Bringing musty bacteria to light

Genetic profiling of off-flavour and odour-producing bacteria in the bottom sediments of Singapore's reservoirs aids water-quality management

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Fig. 1: Reservoirs may harbour bacteria that can affect the taste and smell of the water supply

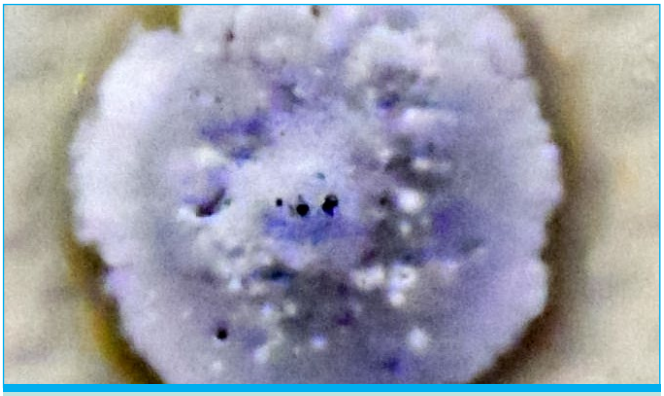

Fig. 2: An example of actinomycetes bacteria isolated from the bottom sediments of a reservoir

Communities of bottom-dwelling bacteria in Singapore's reservoirs contain species known as actinomycetes that produce substances with an earthy and musty odour. Understanding the composition and dynamics of these communities as environmental factors is critical to managing water quality. A custom-designed, genetics-based approach is now available to profile and monitor these communities as conditions vary. A research team from the Interactive Micro-organisms Laboratories (IMO Labs), PUB Singapore and the National University of Singapore developed the microbial community profiling strategy.

The team's strategy is relatively new to the bacteriological analysis of water. Angelito Abaoag of IMO Labs explains the ability to monitor community compositional changes — as a result of variations in environmental conditions — will shed light on the occurrence and dynamics of actinomycetes. This provides valuable insight for the creation of an early detection system of off-flavour and odour compounds in the water. Abaoag adds that this approach has been applied previously to anticipate viral outbreaks in aquaculture, in response to reactions of bacterial communities, and could prove useful in water quality management.

The researchers isolated actinomycetes from the bottom sediments of different reservoirs (Fig. 1) to identify the genes responsible for the biosynthesis of two unpleasant-tasting and malodorous compounds: geosmin and 2-methylisoborneol. They also grew and compared laboratory-grown cultures grown of these isolates (Fig. 2). Initial tests revealed common structural and growth characteristics between the cultures from different reservoirs. Moreover, cultures of actinomycetes originating from geosmin-and 2-methylisoborneol-containing sediments emitted a strong odour in the laboratory. "We can see correlations on how the suspected microorganisms survive and function amidst the microbial diversity of reservoir bottoms," adds Abaoag.

To identify and quantify the microbial species present in the sediments, the team used a combination of well-established techniques: real-time polymerase chain reaction (RT-PCR) with DNA sequencing. "RT-PCR provides a comparative measurement of the abundance of selected microbial groups, while sequencing gives an accurate identification of these groups," explains Abaoag. After characterising the genetic changes within the community over one year, the researchers correlated these profiles to understand bacterial function and biochemical reactivity.

Since environmental factors alter microbial community profiles, and therefore the emission of unpleasant-tasting and –smelling substances, the researchers are investigating the impact of these factors on the growth of the isolated bacteria. The resulting data will facilitate the development of an early warning device that specifically targets odour-emitting microorganisms. "Such a device can provide a more flexible option for water reservoir management in understanding impending outbreaks," says Abaoag.

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