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Effect of meat product components on the tolerance of *Salmonella* bacteriophages against high hydrostatic pressure (#313)

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Introduction

Numerous foodborne diseases are associated with consumption of meat and meat products. Among the pathogens involved, *Salmonella* is still of importance regarding products made from poultry meat and pork. Beside the use of traditional chemical preservation techniques or alternative processing technologies like high pressure processing (HPP), biocontrol techniques like the use of protective cultures or bacteriophages have attracted great attention from the food processing industry, as they are increasingly recognized as a natural solution. Due to the specificity of bacteriophages, phage biocontrol offers the opportunity to tackle pathogens in foods specifically, without altering the indigenous food microbiota. Phage-based products as safeguards against pathogens in the food chain have already been placed on the market.

Research data and practical experience has shown that complete elimination of *Salmonella* cells in foods can hardly be achieved by the sole use of phages, especially in processed food products due to the great increase of surface area taking effect with processing. Thus, an obvious solution would be to combine phage biocontrol with other antagonistic principles. The non-thermal decontamination by HPP has been described as a valuable tool for meat products. However, the use of HPP is restricted to moderate pressure conditions, in order to avoid detrimental sensory quality effects due to protein denaturation. In this study, the sensitivity of *Salmonella* phages to high pressure was investigated under consideration of potential protective effects that some food components may have.

Methods

In this study the *Salmonella* bacteriophage DIL 5302 was used, belonging to the *Myoviridae* family. The counts of biologically active phage particles in solutions or in phage inoculated food was determined using the bacteriophage plaque assay and *Salmonella* Derby as host organism. The results are expressed as plaque forming units (pfu) per ml or g. The integrity of the phage morphology was evaluated by transmission electron microscopy (TEM). High pressure treatment of solutions or foods was performed using the Hiperbaric 55 equipment.

Results

To investigate the effect of typical food components like sugar, protein and salt on the stability of phage particles, their activity in solutions containing sucrose (5 % to 10 % w/v), albumin (5 % to 15 % w/v), peptone (1% to 10% w/v) or sodium chloride (5% to 15 % w/v) during storage at 4 °C for up to 8 days were determined. Sucrose, albumin and peptone did not affect the biological activity of phage DIL 5302, whereas in the presence of sodium chloride the activity was reduced by up to 3 log pfu after 8 days. Furthermore, after inoculation of the phages into minced pork meat, their biological activity remained unchanged for up to 7 days of storage at 4 °C.

The effect of high pressure treatment on the biological activity of phage DIL 5302 was investigated in phosphate buffered saline (PBS) containing approximately 10^8 pfu/ml. Treatment at 200 MPa for 1 min resulted in reduction of only 1 log pfu, whereas at 300 MPa for 1 min nearly all phage particles were inactivated. Compared to the treatment at 250 MPa for 1 min, for which also no effect has been observed, the extension of treatment time up to 3 min resulted in an approximately 1 log pfu reduction. The addition of 10 % (w/v) sucrose or 10 % (w/v) peptone contributed to an increase in the tolerance of phages to HPP, whereas lower concentrations of sucrose and peptone as well as 1 % to 10 % (w/v) sodium chloride resulted in greater activity reduction rates than in a control phage solution in PBS. Investigation of the phage morphology after HPP by TEM revealed the inactivation was due to destructions of tail fibers or to the contraction of phages resulting in empty heads.

HPP of minced pork inoculated with 10^7 pfu/ml revealed that treatments up to 250 MPa for 1 min did not affect the biological activity. The application 300 MPa for 1 min resulted in a reduction of only 2-log. Similar results were obtained in cooked fermented pork meat.

Conclusion

Food components like carbohydrates and proteins can exert a stabilizing effect on the *Salmonella* phage DIL 5302 in aqueous solutions, not only during storage but also under high pressure conditions. In minced meat, the phages exhibited high tolerance to high pressure up to 250 MPa without any inactivation. This indicates that the application of *Salmonella* phages in conjunction with moderate pressure treatment, at which only minor effects on the sensory quality of meat products are observed, is a practicable concept to improve the safety of raw meat products.

Notes