

MCR-analysis of the Raman spectra of the skin of different parts of the body.

Elena Sorokina, Yulia Khristoforova, Irina Matveeva

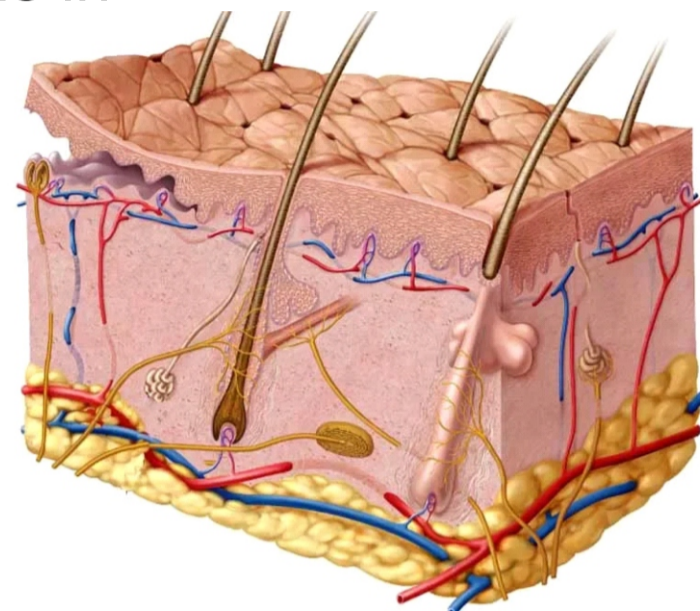
Samara National Research University, Samara, Russia

Motivation

