Sigma J Eng & Nat Sci 36 (2), 2018, 577-582

Sigma Journal of Engineering and Natural Sciences
Sigma Mühendislik ve Fen Bilimleri Dergisi

Research Article

DISCRIMINATION OF *DAEDALEOPSIS NITIDA* MUSHROOMS THAT GROWING IN DIFFERENT ENVIRONMENTS USING FOURIER TRANSFORM INFRARED SPECTROSCOPY

Deniz TÜRKÖZ ALTUĞ*[1], Ömer F. ÇOLAK[2]

[1]*Süleyman Demirel University, Technical Science Vocational School, ISPARTA;*
ORCID:0000-0002-1861-6263
[2]*Süleyman Demirel University, Vocational School of Health Services, ISPARTA;*
ORCID:0000-0002-3094-6046

Received: 06.02.2018 Revised: 30.03.2018 Accepted: 09.04.2018

ABSTRACT

In this study, the chemical structure analysis of two *Daedaleopsis nitida* mushrooms that grown in two different environments have been investigated. Fourier Transform Infrared Spectroscopy (FT-IR) was used to determine functional group vibrations in the chemical contents of two fungi species. As a result of the investigation, it was observed that there were small chemical contents in the structure of two mushrooms belonging to the same species.
Keywords: FT-IR, *Daedaleopsis nitida*, mushrooms.

1. INTRODUCTION

Mushrooms are very intrerested by people all over the world because they are low energy level and high in vegetable proteins, important vitamins, iron, chitin, fibre and some minerals [1, 2, 3, 4, 5]. The value of mushroom in terms of tonic and medicinal is used in the folk medicinal for thousands of years [6, 7, 8]. Mushroom is used in the treatment of many diseases as a very good source of nutraceuticals, antioxidants, anticancerous, antitumor, immune-modulating, antiinflammatory, cardiovascular, enzyme inhibitory activities, antimicrobial and antidiabetic agends [9, 10, 11]. Mushrooms is using to decrease pollution levels in a given area [12].

Structural analysis can be applied when the areas of use are determined. It is used in spectral analysis methods such as FT-IR spectra [2, 3, 10, 12, 13, 14], second derivative spectra [14], NMR spectroscopy [3, 13], GPC and HPSEC-MALLS analyzes [15], while methods such as Microscopic image of tissue section [16], Principal companent analysis [2, 17], hierarchical cluster analysis [18] and curve-fitting analysis [19].

But the FT-IR spectrum is the most widely used method to determine the functional groups [2, 3, 10, 12, 13, 14] as we did so. In the literature [12, 20] we knew from these studies that mushroom absorbs the chemicals and pollution in the environment because of its absorbent

* Corresponding Author: e-mail: denizturkoz@sdu.edu.tr, tel: (246) 211 17 57

property. There is no such study in the literature that analyzes two samples of the same species using FT-IR spectroscopy. With this study, the literature will gain a new perspective.

2. MATERIALS AND METHODS

2.1. Samples Collection

Two fungi (mushroom A and B) belonging to *Daedaleopsis nitida* (Durieu & Mont.) Zmitr. & Malysheva (Syn: *Apoxona nitida* (Durieu & Mont.) Donk; *Hexagonia nitida* Durieu & Mont.) were collected from different localities. In the field, the specimens were photographed on the substrates. The morphological and ecological characteristics were recorded. After the field studies, the specimens were taken to the laboratory. Micromorphological characters were observed by light microscope using KOH, Melzer's reagent, Congo red and distilled water. Identification of the samples was conducted according to Marchand [21]. The dried samples were conserved at the fungarium in the Süleyman Demirel University. Examined examples; **A:** Turkey, Balıkesir, Kazdağları national park, on oak wood, 26.10.2013, leg. & det. Ö.F. Çolak (ÖFÇ 206), **B:** Turkey, Burdur, Bucak district, Kargı village, Sweetgum forest protected area, on sweetgum wood, 11.05.2017, leg. & det. Ö.F. Çolak (ÖFÇ 1292).

2.2. Infrared Analysis (FT-IR)

The main equipment used was Spectrum BX FT-IR spectrometer system (Perkin Elmer). The Infrared spectra were recorded by accumulating 16 scans each in 4000-400 cm^{-1} range with a resolution of 4 cm^{-1} with KBr pellets at room temperature.

2.3. Procedure

About 1 mg *Daedaleopsis nitida* samples powder was mixed evenly with 100 mg KBr. KBr pellets were prepared exerting pressure of not more than 10 psi for approximately 2 min in a pellet press. The FT-IR spectrum of pellet was usually acceptable when a transmission of 60-70% was accomplished. To eliminate any prevention that might be caused by variation in pellet thicness, the test had to be repeated with either same sample powder or with more KBr added.

