RAMAN SPECTROSCOPY FOR ASSESING THE COMPOSITION OF WATER USED IN BIOTECHNICAL IABORATORIES

P.E. Timchenko[1], A.D. Volov[2], E.V. Timchenko[1,2], L.T. Volova[3], A.A. Chernukhin[1]
[1]Samara National Research University, Samara
[2]Samara State Technical University, Samara
[3]Samara State Medical Unuversity, Institut of Experimental Medicine and Biotechnology, Samara

INTRODUCTION

Neglecting water quality in laboratory applications can lead to unsatisfactory experimental results. To achieve the required water purity for biotechnological requirements, deionization is widely used in laboratory settings. This process involves the removal of ions using synthetic resins and electrodialysis, which regenerates the resins. This method effectively removes ions, but is not completely sterilizing, as it does not completely remove non-ionic organic compounds and microorganisms from the water. Among existing water quality monitoringmethods, Raman spectroscopy has proven itself to be an effective tool for contaminant detection, providing rapid and non-destructive determination of critical impurities, which directly impacts the reliability and success of biotechnological research.
Objective: to evaluate purity of the composition of deionized water using Raman spectroscopy.

MATERIALS AND METHODS OF RESEARCH

The experiments were conducted for 4 groups of water: 1 - «Aqualab AL-2 EDI» deionized water; 2 - «DMA-2B OPTIMA» deionized water; 3 - ultrapure water «Atlant»; 4 - tap water.

The research samples 1st and 2nd were processed using a deionized systems from Biotech Research Institute. 3rd sample was purchased from another manufacturer.

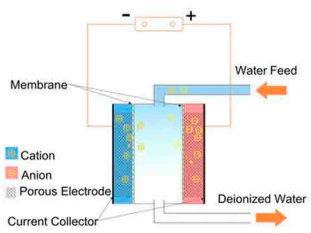

Figure 1. deionization schematic diagram

Figure 2. Aqualab AL-2 EDI deionized system

Figure 3. DMA-2B OPTIMA deionized system

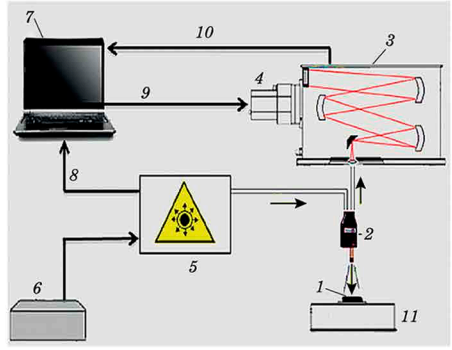

Figure 4. Raman spectroscopy stand:
1 - cuvette with water; 2 - raman probe RPB785;
3 - Shamrock sr-303i spectrometer;
4 - built in DVA420A-OE cooled camera;
5 - LuxxMasterRamanBoxx-785.0 RB-04 laser module; 6 - power supply of the laser module;
7 - computer; 8,9,10 - information cables;
11 - coordinate cable.