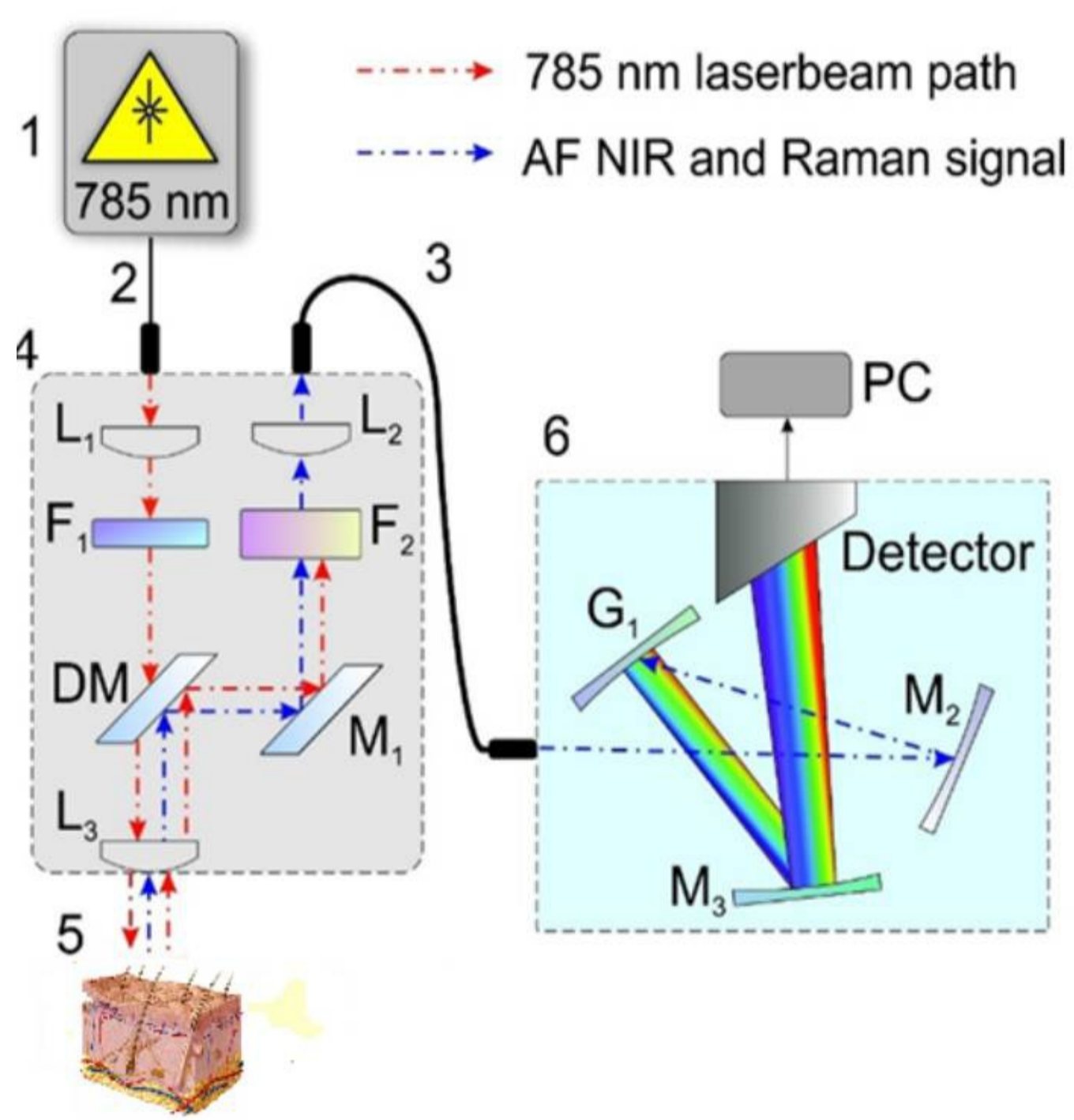
The purpose of this work is to analyze the variability of spectral characteristics of the skin of different localizations in a normal state using the method of resolution of multidimensional curves (MCR).