3. RESULTS AND DISCUSSION

3.1. Data analysis for FT-IR spectra

The FT-IR spectrums of *Daedaleopsis nitida* harvasted from differant areas are shown of samples **A** and **B** in Figure 1. The vibrational spectroscopic results for mushrooms are given in Table 1.

In FT-IR spectra of mushrooms a broad band between 3600 and 3200 cm^{-1} is O-H stretching band [18, 22] and the peaks located at 2925-2921 cm^{-1} in **A**, **B**, respectively, corresponds to CH_2 asymetric stretching vibration in sugar residue [23]. Absorbtion band about 2853 cm^{-1} (shuolder) correspond to symmetric streching vibration of methylene (CH_2) group [18].

When the peak at 2288 cm^{-1} is emerged in **B**, it wasn't observed in **A**. It should be due to two different nitrogen base like N-terminal amino acids in peptides and also due to purines and pyrimidine bases in nucleotides [23].

The peaks which indicate the presence of protein in **A** and **B** were observed with absorption at approximately 1651, 1623 and 1654 cm^{-1} for amide I, 1513 and 1511 cm^{-1} for amide II. They represents C=O groups in the FT-IR spectra of mushrooms for amide I [2, 22]. The amide II absorpsion was attributed to N-H bending vibration coupled to C-N streching vibration mode of the polypeptide protein back bone [18]. As a result of the **B** bifurcation, the degradation of the structure originating from the environment can be considered.

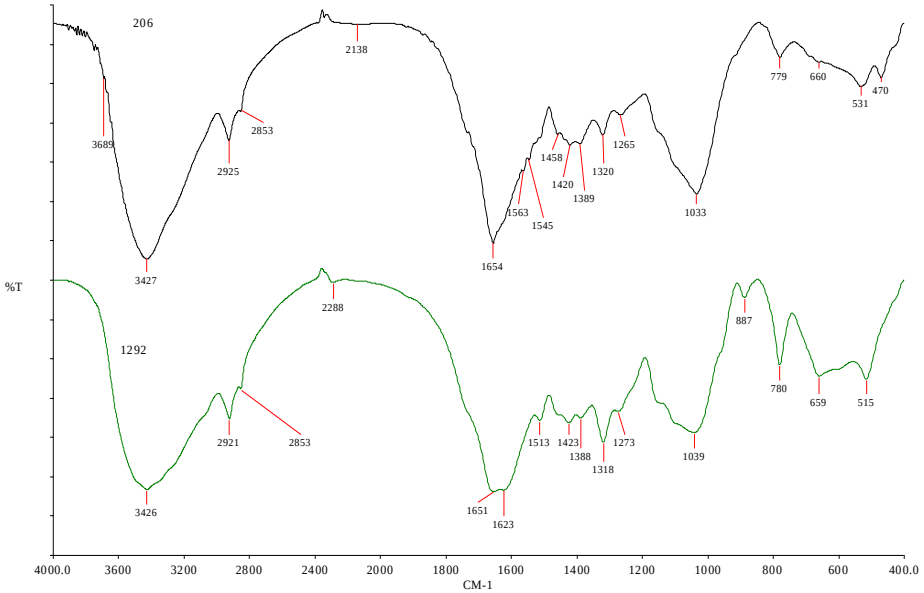

Figure 1. The infrared spectrums of *Daedaleopsis nitida* harvasted from differant areas for samples A (206) and B (1292).

Table 1. Comparison of the main peaks assignment of two samples of *Daedaleopsis nitida* from different locations.

Band (cm^{-1})	**Vibration mode**	**Mushrooms**	
		A	**B**
3465-3200	-OH stretching	3427(br)	3426
2990-2855	Asymetric CH_2 stretching	2925	2921
2990-2855	Symetric streching methylene (CH_2) group	2853(sh)	2853(sh)
2310-2000	$C{=}NH_2$, $C{=}N^+$	-	2288
1800-1630	Amid I group [2]	1654	1651-1623
1510-1460	Amid II group group [2]	1511	1513
1480-1405	Asymetric CH_3 bending	1458	1454
1433	CO-NH, C=C	1420	1423
1379	Symmetric CH_3	1389	1388
1310	C-O-H bending and CH_2 deformation	1320	1318
1240	C-N streching and N-H deformation	1265	1273
1041	Symmetric =C-O-C, in plane bending-CH_2OH	1033	1039
887	$C{=}CH_2$	-	887
776	C-H out of plane bending	779	780
691-616	O-N=O bending	660w	659w
531	S-S streching	531-470w	-
690-515	C-Br streching	-	515

sh:shoulder, br:broud, w:weak

The peaks located at 1454,1458 cm^{-1} were due to asymmetric CH_3 bending mode of protein methyl group, 1423,1420 cm^{-1} are assigned to phosphates in nucleotides and bending modes of CO-NH group in the **A**, **B** in CH_2 group [23].

