RAMAN SPECTROSCOPY METHOD FOR ASSESSING THE QUALITY OF BUFFER SOLUTIONS USED IN BIOTECHNOLOGY LABORATORIES

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INTRODUCTION

Buffers play a key role in modern biotechnological research, as they provide conditions that mimic the biological environment of the body. They are used to cultivate cell cultures and maintain their viability, to wash cellular structures from metabolic products, and to conduct various cellular and biochemical analyses. The quality of buffer solutions is one of the determining factors in obtaining reliable and reproducible results in biotechnological experiments. Traditional methods of buffer solution quality control have a number of significant limitations. Optical methods have found widespread use for various biomedical applications. Raman spectroscopy can be used to assess the quality of buffer solutions used in biotechnology laboratories.
Objective: To examine the potential application of Raman spectroscopy to assess the quality of buffer solutions (Dulbecco and Hanks).

MATERIALS AND METHODS OF RESEARCH

The experiments were conducted for 4 groups of samples: 1 - drinking water (GOST R 51232-98); 2 - Dulbecco's DPBS solution (DPBS) without Ca^{2+} and Mg^{2+}; 3 - deionized water for solution preparation manufactured by the Biotech Research Institute; 4 -Hanks balanced salt solution (HBSS).

The research samples were provided from Biotech Research Institute. The experiments were performed using Raman spectroscopy using an experimental setup which was represented in figure 1.

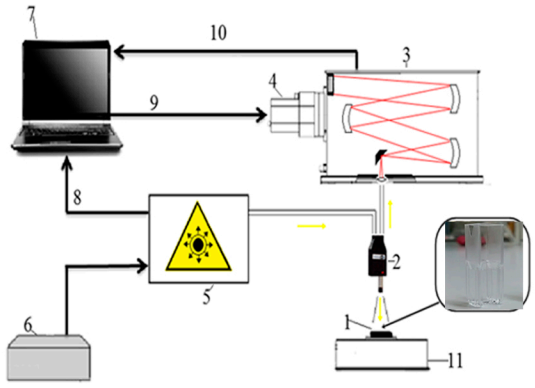


Figure 1. Raman spectroscopy stand:
1 - cuvette with solution;
2 - raman probe RPB785;
3 - Shamrock sr-303i spectrometer;
4 - built in DVA420A-OE cooled camera;
5 - LuxxMasterRamanBoxx-785.0 RB-04 laser module;
6 - power supply of the laser module;
7 - computer;
8,9,10 - information cables;
11 - coordinate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

RESULTS OF RESEARCH

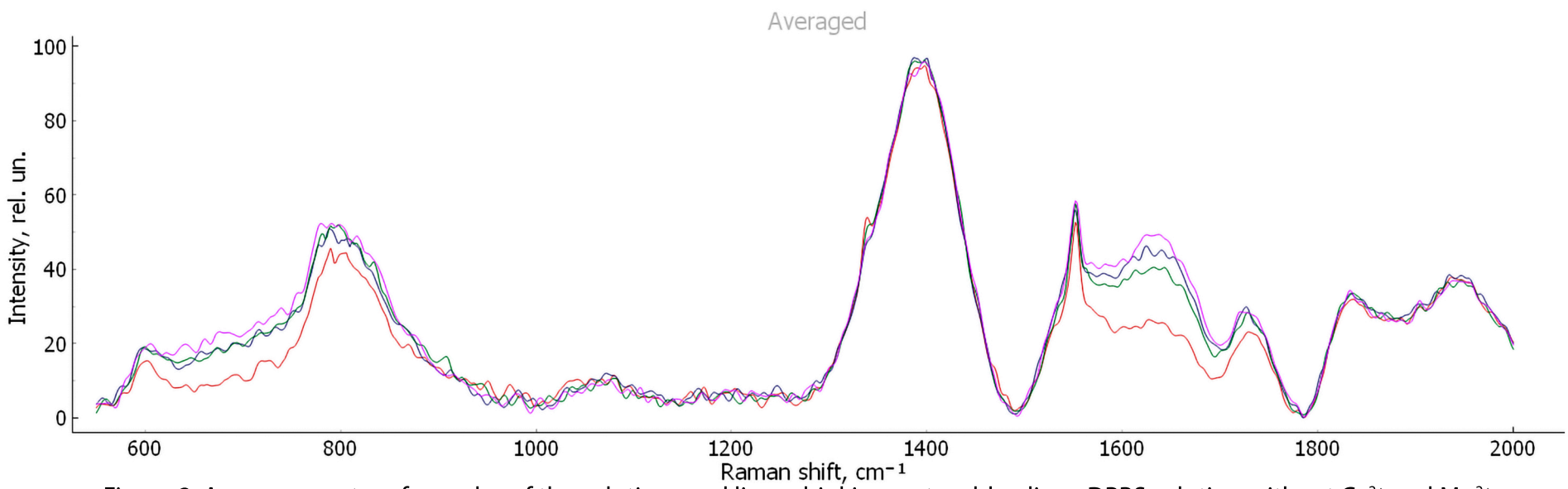


Figure 2. Average spectra of samples of the solutions: red line - drinking water; blue line - DPBS solution without Ca^{2+} and Mg^{2+}; green line - deionized water for solution preparation; purple line - HBSS solution.