Tasks:

- To conduct experimental registration of Raman spectra of the skin at different localizations;
- Process the results obtained;
- Perform decomposition into components using MCR-analysis;
- Evaluate the results obtained;



Materials and methods



- 1 – radiation source
2, 3 – optical fibers
4 - optical probe
5 – skin area
6 - spectrometer

10 people II skin phototype participated in the experiment.

Spectra were recorded:

- | | |
|-----------------------|---------------------|
| 10 from the forehead, | 10 from the cheek, |
| 6 from the neck, | 10 from the lobe, |
| 9 from the palm, | 8 from the forearm, |
| 19 from the ankle, | 10 from the back, |
| 10 from the abdomen | |

- Pre-processing of spectra:
1. background removal by a 6 degree polynomial;
2. Savitsky-Goley smoothing filter

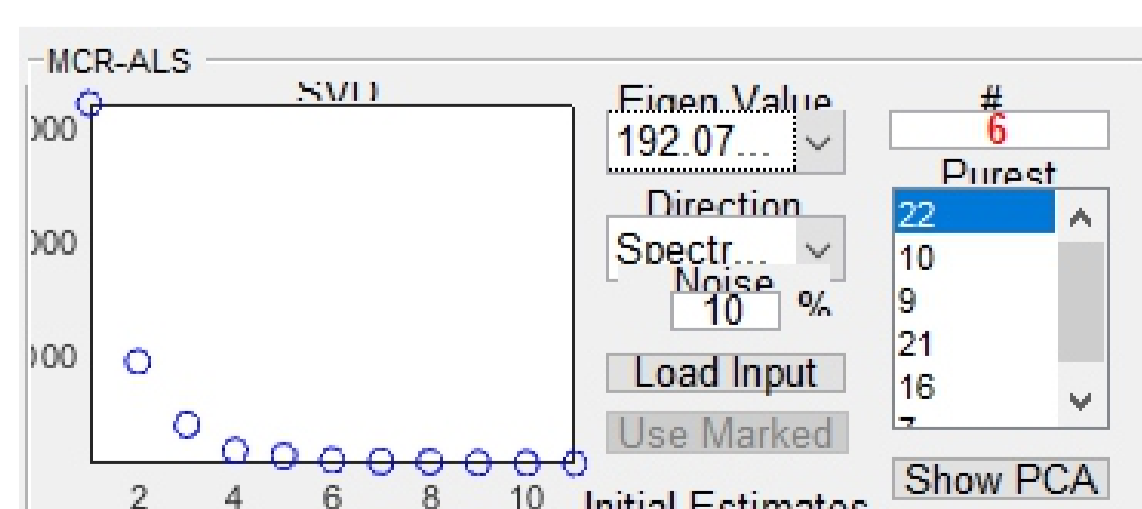
MCR-ALS method of decomposition of skin spectrum d into individual components:

