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IMPACT OF PURIFICATION PROCESSES ON ISOTOPIC AND TRACE ELEMENT SIGNATURES IN BOTTLED WATER IN SRI LANKA

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Bottled water is a rapidly growing global commodity, raising concerns regarding source authenticity and safety. Unlike natural mineral water, which undergoes only filtration, bottled drinking water is commonly treated through reverse osmosis, distillation, ozonation, or filtration. To reduce the cost, manufacturers adopt inexpensive purification techniques, while misleading the water source to demand their products. Stable isotopic signatures are important tools for source authentication. This study investigates how purification techniques affect the isotopic integrity ($\delta^{18}O$ and $\delta^{2}H$) and trace elemental concentrations in bottled water, with implications for source verification and safety. Water samples from twelve brands and from the relevant sources were analysed for stable isotope ($\delta^{18}O$, $\delta^{2}H$) and trace element (Cd, Cr, Cu, Pb, Mn, Ni, Se, Zn and As) composition, using liquid water isotope analyser and inductively coupled plasma-mass spectrometer. Isotopic measurements were quadruplicated, and trace element measurements were triplicated. Statistical differences in isotopic measurements were assessed using Welch's *t*-test at 95% confidence level. The $\delta^{18}O$ and $\delta^{2}H$ isotopic compositions of bottled water deviated by 1 – 15‰ and 0 – 16‰, respectively, from their source waters. Significant isotopic shifts ($p < 0.05$) were observed in eight brands for $\delta^{18}O$ and six brands for $\delta^{2}H$, indicating that the purification processes induced significant alterations in isotopic signatures. All source water samples complied with WHO guidelines for trace elements, except one with elevated Se, which was reduced to acceptable levels (< 10 ppb) after processing. Notably, one product sample contained Pb exceeding the WHO limit of 5 ppb, likely due to post-treatment contamination. The findings indicate that purification processes can substantially alter isotopic signatures, complicating efforts to trace water origins, while generally enhancing trace element safety. However, improper handling may introduce contaminants, underscoring the need for strict quality assurance. Robust statistical models incorporating broader spatiotemporal data could help account for isotopic shifts and improve source verification of bottled water.

Keywords: Bottled water, Isotopes, Purification, Source water, Trace elements