

Evaluating water purification at household level in India

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Household water treatment systems play an important role in safe drinking water supply in India as safety barrier at point of use and contribute to improved public health on short and medium term. In this study three household water purifiers that base on different principles were investigated in order to determine whether and under which conditions they can safeguard the microbial safety of drinking water. The water purifiers consisted of the following treatment trains: (i) activated carbon (AC), ultrafiltration (UF) and reverse osmosis (RO), AC and UV irradiation, (ii) AC and UF, and (iii) AC, passive chlorine dosage and AC. They were examined in a two-phase challenge test using bacteria (*Escherichia coli*) and bacteriophages (MS2) in a laboratory environment. Under normal operation conditions filtering tap water, mean microbial reductions of 4 to 6 log₁₀ and 0 to 3 log₁₀ for *E. coli* and MS2 phages, respectively, were observed that therefore partly comply with WHO requirements. Reduction of protozoa (*Cryptosporidium* oocysts) was estimated based on size exclusion or chlorine exposure to be $\geq 2 \log_{10}$ (membrane-based size exclusion) and $< 2 \log_{10}$ (chlorine-based disinfection), respectively. To further determine their applicability for filtering water sources with higher pollution load, tap water with increased loads of organic and suspended matter simulating turbid river water (which is beyond the intended use of the systems) was studied. Only the multi-stage treatment was able to remove organics and turbidity to $\geq 89\%$. Both tested membrane-based systems suffered from rapid and severe irreversible fouling when challenged with high turbidity whereas the chlorine-based system maintained the production rate, however at the expenses of a lower physico-chemical quality. Hence, none of the tested systems was able to produce water of satisfying physico-chemical and microbial quality at sufficient quantities from raw water with turbid river water quality. Therefore, it is suggested introducing mandatory standardized testing protocols and certification of household water purifiers specifying the usage conditions.