$$d = c_1 s_1^T + c_2 s_2^T + \dots + c_A s_A^T$$

where c_1, c_2, \dots, c_A - are the concentrations of individual components, s_1, s_2, \dots, s_A - are the spectra of individual components.

MCR analysis allows you to:

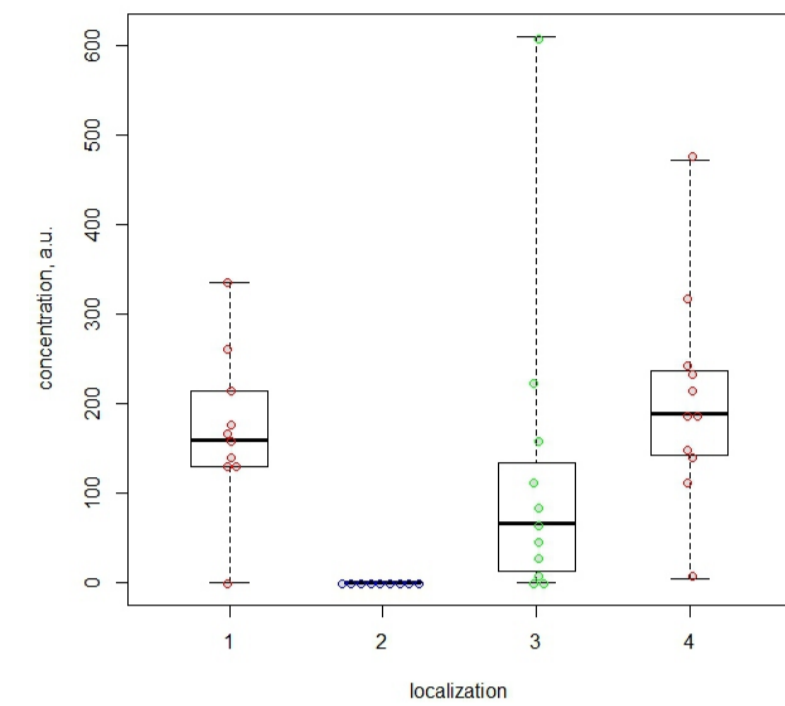
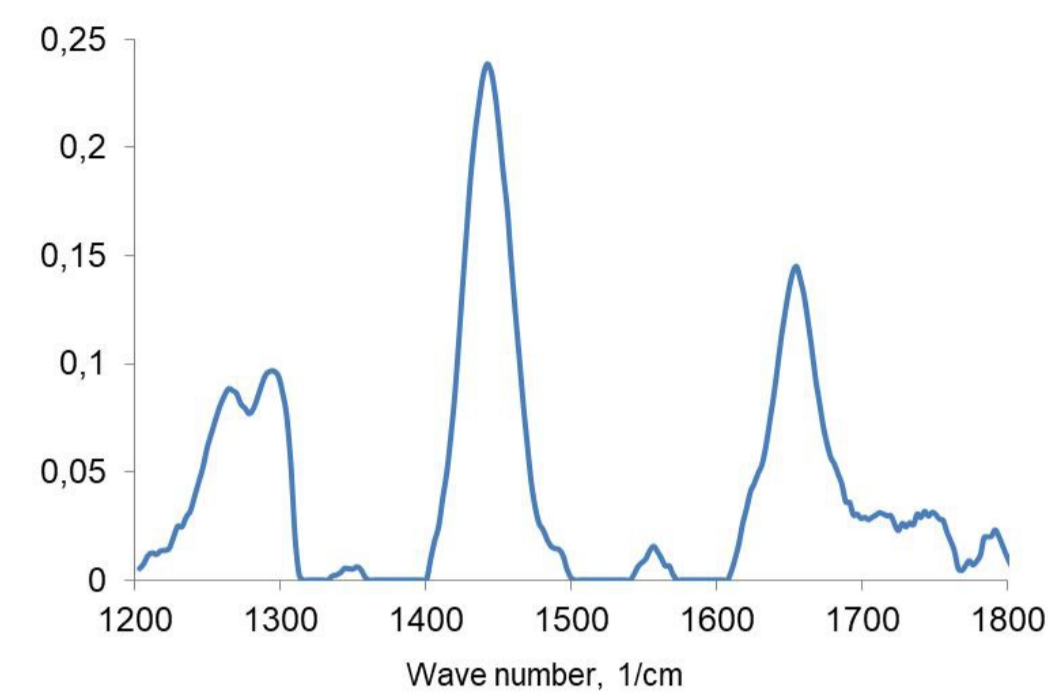
- physically interpret the components;
- to determine the relative concentrations of the components;
- to evaluate the relative contribution of the components to the original spectrum.



