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WQA WHITE PAPER ON MICROBIAL GROWTHS IN POINT-OF-USE AND POINT-OF-ENTRY WATER TREATMENT DEVICES

INTRODUCTION

Heterotrophic bacteria are found all around us, including in our drinking water. Many studies have shown Point-of-Use (POU) and Point-of-Entry (POE) devices support the growth of heterotrophic bacteria and cause an increase in HPC levels. However, extensive scientific evidence has consistently verified heterotrophic bacteria present in POU and POE devices pose no health risk, and that these heterotrophic bacteria decrease the levels of harmful pathogens due to bio-competitive exclusion. Thus, it is the position of WQA that the presence of heterotrophic bacteria and measurement of HPC levels in drinking water should not be used to correlate or imply a health risk.

SUMMARY

Heterotrophic bacteria are microorganisms that consume organic compounds for their nutrients. These heterotrophic bacteria are found everywhere; in the soil, air, food, and in water. They can thrive in a variety of water environments, including lakes, streams, well water, hot water heaters, bottled water, and drinking water treatment equipment.

Heterotrophic Plate Count (HPC) is a technique used to estimate the heterotrophic bacteria population in a sample. Bacteria are cultured using a non-selective, low nutrient agar, incubated until colonies grow, then counted. It is important to understand that the name of this test which is used to count heterotrophic bacteria colonies (i.e., HPC) has become synonymous with the bacteria itself in some circles. For example, sources may refer to “the presence of HPC”, instead of “the presence of heterotrophic bacteria.” The U.S. EPA National Primary Drinking Water Regulations do a good job of summing up this issue by stating: “HPC has no health effects; it is an analytic method used to measure the variety of bacteria that are common in water.” (U.S. EPA National Primary Drinking Water Regulation Table, 2016).

Studies have shown POU and POE devices provide a suitable environment for heterotrophic bacteria to grow, and that HPC levels downstream of the treatment equipment can be higher as a result (Geldreich et al., 1985; Calderon, 1988 & 1991; WHO, 2002). However, food contains much higher concentrations of heterotrophic bacteria than water. Tens of thousands to millions of heterotrophic bacteria are consumed every day in fruits, vegetables, meats, cheeses, and other foods without causing illness (Allen et al., 2015). Only 0.048-4.5% of the average consumer’s daily intake of heterotrophic bacteria comes from drinking water (Stine et al., 2004). If the consumption of millions of heterotrophic bacteria from food is not a cause for concern, then neither is the significantly smaller contribution from drinking water.

A number of epidemiological studies have confirmed that drinking water containing heterotrophic bacteria does not pose a risk to human health. The U.S. EPA funded two research studies at the Yale School of Medicine to investigate the potential health risk due to drinking water containing heterotrophic bacteria from point-of-use and point-of-entry drinking water treatment systems. Both studies concluded the filters caused

increased heterotrophic levels but did not result in any difference in gastrointestinal illnesses between those drinking tap water and those using a filter (Calderon, 1988; Calderon & Mood, 1991). A similar study conducted at Monash University in Australia came to the same conclusion (Hellard, 2001).

Other studies have focused on the virulence factors of heterotrophic bacteria. A microbe must possess four virulence characteristics to cause gastrointestinal disease; extracellular enzymes, the ability to kill cells (cytotoxicity), the ability to adhere to cells, and the ability to survive stomach acid. A study conducted at Yale University showed heterotrophic bacteria isolated from water possess very few virulence factors. They found that heterotrophic bacteria could not survive short exposure to low pH, they did not possess significant cytotoxic activity, and the bacteria could not invade human colonic epithelium cells (Edberg et al., 1997). A different study severely immunosuppressed mice and then inoculated them with between 10^4 and 10^5 heterotrophic bacteria isolated from filter water effluent. Even under these conditions the mice did not get sick (Smith et al., 2001).

The benefits of heterotrophic bacteria are also worth noting. Studies have shown that the presence of heterotrophic bacteria in water treatment equipment can protect the end user from other waterborne pathogens (Reasoner et al., 1987, Geldreich et al., 1985). A study carried out by Montana State University looked at the ability of three enteric pathogens to colonize GAC filters. They found these organisms were able to colonize sterile GAC, but when these enteric pathogens were introduced to sterile GAC along with heterotrophic bacteria, the enteric pathogens were not able to compete, and their levels decreased at a rapid rate. When these pathogens were introduced to GAC which already had a mature biofilm of heterotrophic bacteria, the levels of pathogenic bacteria decreased at a much more rapid rate (Camper et al., 1985). These studies show that heterotrophic bacteria have an antagonistic effect on pathogenic bacteria due to competition for resources needed to survive.

WQA's position on heterotrophic bacteria is consistent with both the World Health Organization (WHO) and the U.S. Environmental Protection Agency (EPA). In 2002, WHO held an international meeting of experts in Geneva, Switzerland to address the issue of heterotrophic bacteria in drinking water. This symposium consisted of more than 180 participants from academia, government, industry, public health organizations, and trade associations. This meeting concluded heterotrophic bacteria in drinking water are not a health concern (WHO, 2002).

It should be noted that individuals who are severely immunocompromised (e.g., an absolute neutrophil count <500/uL) may be at risk without specially processed water (WHO, 2002). Such individuals should follow the advice of their physician.

CONCLUSION

The Water Quality Association (WQA) concurs with the position reached by numerous research studies, as well as the United States Environmental Protection Agency and the World Health Organization, that the presence of heterotrophic bacteria in water from home water treatment equipment does not indicate a health risk, and water treated with these devices remains safe to drink.

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