

## A perspective on hepatitis A virus and other infectious and non-infectious *noxae* from edible shellfish

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### Abstract

Edible shellfish, with special reference to mussels, may host inside their bodies a huge number of oro-faecally transmitted microorganisms alongside micro-nanoplastics carrying, at their time, protozoan pathogens as well as a large amount of persistent environmental pollutants. Hundreds of cases of hepatitis A virus infection, most likely linked to the consumption of raw/uncooked mussels, have been observed in the last few months in Southern and, to a lesser extent, in Central Italy. The biological and chemical hazards originating from the consumption of raw/uncooked edible shellfish emphasize the crucial role of a multidisciplinary, shared and collaborative intersectorial effort between the medical and veterinary profession for the eco-epidemiological surveillance and prevention of all the infection, food poisoning and chemical contamination occurrences linked to the ingestion of edible shellfish, within a sound "One Health, One Earth, One Ocean" perspective.

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## 1. Introduction

The huge number of hepatitis A (HA) cases diagnosed in the last few months in patients from Southern (Campania region) and, to a lesser extent, from Central (Latium region) Italy, which were likely caused by the consumption of HA virus (HAV)-contaminated mussels, is of concern.

Noteworthy, mussels (e.g. *Mytilus edulis*, *M. galloprovincialis*) are invertebrate organisms possessing an extraordinary filtering ability, with 5-7 litres of marine water per hour being filtered by each individual. In other words, a single specimen may filter over 100 litres of seawater every 24 hours! This implies, in turn, that any biological and/or chemical contaminant polluting the marine environment may be acquired by mussels inhabiting the surrounding waters through their water-filtering activity.

## 2. Infectious and non-infectious *noxae* in shellfish

### 2.1 Infectious *noxae*

Apart from HAV, several other viral, bacterial and protozoan pathogens characterized by an oro-faecal

infection's cycle may be harboured inside edible shellfish, especially in mussels. Within such context, bacterial and protozoan agents of significant concern include *Salmonella* spp., *Escherichia coli*, *Vibrio cholerae* and *Listeria monocytogenes*, along with *Toxoplasma gondii* (Di Guardo, 2023). As far as concerns viruses, the SARS-CoV-2 betacoronavirus, responsible for the COVID-19 pandemic, once shed via the faecal route into the external environment (Zheng *et al.*, 2020), may potentially contaminate (as in the case of other oro-faecally transmitted viral pathogens) the mussel organisms living in the nearby waters.

### 2.2 Non-infectious *noxae*

With reference to chemical pollutants, micro-nanoplastics (MNPs) appear to be of special concern, given their progressively growing contamination of planetary seas and oceans (Di Guardo, 2024), coupled with their well-established ability to attract and concentrate upon themselves both persistent environmental pollutants (e.g. dioxins, PCBs, heavy metals, etc.) and protozoan agents like *T. gondii*, *Giardia enterica* and *Cryptosporidium parvum* (Zhang *et al.*,

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2022). This already frightening scenario is further complicated by the proven ability of MNPs to attract and concentrate also antibiotic-resistant bacteria, which may then transmit, by means of "horizontal gene transfer", their antimicrobial resistance genes to other MNP-colonising bacteria (Gaur *et al.*, 2023; Nath *et al.*, 2023).

### 2.3 Challenges

Within such a challenging and scientifically intriguing context, it is worth emphasizing that, alongside HAV, all the aforementioned microorganisms and several other oro-faecally transmitted pathogens may be ingested and concentrated by mussels inside their bodies. Remarkably, these phenomena tend to occur more frequently and intensely under flooding events, causing in turn an increased land-to-sea transfer of faecally excreted microbial agents (Di Guardo, 2023).

Notwithstanding the above, it should be also underlined, however, that an *ad hoc* legislative screen protecting people from the biological and chemical hazards associated with the consumption of edible shellfish is in place in Italy since over sixty years (Law no. 125/1959) and, since over twenty years, all over the European Union (EU) territory (EC Regulation no. 853/2004), within a sound and reassuring "from sea to table" framework. Anyway, as a general rule dictated by common sense, shellfish should be never eaten raw but they should be always cooked before consumption.

### Conclusion

Finally and no less important, the eco-epidemiological surveillance and the prevention of all the infection, food poisoning and chemical contamination occurrences linked to the ingestion of edible shellfish should be necessarily performed in a multidisciplinary, shared and collaborative intersectorial effort between the medical and veterinary professions and within a "One Health, One Earth, One Ocean" perspective, once again reminding us that human, animal and environmental health are mutually and inextricably linked to each other.

### Conflict of interest

The authors declare no conflict of interest.

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