RESULTS OF RESEARCH

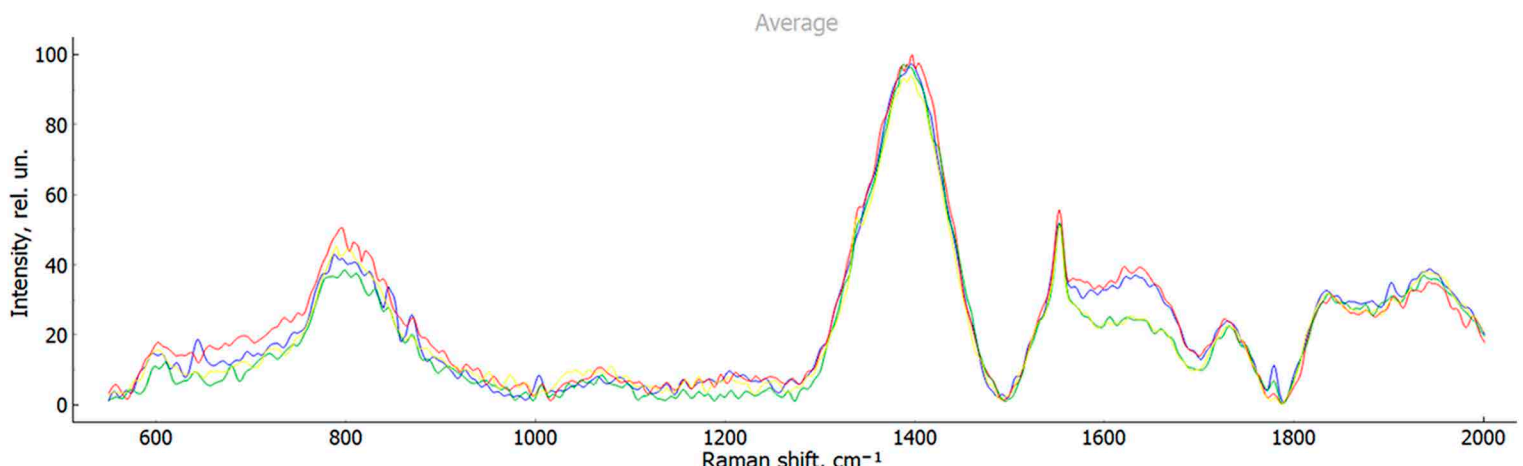

Figure 5. Average spectra of samples of the water: green line - Aqualab AL-2 EDI; red line - DMA-2B OPTIMA; blue line - ultrapure «Atlant»; yellow line - tap water.

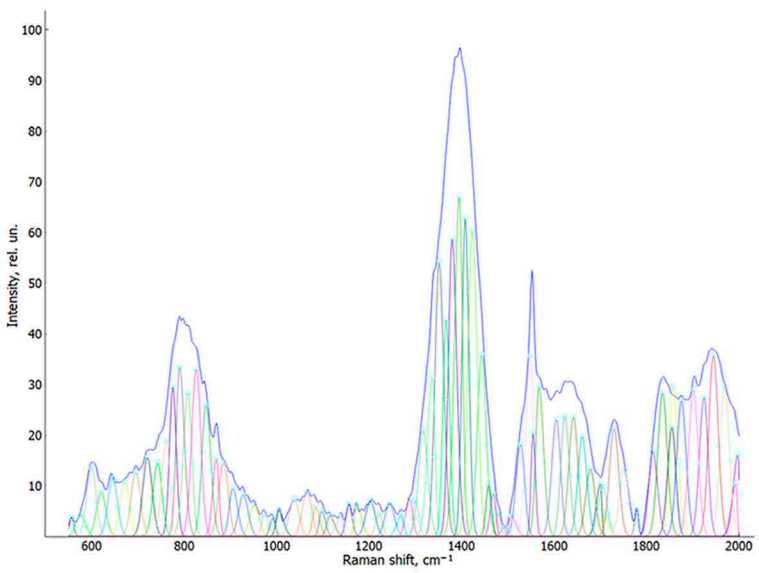

Figure 6. Spectral contour decomposition of the researched samples

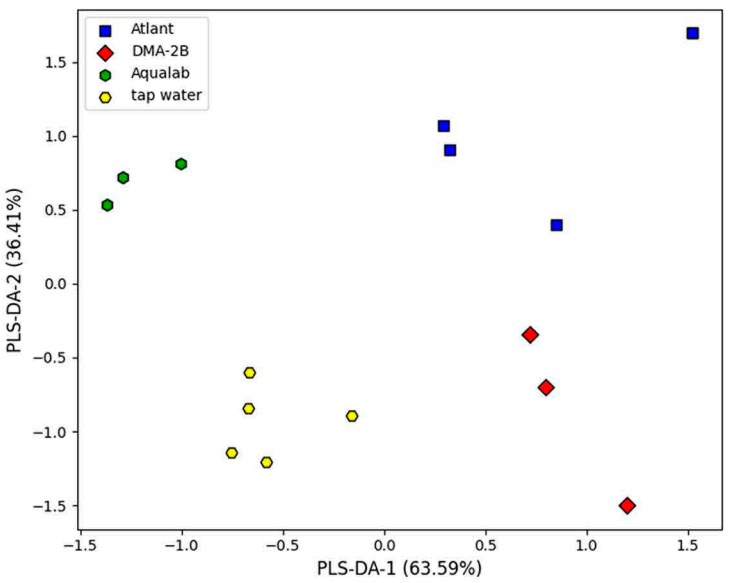

Figure 7. The charts of values of partial least-squares discriminant analysis

CONCLUSION

A discriminant analysis of Raman spectra showed that deionized water DMA-2B OPTIMA has a spectral composition similar to that of commercially available deionized ultrapure water Atlant, meaning it has the best composition and degree of deionization compared to the other studied groups. It was found that in the Raman spectral region of ~1200 cm-1, all three studied groups of deionized water have similar spectral properties, which may indicate complete deionization.
It is demonstrated that Raman spectroscopy can be used to evaluate the composition of deionized water used in biotechnology laboratories.