency, whereas a reduction of 1.9 log_{10} was determined. The treatment of inoculated strawberries resulted in no reliable reduction rates of MNV. First steps for the application of cold misted H_2O_2 in the food industry were demonstrated in this study and the fundamental effectiveness of the procedure was shown.

Usage of cold hydrogen peroxide vapour for inactivation of murine norovirus on fruit and vegetable surfaces

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Introduction

In 2017 15 outbreaks of human norovirus (hNV) in fruit and vegetables were reported in the Rapid Alert System for Food and Feed Portal (https://ec.europa.eu/food/safety/rasff_en). For research investigations, surrogates as murine norovirus (MNV) are utilized for studying norovirus infection due to the lack of a cell culture for hNV. It is known that hydrogen peroxide vapour (H_2O_2) can be utilized as cold fog (nebulization at room temperature) in order to inactivate MNV on surface areas. Although hNV contamination of fruit and vegetables is an ongoing problem the virucidal efficiency of this application regarding the inactivation of norovirus on different fresh produce is not characterized.

Materials and Methods

The DCXpert system (DCX Technologies GmbH) and the Diosol Generator MF (DIOP GmbH & Co. KG) (Fig.1) were applied for cold fogging decontamination with H_2O_2 (19 % H_2O_2, 60 min). MNV (S99 P19) was used in order to illustrate if cold nebulized H_2O_2 inactivates the virus on different fruit and vegetable surfaces (apples, blueberries, cucumbers, strawberries).

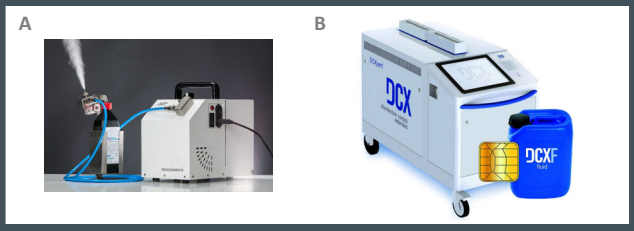

Fig.1: Two different application systems for nebulization of cold H_2O_2. A: Diosol Generator MF (DIOP GmbH & Co. KG). B: DCXpert (DCX Technologies GmbH).

After H_2O_2 treatment spiked MNV was recovered from untreated and treated fresh products according to DIN EN ISO 15216-2. Plaque assays were performed after recovery of MNV to compare the quantity of infective MNV.

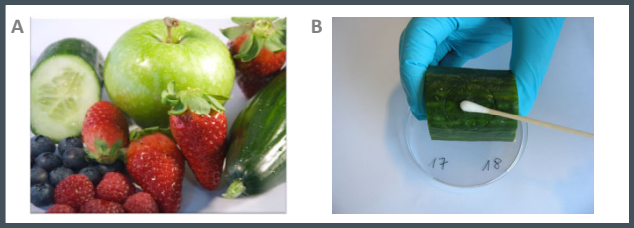

Fig.2: Fruit and vegetables used in this study (A). Recovery of MNV from cucumber surface (B).

Details on this study: Weinstock et al., 2018: Inactivation of murine norovirus on fruit and vegetable surfaces by cold nebulized hydrogen peroxide. Food Microbiology. Under review.

Results

Infective MNV were reduced on smooth surfaces (apples, blueberries) by approximately 4 log_{10} with cold nebulized H_2O_2 (19 % H_2O_2, 60 min, max. 260 ppm H_2O_2). Cucumbers were chosen as additional vegetable for this study to show the reduction rate due to cold misted H_2O_2 procedure of infective MNV on hard surfaces, because they are more structured than apples and blueberries. However, similar treatment of artificially contaminated cucumbers resulted in lower virucidal efficiency of this application, whereas a median value of 1.9 log_{10} reduction can be determined (0.6 log_{10} up to 2.8 log_{10}).

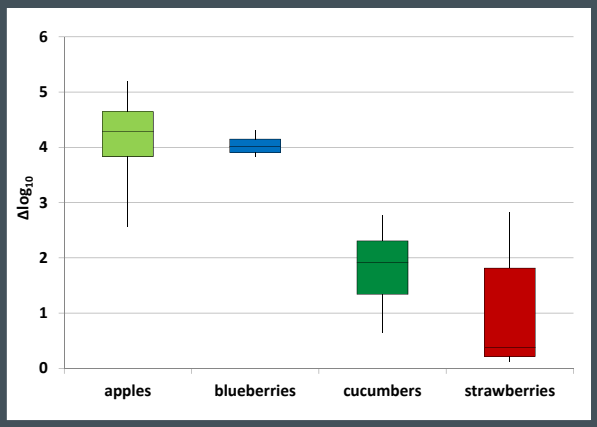

Fig.3: Inactivation of infectious MNV on apples (n=23), blueberries (n=8), cucumbers (n=16) and strawberries (n=14). Log_{10}-Reduction is shown.

Strawberries were used as an example of soft berry fruit with a rougher exterior and inoculated with MNV on the surfaces. There was no reproducible reduction rate of infectious MNV after treatment with 214 ppm of aerosolized H_2O_2. However, recovery of MNV from untreated strawberries varied between 2.5×10^4 and 1.4×10^7 PFU/mL. The reductions measured during treatment varied between 0.1 and 2.8 log_{10} PFU/mL (Fig.3).

In particular, the influence of H_2O_2 treatment on the color of the fruit was considered. No color differences were detected of apples, blueberries, cucumbers and strawberries due to treatment with H_2O_2 for 60 min.

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