The bands centered at 1388-1389cm^{-1}, respectively **B** and **A**, were assigned to symmetric CH_3 vibration mode [14]. The absorbtion band at around 1320-1318 cm^{-1}, respectively **A** and **B**, mainly originated from C-O-H bending and CH_2 deformation vibration [18].

The peaks 1273 (in **B**) -1265 (in **A**) cm^{-1} were mostly due to the amide III band components of protein, corresponding to C-N stretching vibrations and N-H deformations vibration [18, 23].

The bands centered at 1039 (in **B**) -1033 (in **A**) cm^{-1} corresponds to symetric stretching of =C-O-C, and symetric in plane bending -CH_2OH in polysaccharides [14, 18].

The medium band at around 780-779 cm^{-1} in **B**, **A** in respectively belongs to the characteristic absorbtion of β-glucan, corresponding to C-H out of plane bending [18, 24]. In the above order, the weak bands observed at 659-660 cm^{-1} due to O-N=O bending shows the presence of nitrite [24].

The peak 887 cm^{-1} (only in **B**) is probably attributed to the C=CH_2 presented that it is mostly assigned to the existence of polysaccharides, such as β-D-Glucan, the pyranose from of glucose [25].

The weak absorbsion bands observed at 515 cm^{-1} only in **B** due to C-Br stretching show the presence of Brome [26].

The weak absorbsion bands observed at 531 and 470 cm^{-1} only in **A** due to S-S stretching show the presence of sulphide [24, 27].

After detailed examination of the FT-IR spectroscopy, little chemical changes were observed in the structure of two fungi grown in different area of the same species. These small differences are an indication that fungi absorb small molecules in the environment. In the meantime, it is useful to add that there must be molecules that can fit into the holes within our own chemical structure. This shows us that fungi can also be used as chemical sieves at the same time.

4. CONCLUSION

We have investigated that chemical analysis of two *Daedaleopsis nitida* mushrooms belonging to the same species in two different environments. FT-IR spectroscopy was used for this research. As a result of the studies carried out, it was determined that there are minor changes in the chemical structure of the mushrooms grown in different environments of the same species. These small changes showed; even if they have the same species, the fungicidal structure of the fungi may show changes depending on the environment in which they grow. We generally encounter these changes in the area of 1500-400cm^{-1} which we call fingerprint region in FT-IR spectroscopy. These results mean that the mushrooms can trap small chemicals with the effect of outer space. This event can also create the impression that the fungi are biological sifter as well as a lot of other benefits that can be used for environmental cleansing.

REFERENCES

[1] Vetter J., (2007) Chitin content of cultivated mushrooms *Agaricus bisporus*, *Pleurotus ostreatus* and *Lentinula edodes*, *Food Chemistry* 102(1), 6-9.

[2] O'Gorman A., Downey G., Gowen A. A., Barry-Ryan C., Frias J. M., (2010) Use of Fourier transform infrared spectroscopy and chemometric data analysis to evaluate damage and age in mushrooms (*Agaricus bisporus*) grown in Ireland, *Journal of agricultural and food chemistry* 58(13), 7770-7776.

[3] Li N., Li L., Fang J. C., Wong J. H., Ng T. B., Jiang Y., ... & Lv P. Y., (2012) Isolation and identification of a novel polysaccharide–peptide complex with antioxidant, anti-

proliferative and hypoglycaemic activities from the abalone mushroom, *Bioscience reports* 32(3), 221-228.

[4] Metin İ., Güngör H., Çolak Ö. F., (2013) Investigations on foreign trade of some mushroom and mushroom products in our country and suggestions for global marketing, *The Journal of Fungus* 4(2), 1-9. (in Turkish)

[5] Üçgül İ., Aras S., Özdemir Küçükçapraz, D., (2016) Purification of the Chitin from Different Sources Material and Textile Applications, *Erzincan University Journal of Science and Technology* 9 (1), 46-56. (in Turkish)

[6] Sheu F., Chien P. J., Chien A. L., Chen Y. F., Chin K. L., (2004) Isolation and characterization of an immunomodulatory protein (APP) from the Jew's Ear mushroom *Auricularia polytricha*, *Food Chemistry* 87(4), 593-600.

[7] Sümer S. (2006). Genel mikoloji. *Nobel Yayın Dağıtım*, Ankara, Türkiye. (in Turkish)

[8] Jeong Y., Yang B., Jeong S., Kim S., Song, C., (2008) *Ganoderma applanatum*: A promising mushroom for antitumor and immunomodulating activity, *Phytother. Res.* 22, 614–619.

[9] Kaya M., Akata I., Baran T., Menteş A., (2015) Physicochemical properties of chitin and chitosan produced from medicinal fungus (*Fomitopsis pinicola*), *Food Biophysics*, 10(2), 162-168.

