



Employment of Chemometric Methods for Determining the Wood Species Used for the Construction of Wooden Churches from Transilvania

V. C. Măruțoiu¹, I. Bratu², I. Feher², O. F. Măruțoiu-Nemes¹, C. Măruțoiu¹

¹ Babeș-Bolyai University, Faculty of Orthodox Theology, Cluj-Napoca;

² National Institute for Research and Development of Isotopic and Molecular Technologies; Romania

Abstract

FTIR spectra of fir and pine samples from various wooden churches built in different historical periods were analysed. Fourier Transform Infrared spectroscopy [1] measurements were performed with a Jasco 6100 spectrometer in the 4000 to 350 cm⁻¹ spectral range with a resolution of 4 cm⁻¹ employing several mg of sample and the KBr pellet technique. The spectra were processed by Spectral Analysis software.

Introduction

All statistical interpretations were processed using SPSS (IBM, USA). The chemometric methods employed aimed for two purposes, namely to differentiate the samples according to their age (starting from XIX century to modern wood samples) and between fir and pinewood essences. Linear discriminant analysis (LDA) was applied, having as the first discrimination variable the wood age and second variable being the wood essences.

Materials & Methods

The validation of proposed models was made using leave one out classification [2]. The matrix used for further interpretation consisted of 13 and 14 samples, with characteristic registered IR spectra. Some samples were omitted from the analysis each time, because one single sample cannot form a separate group, because such results could lead to a wrong interpretation. Therefore for the first case, since two groups were compared, one discriminant function was obtained, having statistical

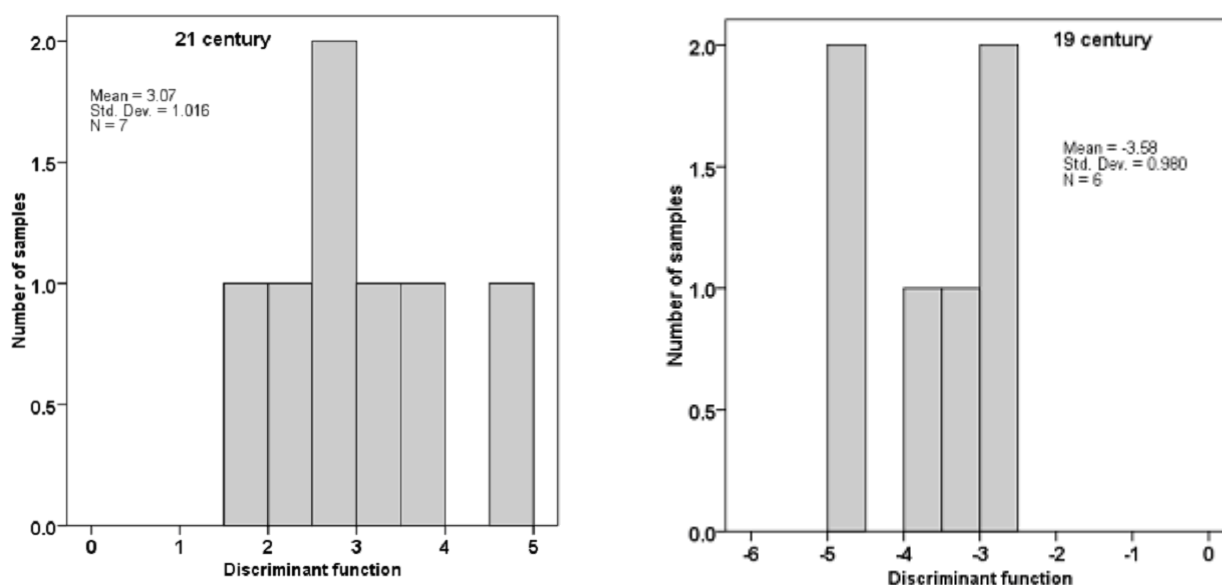


Figure 1. Samples distribution after using LDA according to wood age

significance ($p=0.001$). The percent for initial and cross validation procedure was 100 %. The most significant wavelengths for this classification criterion were at 3685, 1778 and 353 in the recorded IR spectrum.

Results

The graphical representation can be seen below, in Figure 1. For wood essences differentiation, one discriminant function was obtained ($p=0.001$), which was able to make an initial classification of 100 % and the percent for cross validation of 92.9 %, and only one sample being misclassified. The significant wavelengths which were used in LDA model, are at 2931, 2917, 3204 and 1201 in the recorded spectrum. The sample distribution is presented in Figure 2.

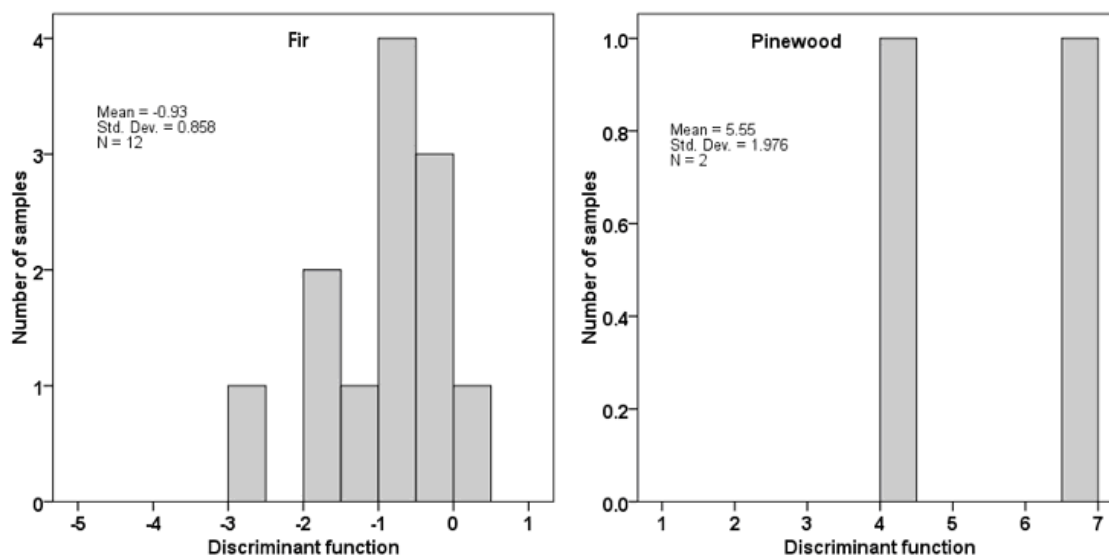


Figure 2. Sample classification using LDA according to wood essences

Conclusions

For the first case, since two groups were compared, one discriminant function was obtained, having statistical significance ($p=0.001$). For wood essences differentiation, one discriminant function was obtained ($p=0.001$), which was able to make an initial classification of 100 % and the percent for cross validation of 92.9 %, and only one sample being misclassified.

References

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- 2) S. Carlesi, M. Ricci, C. Cucci, C. Lofrumento, M. Picollo, M. Becucci, Multivariate analysis of combined reflectance FT-NIR and micro-Raman spectra on oil-paint models, *Microchemical Journal*, 124, 703-711, 2016