2nd PANHELLENIC CONGRESS OF MEDICAL PHYSICS
4-6 OCTOBER 2024| EUGENIDES FOUNDATION

Raman Spectroscopy towards the evaluation of *Candida auris* metabolomics

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Background: *Candida auris* is an emerging fungal pathogen that has been designated as an urgent and critical public health threat by CDC and WHO. This pathogen is associated with hospital outbreaks and exhibits a higher level of resistance to antifungal drugs compared to other *Candida* species. Here, we employed Raman spectroscopy to characterize *C. auris* grown on modified Dixon's agar and to differentiate it from *C. albicans* and *C. parapsilosis*.

Materials & Methods: The profile of three major pathogens, *C. auris*, *C. parapsilosis*, *C. albicans* was analyzed with Raman spectroscopy. The strains were cultured on Dixon's agar for 14 days at 32°C. The Raman setup consisted of a laser (Mini-Benchtop Stabilized Laser, Coherent, Santa Clara, CA, USA) operating at 785 nm with maximum power output of 300 mW, and an f/1.3 Raman spectrometer with the excitation and collection optical fibers coupled to a single probe tip (Wasatch Photonics, Morrisville, NC, USA). Multivariate analysis was performed using in-house developed software.

Results: PCA was applied to discriminate *C. auris* from other *Candida* species. The results of the PCA method are shown on the PCA Scores plot (Fig. 1) and PCA Loading plot (Fig. 2). The *Candida* clusters differentiation is explained by the PC1. In PCA Loading plot of PC1 (Fig. 2), we could trace the contribution of 1171 cm^{-1} and 1452 cm^{-1} bands to discrimination of *Candida* species. Intensity ratios (I_{1452} / I_{1171}) were found to be different among the clusters with high ratios (*C. albicans* & *C. auris* A) attributed to high metabolic activity and low ratios (*C. auris* B & *C. parapsilosis*) attributed to low metabolic activity (Table 1).

Conclusion: Raman spectroscopy offers a rapid (within seconds) method for identifying and classifying *Candida* yeasts for the effective management of infections caused by such pathogens based on their metabolomic profile.

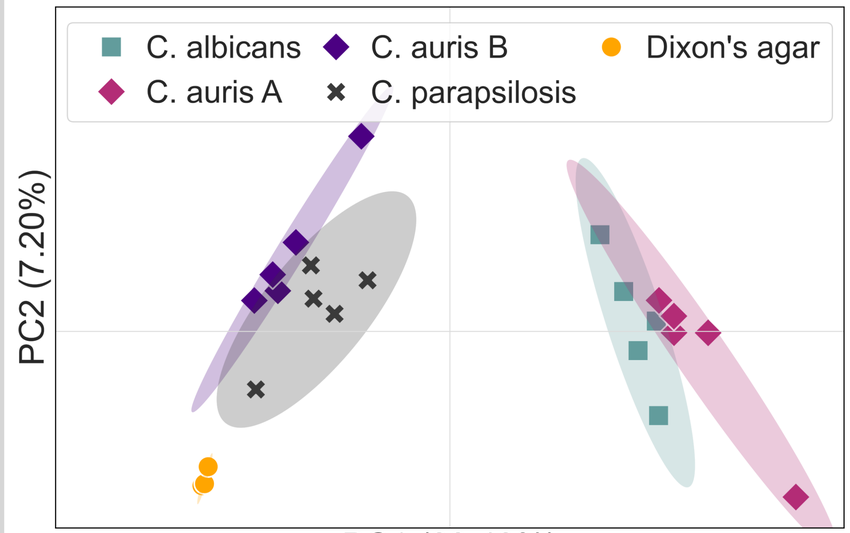

Fig. 1. PCA Scores plot. Four clusters are developed on PCA Scores plot, and include *C.albicans*, *C.parapsilosis* and *C.auris*. *C.auris* samples are classified into two clusters, which are named *C.auris* A and *C.auris* B.

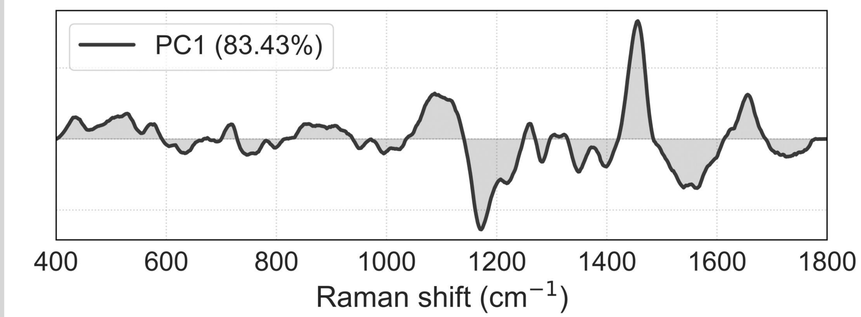

Fig.2. PCA Loading plot of PC1.

Species	*Candida albicans*	*Candida auris* **A**	*Candida auris* **B**	*Candida parapsilosis*
I_{1452} / I_{1171}	4.6	10.7	0.3	0.4

Table 1. Calculated band ratios for the four clusters of *Candida* species.