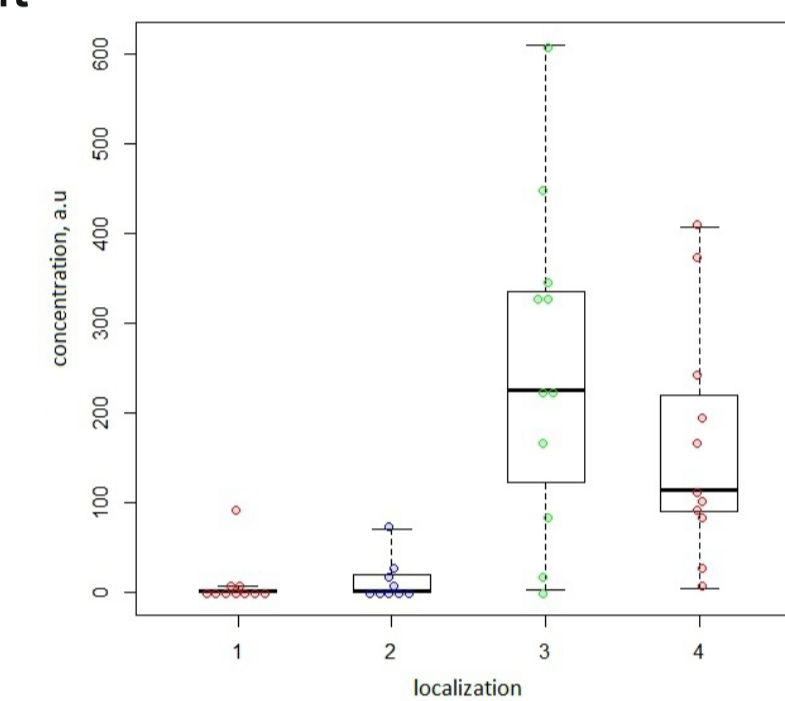
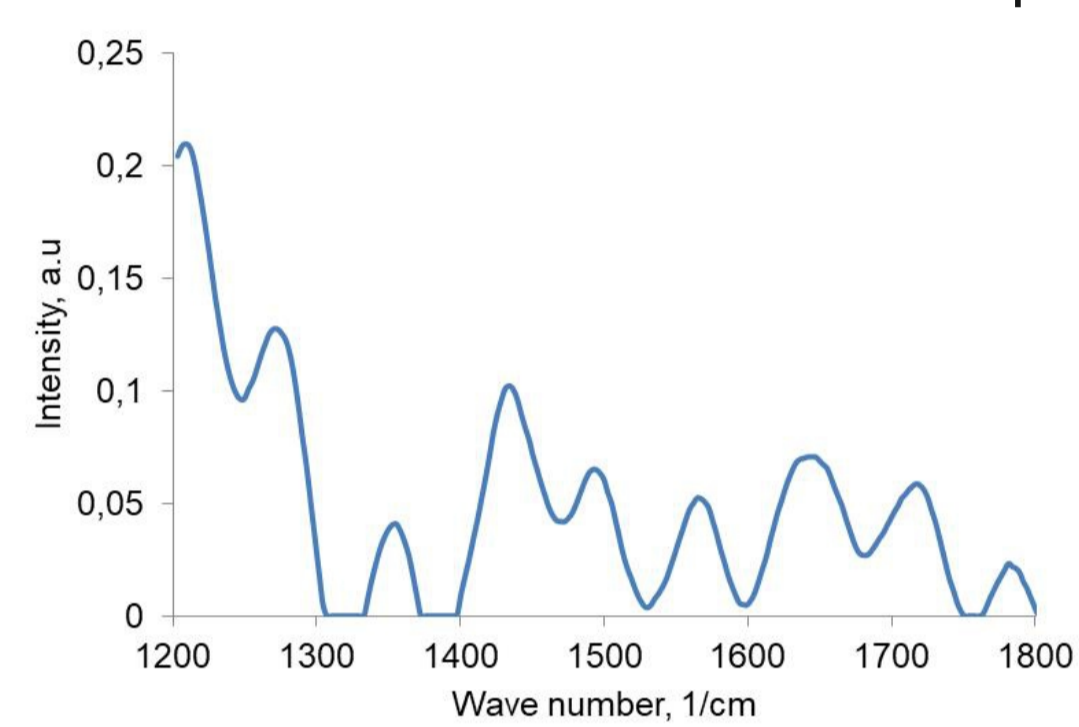
singular decomposition into components

