ANALYSIS OF GROUNDWATER QUALITY IN SHALLOW WELLS BEFORE AND AFTER DISINFECTION WITH PERACETIC ACID

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ABSTRACT

Peracetic acid has garnered increasing attention as an alternative oxidant and disinfectant in water treatment due to the rising demand to reduce chlorine usage and control disinfection byproducts. The main aim of the research was to assess the well water quality before and after disinfection with peracetic acid. The water samples were taken from 5 wells in the rural areas of Probishtip and Kocani regions of North Macedonia. Sampling was conducted twice during the winter season, both before and after disinfection. Water samples from 5 private wells were analysed for physical, chemical, and microbiological parameters using referent methods. The results were compared with the quality of control water and permissible limited values according to the national legislation. Water quality parameters indicated that all well water samples failed to meet safe drinking water limits. Disinfection with 0.025% peracetic acid did not increase the groundwater quality. The paired sample t-test showed that there was no statistically significant difference in parameters for water quality before and after disinfection. These findings may be linked to permanent sources of faecal contamination in well water. In the subsequent research, the highest concentration of peracetic acid will be used to reach better results in water disinfection. Identification and management of groundwater quality are of utmost importance for maintaining freshwater resources, which is essential for sustainable development. Based on the groundwater quality in different areas, householders can allocate resources for either drinking or agricultural purposes.

Keywords: well water quality, disinfection, peracetic acid

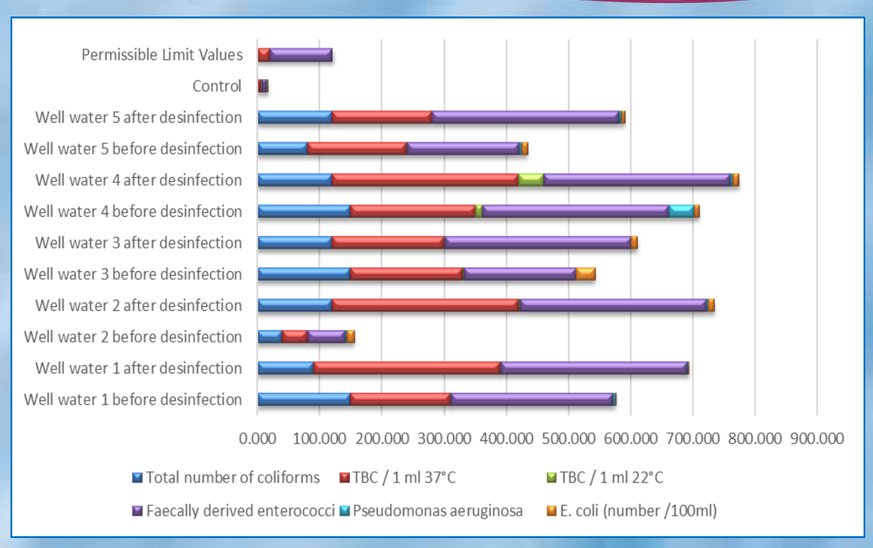
INTRODUCTION

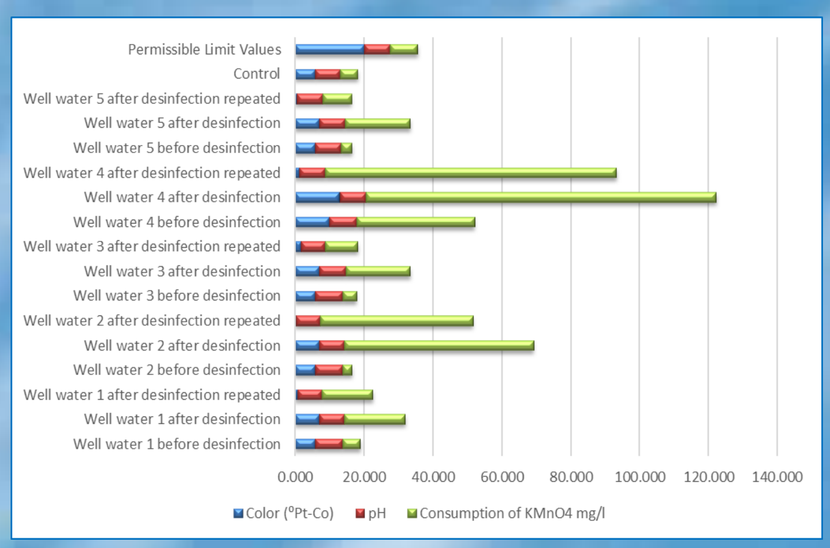
The suitability of groundwater for various uses depends on its quality. Moreover, the groundwater quality is largely influenced by the surrounding area's natural processes and anthropogenic activities. Hence, to safeguard the groundwater in the region, groundwater quality monitoring and assessment are vital steps for effective water resources management. Once the groundwater is contaminated, its quality cannot be restored easily and to device ways and means to protect it. Water quality standards are needed to determine whether groundwater of a certain quality is suitable for its intended use. Shallow wells are neither lined nor covered and are located close to the surface, near to waste dumps or pit latrines, making the water susceptible to high levels of contamination. Hardly any work has been undertaken on monitoring the water quality from shallow wells to assess seasonal changes over a period of time. Shallow wells are one of the most important types of water supplies for rural areas mainly due to their low cost and easy of construction. This research work was undertaken to establish the water quality yielded from shallow wells in two districts of North Macedonia (Probishtip and Kocani) before and after disinfection with peracetic acid.

