Asellus aquaticus and other invertebrates in drinking water distribution systems - DTU Orbit (27/10/2019)

Asellus aquaticus and other invertebrates in drinking water distribution systems: Occurrence and influence on microbial water quality

Few if any drinking water distribution systems worldwide are completely free of invertebrate animals and presumably it has been that way since the very first distribution system was constructed. Invertebrates visible to the naked eye cause consumer complaints and are considered a sign of bad hygiene. Whereas invertebrates in drinking water are known to host parasites in tropical countries they are largely regarded an aesthetical problem in temperate countries. Publications on invertebrate distribution in Danish systems have been completely absent and while reports from various countries have described the occurrence of invertebrates in drinking water there have been a knowledge gap concerning a quantitative approach to the controlling parameters of their distribution and occurrence. This thesis describes the distribution and controlling parameters of invertebrates with special emphasis on the largest of the regularly occurring invertebrates in temperate regions, Asellus aquaticus, which is also a cause of consumer complaints. The main controlling parameters of the occurrence of A. aquaticus, studied in a non-chlorinated distribution system, were the pipe material and sediment volume in the pipes. Cast iron pipes and a substantial sediment volume (>100 ml/m3 sample) supported relatively large concentrations of A. aquaticus (up to 14/m3). Microscopic invertebrates were present in almost all samples regardless the sediment volume and pipe material. Whether invertebrates are solely an aesthetic problem or also affect the microbial water quality is a matter of great interest. The few studies on the influence of the invertebrates on microbial water quality have shown opposite tendencies for different invertebrate-bacteria relations, thus some crustaceans graze on pathogenic bacteria while other crustaceans and nematodes protect bacteria from treatment processes. The influence of A. aquaticus has never previously been investigated. Investigations in this Ph.D project revealed that presence of A. aquaticus did not influence microbial water quality measurably in full scale distribution systems. The influence of A. aquaticus on survival of indicator and pathogenic bacteria was studied in laboratory experiments, and no effects on bacterial concentrations could be measured for the faecal indicators and opportunistic pathogens Escherichia coli and Klebsiella pneumoniae nor for the pathogen Campylobacter jejuni. Invertebrates enter drinking water systems through various routes e.g. through deficiencies in e.g. tanks, pipes, valves and fittings due to bursts or maintenance works. Some invertebrates pass treatment processes from ground water or surface water supplies while other routes may include back-siphonage of waste water or surface water via unprotected connections or cross connections. Since A. aquaticus is known to enter drinking water distribution systems through deficiencies in the systems, the risk of transport of faecal contaminations into drinking water supply systems by intruding A. aquaticus was assessed. E. coli and other coliform bacteria were associated with A. aquaticus from fresh water environments such as lakes and ponds. However, incoming water and sediment were found to pose a larger risk of faecal contamination of the supply systems than transport by A. aquaticus. Previous and currently applied methods for removal of invertebrates from distribution systems are discussed and suggestions of control strategies are given, based on the results obtained in this study in order to obtain or maintain an acceptable level of invertebrates in drinking water systems.

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