Results

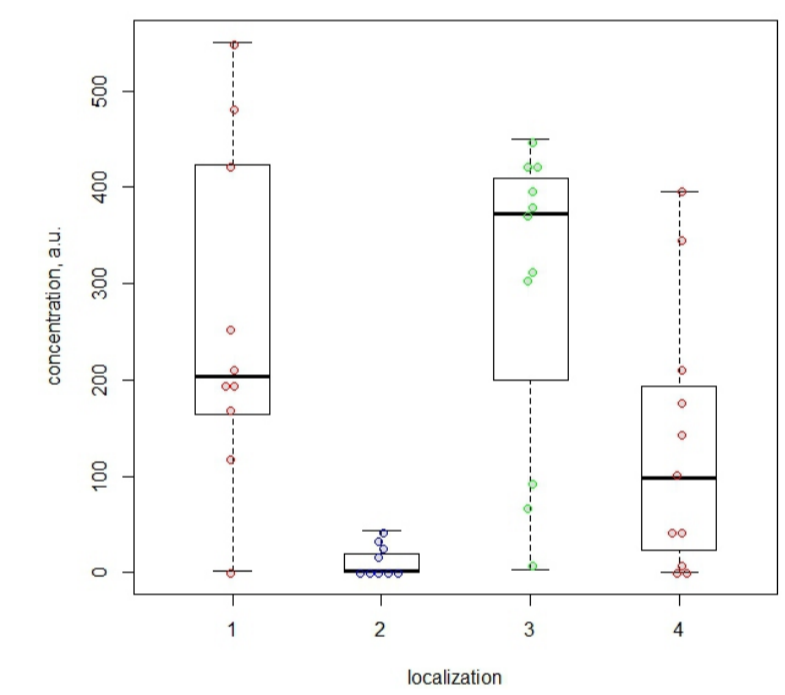
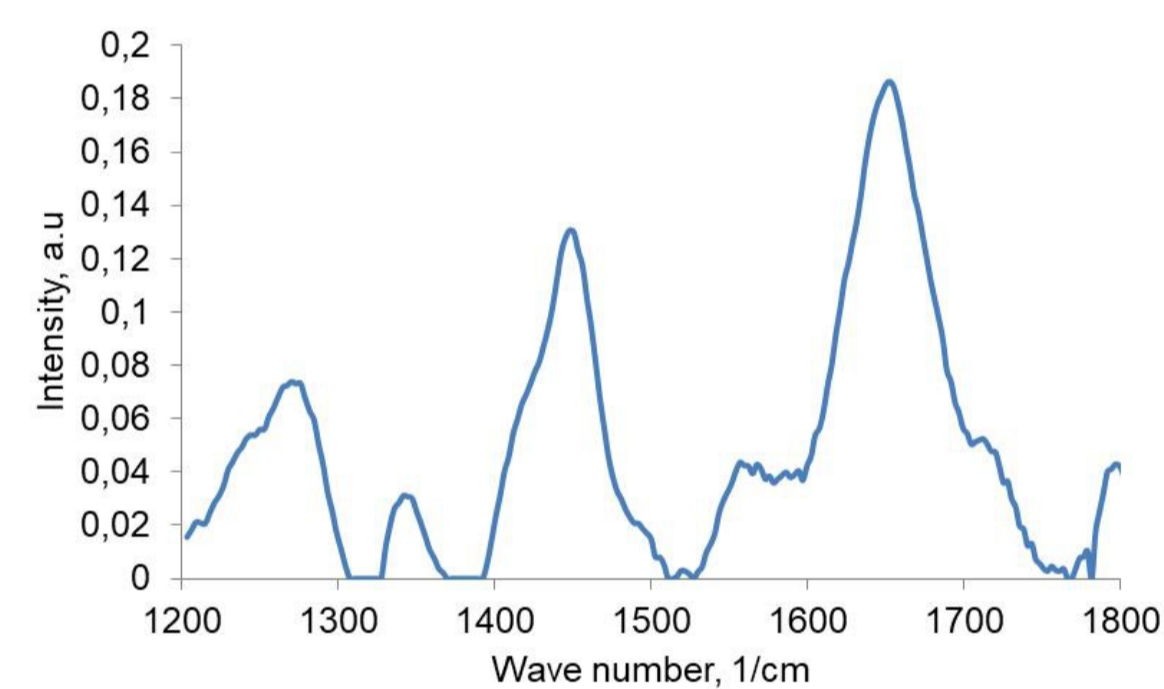
1 MCR-component