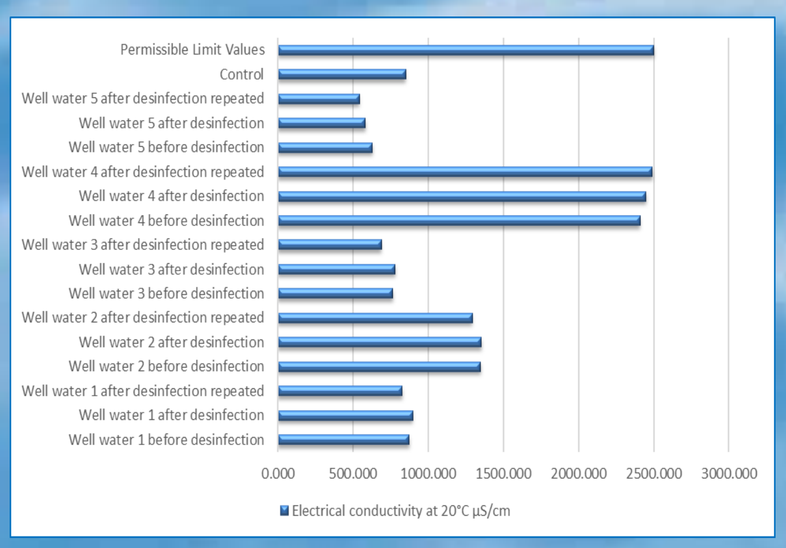
MATERIAL AND METHODS

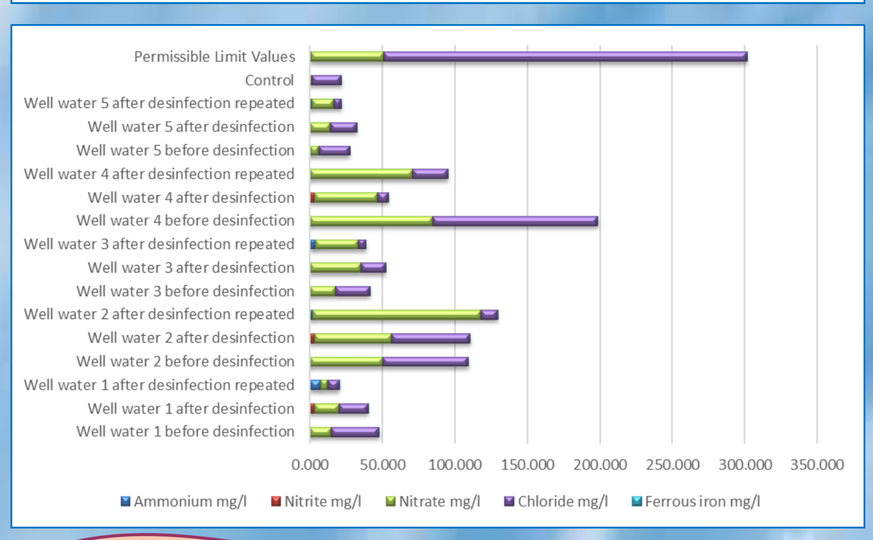
The water samples were taken from 5 wells in the rural areas of Probishtip and Kocani regions of North Macedonia. For the assessment of groundwater quality before and after disinfection with 0.025% peracetic acid, the following drinking water parameters were analyzed in duplicate: physical parameters (colour, pH, consumption of $KMnO_4$, electrical conductivity at 20°C), chemical parameters (ammonium, nitrite, nitrate, chloride, ferrous iron) and microbiological parameters (total number of coliforms, total bacteria count in 1ml at 37°C, total bacteria count in 1 ml at 22°C, faecally derived enterococci, Pseudomonas aeruginosa, E. coli as number /100ml). Heavy metal profile of well water included: As, Pb, Hg, Cg, Fe, Mn, Al, Sb, 63Cu, ^{138}Ba, Be, Bi, B, V, SO_4, Ga, Ge, Sn, K, Ca, Cl, Co, Li, Mg, Mo, Na, Ni, P, Pd, Se, Ag, Sr, Si, Tl, Ti, Cr, ^{64}Zn. The radionuclides presence in well water samples was measured with a Gamma spectrometer Canberra Packard with a high-purity germanium detector.

