Innovations to reduce contaminants from seafood products: Improved norovirus removal from Pacific oysters during depuration

SEAFOOD TOMORROW
NUTRITIOUS, SAFE AND SUSTAINABLE SEAFOOD FOR CONSUMERS OF TOMORROW


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SUMMARY

Norovirus (NoV) is a highly contagious and widespread virus that can cause viral gastroenteritis in humans. Filter-feeding bivalve molluscan shellfish, such as oysters, mussels and clams, can readily accumulate NoV present in water contaminated by human faecal material, leading to illness in consumers when raw or partially cooked shellfish is eaten. This output describes strategies to improve the commercial purification and removal of certain strains of NoV from Pacific oysters (*Crassostrea gigas*). A series of depuration trials were carried out to find the best strategy. Trials considered the effects of temperature, algal feeding (natural algae and commercial preparation), salinity, tank pump vibration disturbance, and light levels. Results show that raising temperatures to 18°C during the purification phase is most successful for NoV removal, and did not appear to affect the shelf-life of the oysters up to 12 days post-depuration compared with trials at 8°C.

KNOWLEDGE NEED

Norovirus (NoV) is the principal agent of bivalve shellfish–associated gastroenteric illness worldwide. Under European legislation, purification (depuration) in tanks of clean seawater is the main method for purging sewage contaminants from class B shellfish. Whilst bacteria (e.g. *E. coli*) are rapidly and effectively removed during this process, NoV is not, particularly in the prevailing winter temperatures at Northern European depuration centres. There is a need for improved NoV removal from contaminated produce. Aside from the detrimental health effects, NoV outbreaks damage public confidence in the shellfish industry, and in the seafood industry as a whole.

RESULTS

NoVs can be classified into different genotypes. Recent studies show that certain strains can bind to the digestive tract of the oyster, resulting in reduced depuration efficacy. Results of the current study provide evidence that elevated temperatures during depuration can achieve significant removal of NoV. However, the extent of removal appears to depend on the strains of NoV present. A raised temperature of 18°C was found to be most effective. Double the rate of NoV GII removal was achieved at 18 °C compared with 8 °C after five days. Approximately 46% removal of NoV genogroup II (GII) was recorded at 18°C after two days, and 60% after five days, compared with a maximum of 16% NoV genogroup I (GI) removal. No difference was found in shelf life for oysters held at <8C for up to 12 days post-depuration and oysters from trial runs at 8 and 18°C. The trials also showed improved NoV removal at 25 ppt salinity compared with 35 ppt. This highlighted the importance of depurating oysters in water of a similar salinity (within 20%) to the harvesting area from which they originated. The oysters used in our study came from an estuarine source with salinity typically in the range of 25-30ppt. Feeding and light regimes, and water flow appear not to have any impact on NoV reduction/removal.

IMPACTS

Implementation of this strategy can help to increase the availability of safe shellfish for consumption and increase consumer trust. It would support greater economic activity by helping producers growing oysters at class B sites to avoid product loss.

Contributes to the UN Sustainable Development Goal 12: Responsible consumption and production.

END-USERS & APPLICATIONS

Pacific oyster producers: this method may help reduce product losses when contamination does occur and, potentially give producers growing oysters in class B areas the option to significantly reduce risks to consumers.

Processing (purification and dispatch centres): depuration operators and shellfish processors can implement this strategy, ensuring higher quality and safety of shellfish.

Food safety and environmental regulators: monitoring agencies and officers can recommend the inclusion of this method in shellfish processing, ensuring safer shellfish, and increasing economic activity in the sector.

Scientific community: academics and scientists working in the area of seafood safety can use the validated datasets and new knowledge to support further research.

DISSEMINATION AND EXPLOITATION

Exploitation activities for seafood industry:

- The method was shared with the Irish Seafood Development Agency and Irish Aquaculture technology and Innovative Platform (April 2020).
- Results from the trials were presented at the **SEAFOOD**TOMORROW demonstration workshop in France of which the proceedings can be found on the project website.
- Horizon Results Platform: seafoodtomorrow.eu/horizon-results-platform
- Cefas has produced an industry protocol and recommendations document that will be shared with regional shellfish producers, processors and regulators in the UK.
- Monitoring agencies, regulators and policy makers will be reached through the final **SEAFOOD**TOMORROW event, info session, and a dedicated EU policy event.

Dissemination activities for scientific community::

- Younger AD, Neish A, Walker DI, Kaitlyn L. Jenkins KL, Lowther JA, Stapleton TA, Alves MT. (2020). Strategies to reduce norovirus (NoV) contamination from oysters under depuration conditions. *Food and Chemical Toxicology*, 143, 111509. DOI: 10.1016/j.fct.2020.111509.
- Open access version: zenodo.org/record/4323045#.YCPvNej7TIV
- Open access validated data sets: zenodo.org/record/2791858#.XXjRWShKjIU
- Poster presentation at Aquaculture Europe 2019: seafoodtomorrow.eu/wp-content/uploads/2019/10/Seafood-Tomorrow_DEPURATION-poster-FINAL.pdf

Dissemination activities for society / all users:

- Project newsletters and news articles
- Promotion on Twitter and LinkedIn

INNOVATION STATUS

Technology Readiness Level 5 - the technology has been validated in commercially used systems.

Patents and IPR: Not applicable

FUTURE RESEARCH

For final commercial implementation, the methodology must be demonstrated in a wider range of commercial depuration systems and with other bivalve species (TRL6), especially in those with higher levels of NoV, as trial concentrations were low in some of the trials. The suitability of FRNA bacteriophage as a surrogate for NoV infectivity under depuration conditions should also be investigated.

CONTACT AND CONTRIBUTORS

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