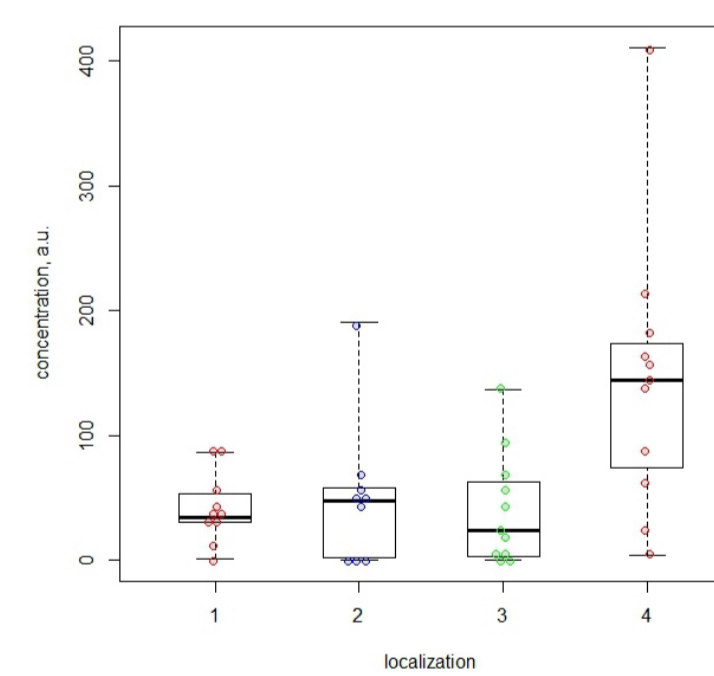
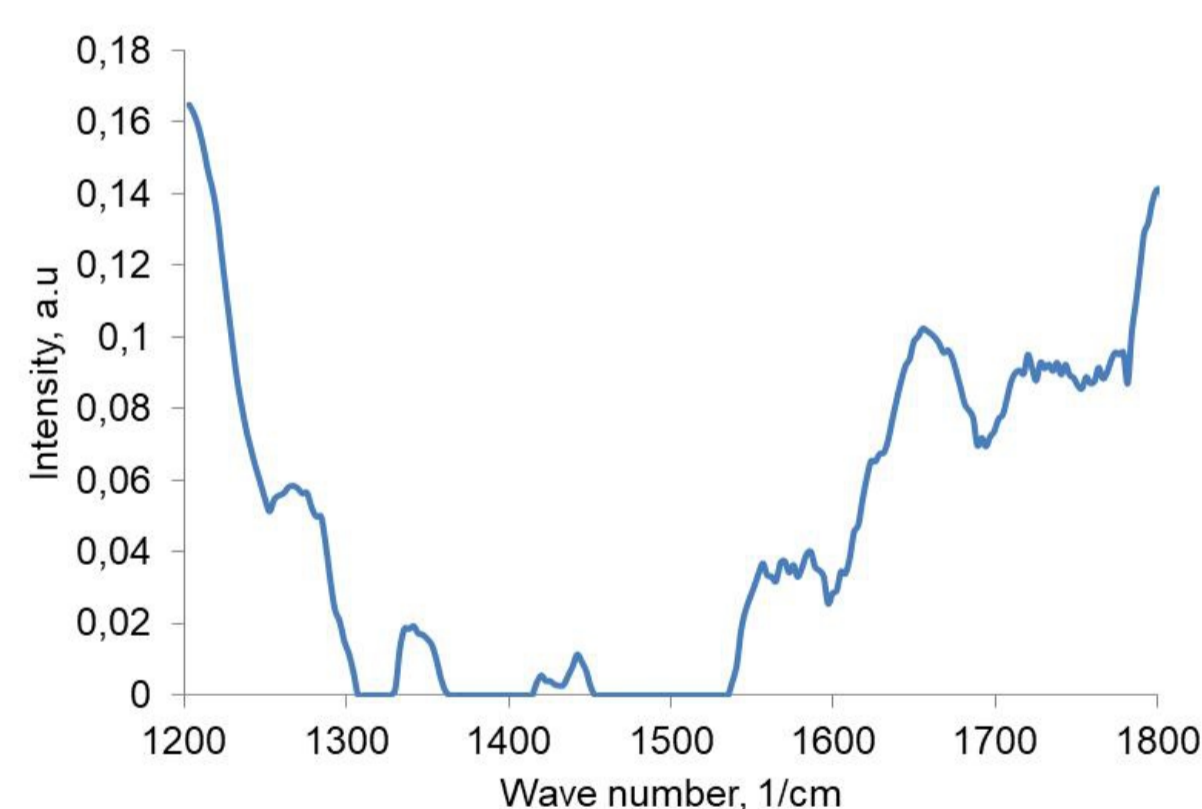
3 MCR-component



4 MCR-component



5 MCR-component



On the boxplot: 1 - palm, 2 - forearm, 3 - stomach, 4 - cheek

Conclusions

When decomposed into chemical components, the Raman spectra of the skin of different phototypes are in a normal state:

1. When decomposed into chemical components, the raman spectra of the skin of different localizations differ in the relative concentrations of the 3 and 4 components.
2. The level of 1, 2 and 5 components varies slightly for different localizations.
3. Such results can be explained by the physiological and biochemical features of the skin on various anatomical parts of the body.