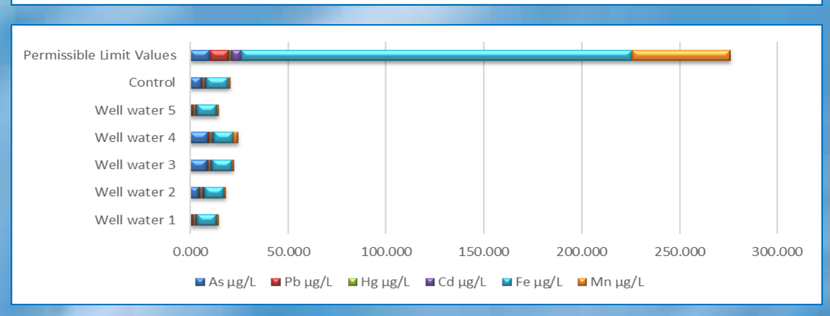
RESULTS AND DISCUSSION

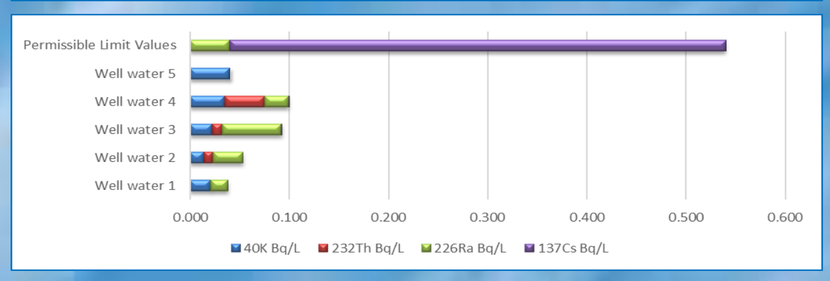


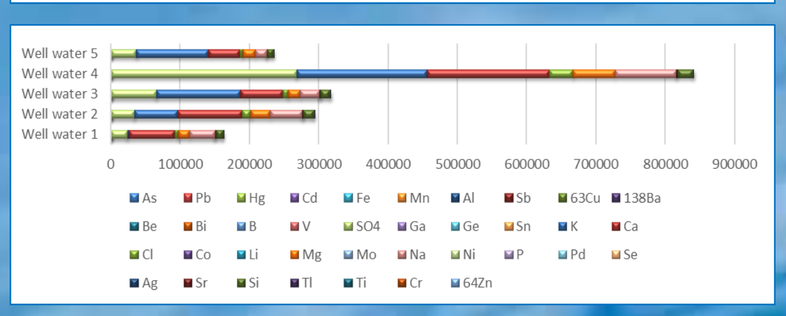












Paired samples t-test	df	t-value
Well water 1 before disinfection vs. well water 1 after disinfection	14	0.902^{NS}
Well water 2 before disinfection vs. well water 2 after disinfection	14	1.889^{NS}
Well water 3 before disinfection vs. well water 3 after disinfection	14	0.860^{NS}
Well water 4 before disinfection vs. well water 4 after disinfection	14	0.159^{NS}
Well water 5 before disinfection vs. well water 5 after disinfection	14	0.937^{NS}

CONCLUSION

All physical and chemical parameters are mostly within the permissible limits set by national legislation, except for nitrates and $KMnO_4$ consumption, which indicate organic contamination. The results showed that shallow wells yield water of very poor microbiological quality. There is an urgent need to develop effective disinfection treatments for purifying shallow well water. However, disinfection with 0.025% peracetic acid did not achieve the required microbiological standards. Further investigation is recommended to optimize the disinfectant's efficiency.