Mushroom's evaluation based on FT-IR fingerprint and chemometrics

I Feher[1], V Floare-Avram[1], F Covaciu[1], O Marincas[1], D A Magdas[1] and C Sârbu[2]

[1] National Institute for Research and Development of Isotopic and Molecular Technologies, 67-103 Donat, 400293 Cluj-Napoca, Romania

[2] Faculty of Chemistry and Chemical Engineering, Babeş-Bolyai University, 11 Arany Janos, 400028 Cluj-Napoca, Romania

Corresponding author: ioana.feher@itim-cj.ro

Cantharellus cibarius

Armillaria mellea

Aim of the work

- Wild edible mushrooms evaluation using FT-IR analysis and classical and advanced chemometric methods

Introduction

➢Mushrooms are important source of **vegetarian proteins**, along with other **bio-active molecules.**

➢Infrared spectroscopy provides a non-destructive measurement, user-friendly, which is able to assess the presence of bio-active compounds within minutes, thus becoming suitable for classification purposes, where a large data set is needed.

➢Three mushroom species grown in Romania, were selected for this study:
***Armillaria mellea* (12 samples), *Boletus edulis* (31 samples) and *Cantharellus cibarius* (34 samples).**

➢For highlighting the subtle differentiations that occurred in the obtained IR spectra, some chemometric methods were applied: **principal component analysis (PCA), linear discriminant analysis (LDA)** and **k nearest neighbour (kNN).**

Samples preparation and measurement

Samples collection

→ Drying 60 ºC → Grounding into a fine powder → FT-IR analysis 4000–400 cm^{-1} → Chemometric processing

- -principal component analysis (PCA)
- -linear discriminant analysis (LDA)
- -k nearest neighbor (kNN)
- -fuzzy c-means clustering (FCM)

Results and discussion

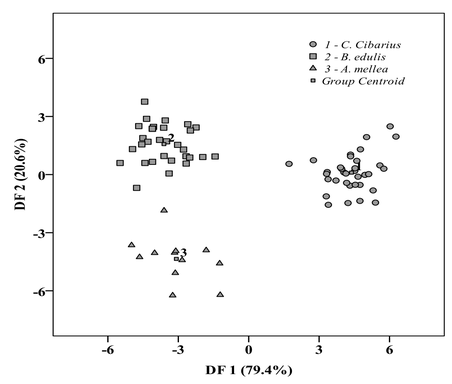

Fig. 1 Mushrooms differentiation after applying LDA

- 100 % initial classification
- 97.4% cross validation
- Fingerprint region 400 to 925 cm^{-1}

this region could be assigned to α-glucans and β-glucans (d'Souza et al. 2017; Meenu et al. 2019)

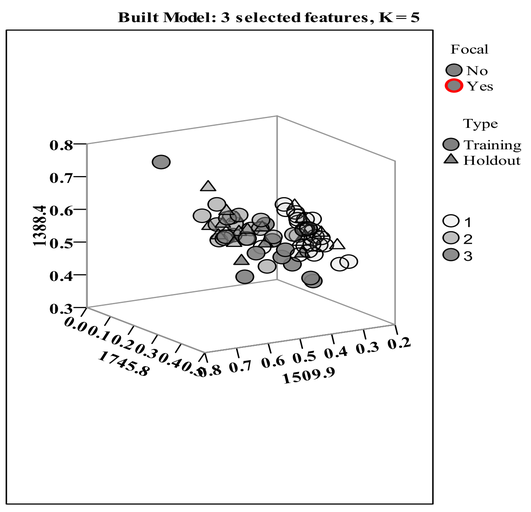

Fig. 2 kNN modeling of mushrooms samples

- 3 features selected and 5 neighbors (Dhanabal et al. 2011)
- In the training step, the overall percent of correctly classified samples was 86.21%, while for holdout set the percent raised at 94.74%
- Representative features selection: 1745.8 cm^{-1}, 1509.9 cm^{-1} and 1388.4 cm^{-1}

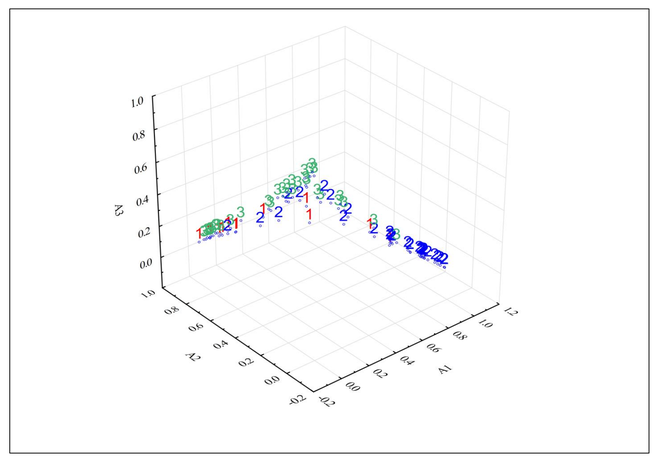

Fig. 3 3-D scatterplot of DOMs corresponding to partition A1, A2 and A3

- FCM (Sârbu C., Moţ, A.C. 2011) produced 3 fuzzy partitions, which were all represented by a prototype
- A cluster center with the spectrum corresponding to the fuzzy robust means of the original IR spectra characteristics for 77 samples weighted by degree of membership (DOMs) corresponding to each partition was also obtained

Conclusions

- ✓ This approach (IR spectra combined with chemometric interpretation), provided good classification models.
- ✓ The most representative IR region was assigned to α-glucans and β-glucans, whose beneficial effect upon human health is well known: immunomodulatory, antitumoral, hipolipidemic and antimicrobial.
- ✓ Both classical and advanced chemometric methods provided high percent of differentiations for the investigated dried mushrooms

References

1. Meenu, M., Xu, B. 2019. *Application of vibrational spectroscopy for classification, authentication and quality analysis of mushrooms: A concise review*. **Food Chemistry**, 289, 545-557.
2. D'Souza, R. A., Kamat, N. M. 2017. *Potential of FTIR spectroscopy in chemical characterization of Termitomyces Pellets.* **Journal of Applied Biology & Biotechnology,** 5, 080-084.
3. Dhanabal, S., Chandramathi S. 2011. *A review of various k-nearest neighbor query processing techniques.* **International Journal of Computer Applications,** 31(7), 14–22.
4. Sârbu, C., Moţ, A.C. 2011. *Ecosystem discrimination and fingerprinting of Romanian propolis by hierarchical fuzzy clustering and image analysis of TLC patterns.* **Talanta,** 85, 1112-1117.

Acknowlegment: This work was funded by Ministry of Education and Research, grant number PD 90 / 2020.