[10] Nisha A. P., Kumuthakalavalli R., (2016) Fractionation, radical scavenging activity of bioactive compounds and FT-IR spectroscopy study of milky mushroom, *Calocybe indica* var. APK2, *International Journal of Applied Research* 2(2):565-568.

[11] Zengin G., Üren M. C., Koçak M. S., Güngör H., Locatelli M., Aktümsek A., Sarıkürkcü C., (2017) Antioxidant and enzyme inhibitory activities of extracts from wild mushroom species from Turkey, *International journal of medicinal mushrooms*, 19(4),327-336.

[12] Bordean D. M., Raba D., Alda S., Pintilie S., Borozan A. B., Harmanescu M., Pirvulescu L., (2016) Mushrooms, The Miracle of Nature, A Treat to Human Health, *Agronomy Series of Scientific Research* 59(1), 157-160.

[13] Synytsya A., Novak M., (2014) Structural analysis of glucans, *Annals of translational medicine* 2(2), 17–30.

[14] Choong Y. K., Lan J., Lee H. L., Chen X. D., Wang X. G., Yang Y. P. (2016) Differential identification of mushrooms sclerotia by IR macro-fingerprint method, *Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy* 152, 34-42.

[15] Fırat A., (2007) Subcritical water extraction of shiitake (*Lentinula edodes*) and characterization of its components, MsC Thesis, *Graduate School of Natural and Applied Sciences, Çukurova University*, Adana, Turkey. (in Turkish)

[16] Alvarez Jubete L., Bonnier F., Byrne H., Grogan H., Frias J. M., (2011) Detection of Mushroom Virus X (MVX) Infection in Asymptomatic Mushrooms Using FTIR Microscopic Imaging, *11th International Conference of Engineering and Food (ICEF11)*, May 2011, Athens, Greece.

[17] Ergin Ç., Vuran M. E., Gök Y., Özdemir D., Karaarslan A., Kaleli İ., ... & Çon A. H., (2011) Fourier Dönüşümlü Kızılötesi (FT-IR) Spektroskopisi ile *Malassezia* Türlerinin Değerlendirilmesi. *Mikrobiyol Bul* 45(4), 707-715. (in Turkish)

[18] Shi Y. M., Yan C. Q., Li D. Y., Liu G. (2011) Discrimination of *Amanita* mushrooms using Fourier transform infrared difference spectroscopy and cluster analysis, *Photonics and optoelectronics (SOPO), Symposium*, May 2011, DOI: 10.1109/SOPO.2011.5780668.

[19] Baltacıoğlu H., Bayındırlı A., Severcan F., (2017) Secondary structure and conformational change of mushroom polyphenol oxidase during thermosonication treatment by using FTIR spectroscopy, *Food chemistry* 214, 507-514.

[20] Chang S.T., Wasser S. P., (2017) The Cultivation and Environmental Impact of Mushrooms, *Oxford Research Encyclopedia of Environmental Science* 1-39.

[21] Marchand A., (1975) Champignons du nord et du midi (Tome III, *Bolétales* et *Aphyllophorales*). *Société mycologique des Pyrénées méditerranéennes,* Perpignan. (in French)

[22] Radzki W., Kalbarczyk J., (2010) Water soluble polysaccharides content in three species of edible and medicinal mushrooms: *Lentinula edodes*, *Pleurotus ostreatus*, *Agaricus blazei*, *Herba Polonica* 56(4), 31-38.

[23] Ranjani M., Rajan S., Murugesan A.G, Thamilmarai S., (2014) Cultivation of medicinal mushroom (*Pleurotus* spp.) using paddy straw, *World Journal of Pharmacy and Pharmaceutical Sciences* 3(3), 2033-2041.

[24] Joshi M., Pathania P., Sagar A., (2015) FTIR studies and antimicrobial potential of *Cordyceps militaris* (a highly medicinal fungus) against Hospital Pathogens, *International Journal of Scientific research* 4(5), 203-205.

[25] Li Y., Zhang J., Li T., Liu H., Wang Y., (2016) A Comprehensive and Comparative Study of *Wolfiporia extensa* Cultivation Regions by Fourier Transform Infrared Spectroscopy and Ultra-Fast Liquid Chromatography, *PLoS ONE* 11(12): doi.org/10.1371/journal.pone.0168998.

[26] Gündüz T., (2002). İnstrümental Analiz, *Gazi Kitabevi*, Ankara, Türkiye. (in Turkish)

[27] Kloprogge J.T., Schuiling R.D., Ding Z., Hickey L., Ruan H., Wharton D., Frost R.L., (2002) Vibrational spectroscopic study of syngenite formed during the treatment of liquid manure with sulphuric acid, *Vibrational Spectroscopy* 28(2), 209- 221.