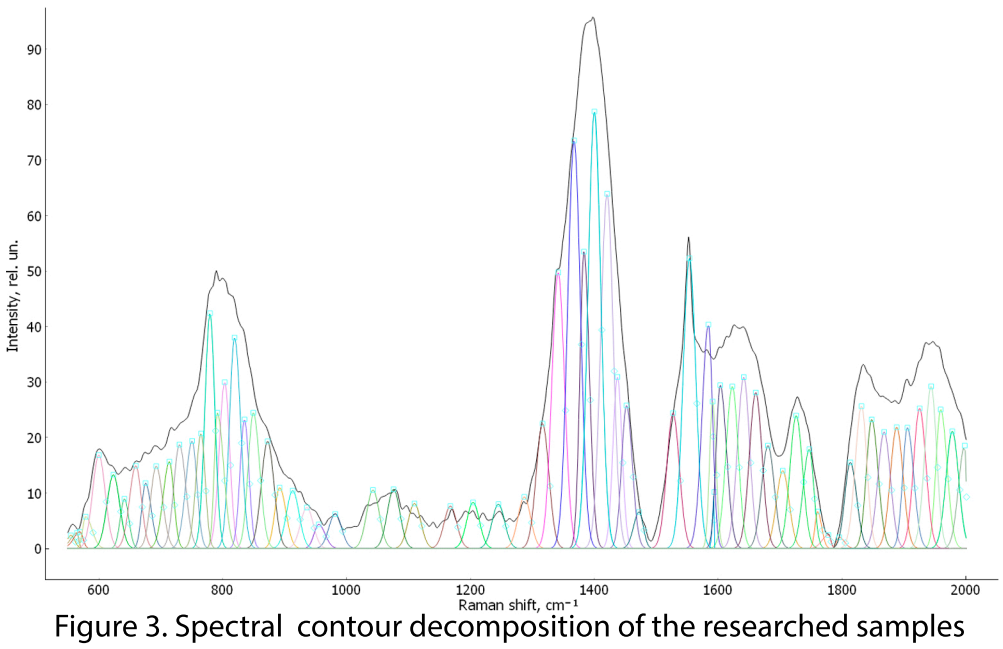


Figure 3. Spectral contour decomposition of the researched samples

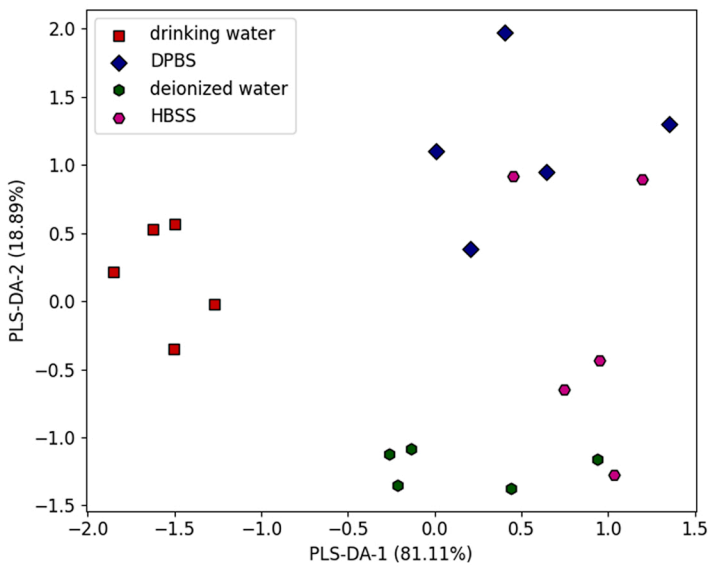


Figure 4. The charts of values of values of partial least-squares discriminant analysis

CONCLUSION

Raman spectroscopy analysis revealed that the Hanks solution and Dulbecco's solution without Ca^{2+} and Mg^{2+} were prepared using highly deionized water; this is confirmed by a characteristic Raman response in the 1660–1700 cm^{-1} region and by PLS-DA analysis results.
It has been demonstrated that Raman spectroscopy is an effective, non-destructive tool for the characterization and quality control of various buffer solutions used in biotechnology laboratories. The buffer solution samples analyzed meet the quality requirements for reagents used in biotechnological research and can be considered a viable alternative to imported counterparts.