

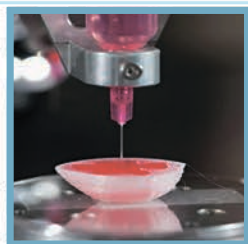


APPLICATION OF OPTICAL METHODS IN THE STANDARDIZATION OF COLLAGEN-CONTAINING HYDROGEL FOR 3D BIOPRINTING OF SUPPORTING AND CONNECTIVE TISSUES

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INTRODUCTION

The paper presents the results of the application of optical methods in the standardization of collagen-containing allogeneic hydrogel produced at the Biotech Research Institute (Samara, Russia) from bioimplants of the Lioplast® trademark in comparison with the hydrogels available on the market from Rokit and Cellink companies. The Raman spectroscopy method was used as the main research method. An additional research method was the method of IR Fourier spectroscopy. As a result of the conducted research using optical methods, it was found that the collagen structure is completely preserved in the composition of the allogeneic hydrogel produced at the Biotech Research Institute (Samara, Russia). Hydrogels of the imported production companies ROKiT and Cellink also have a similar

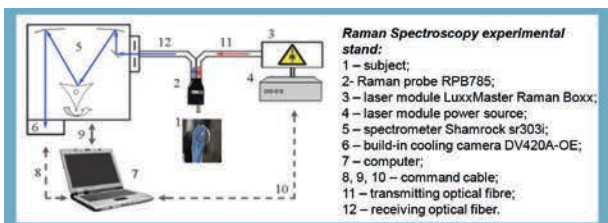
MATERIALS AND METHODS OF RESEARCH

Group 1 - allogeneic collagen-containing hydrogel, Samara, Russia, Biotech Research Institute, Lioplast®

Group 2 - hydrogel PureCol® «CELLINK» (Sweden)

Group 3 - hydrogel INVIVO-GEL-ESSENTIAL (Korea)

Group 4 - collagen sample I type «CELLINK» (Sweden).



RESULTS OF RESEARCH

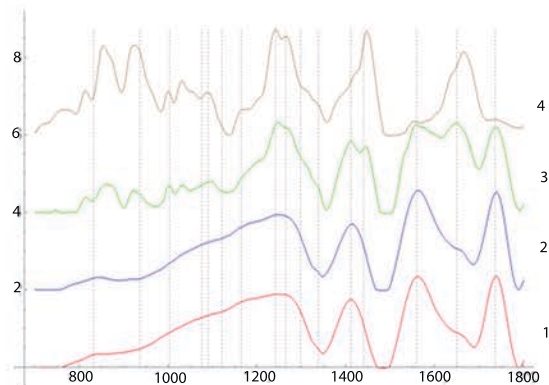


Figure 1 - Averaged Raman spectra of the studied samples:
 1 - allogeneic collagen-containing hydrogel (Russia, Samara, SamSMU, Research Institute "Biotech", Lioplast®);
 2 - PureCol® "CELLINK" hydrogel (Sweden)
 3 - INVIVO-GEL-ESSENTIAL hydrogel (Korea)
 4 - a sample of type I collagen "CELLINK" (Sweden).

	precision	recall	f1-score	support
Hydrogel	0.00	0.00	0.00	2
PureCol	0.00	0.00	0.00	1
ESSENTIAL	0.40	1.00	0.57	2

Figure 3 - Metric values for each sample group.

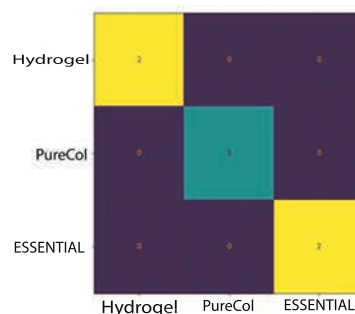


Figure 2 - Decision matrix

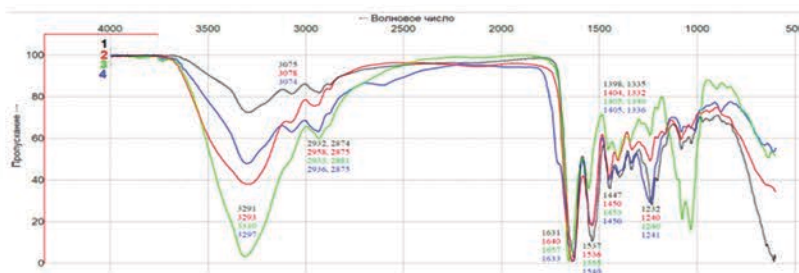


Figure 4 – Averaged IR-Fourier spectra of the studied samples:
 1 - is a sample of type I collagen "CELLINK" (Sweden).
 2 - INVIVO-GEL-ESSENTIAL hydrogel (Korea)
 3 - PureCol® "CELLINK" hydrogel (Sweden)
 4 - allogeneic collagen-containing hydrogel (Russia, Samara, SamSMU, Research Institute "Biotech", Lioplast®)

CONCLUSION

As a result of the conducted studies using the Raman spectroscopy method, it was found that the composition of the studied hydrogels of imported production, as well as the manufactured collagen-containing hydrogel, revealed AMIDI (KR lines~1200-1300cm⁻¹), Amide II (KR line~1554cm⁻¹), CH2bend in g-and scissoring modes of collagen and phospholipids~1450 cm⁻¹ and Amid I (KR line~1650-1665cm⁻¹). These CD lines indicate the presence and preservation of the collagen structure in the composition of the studied hydrogels. The spectral composition of the allogeneic hydrogel developed at the Biotech Research Institute (Russia, Samara, Biotech Research Institute, Lioplast®) has a similar composition to imported hydrogels. Additionally, using IR Fourier spectroscopy, it was found that the main absorption bands in the infrared spectrum of the allogeneic collagen hydrogel of the Biotech Research Institute are associated with characteristic fluctuations of specific groups in collagen polypeptides and are identical to the IR spectrum of the human type 1 collagen standard CELLINK (Sweden), which reflects their qualitative composition and confirms the preservation of collagen structure, and also has similar absorption bands with commercial hydrogels from Rokit and Cellink companies, this indicates the possibility of using the proposed allogeneic hydrogel of the Biotech Research Institute in the future as an alternative to analogues available on the market as part of the implementation of the import substitution program.