



THEM WORKSHOP

2022. március 18-19, Baja



**Természettudományok helyzete hazánkban
Egyetemtől a munkaerőpiacig workshop**

Absztraktfüzet 2022

Természettudományok helyzete hazánkban
Egyetemtől a munkaerőpiacig workshop

Absztraktfüzet

Szerkesztette:

Allaga Henrietta

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Kiadó:



Minden jog fenntartva.

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Barna Lilla - *The effect of acute adenosine treatment on the blood-brain barrier* (SZBK)

Bordé Ádám - *Isolation and identification of fungal and bacterial strains from sweetpotato plants for the development of a microbial-based foliar treatment formulation* (SZTE-TTIK)

Bozóki Boglárka - *Szója és borsó fehérjenövények termesztésben betöltött szerepének vizsgálata, piaci helyzetük értékelése* (MATE)

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Horkics Dóra - *Ecophysiological characterization of isolated Bacillus strains from recycled spent mushroom compost* (SZTE-TTIK)

Jáger Olivér - *Investigation of the potential roles of survival factor genes in Mucor circinelloides* (SZTE-TTIK)

Kiss Karina - *Investigation of the CotH kinase protein family in an opportunistic human pathogenics fungus, Mucor lusitanicus* (SZTE-TTIK)

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Programfüzet

2022.03.18 (Péntek)

13:00-13:30 Megnyitó:

13:00-13:15 Nyitóbeszéd - Nyirati Klára, Baja város Polgármestere

13:15-13:30 Prof. Dr. Vágvölgyi Csaba – Szegedi Tudományegyetem Biológia Doktori Iskola Vezető - online

13:30-14:00 Előadás szekció I:

Szarvas Adrienn – Batáta termesztése hazánkban (Szegedi Tudományegyetem – Mezőgazdasági Kar)

14:00-14:20 Kávészünet I

14:20-17:10 Előadás szekció II:

14:20-14:30 Kocsis Zsófia - *The Role of Student Employment in Persistence and Efficiency in STEM Higher Education* (DE-BTK-NMI) – online

14:30-14:40 Bordé Ádám - *Isolation and identification of fungal and bacterial strains from sweetpotato plants for the development of a microbial-based foliar treatment formulation* (SZTE-TTIK)

14:40-14:50 Bozóki Boglárka - *Szója és borsó fehérjenövények termesztésben betöltött szerepének vizsgálata, piaci helyzetük értékelése* (MATE) - online

14:50-15:00 Dömötör András - *Ecophysiological characterization of Rhodotorula species* (SZTE-TTIK)

15:00-15:10 Horkics Dóra - *Ecophysiological characterization of isolated Bacillus strains from recycled spent mushroom compost* (SZTE-TTIK)

15:10-15:20 Jáger Olivér - *Investigation of the potential roles of survival factor genes in Mucor circinelloides* (SZTE-TTIK)

15:20-15:30 Kiss Karina - *Investigation of the coth kinase protein family in an opportunistic human pathogenics fungus, Mucor lusitanicus* (SZTE-TTIK)

15:30-15:40 Barna Lilla - *The effect of acute adenosine treatment on the blood-brain barrier* (SZBK)

15:40-16:00 Kávészünet II

16:00-16:10 Kovács Terézia - *Decreased R:FR Ratio in Incident White Light Affects the Composition of Barley Leaf Lipidome and Freezing Tolerance in a Temperature-Dependent Manner* (SZBK)

16:10-16:20 Marik Tamás - *Using peptaibols instead of Trichoderma as potential biocontrol agents* (SZTE-TTIK)

16:20-16:30 Rozsnyói Ákos - *New peptaibol compounds from Trichoderma species* (SZTE-TTIK)

16:30-16:40 Szűcs Balázs - *Invastigation of the effects of Candida albicans on the progression of oral squamous cell carcinoma using in vivo mice model* (SZTE-TTIK)

16:40-16:50 Dr. Veres Csilla – *Effect of essential oils on the fungal growht and morphology of Aspergillus nomius and Aspergillus parasiticus* (SZTE-TTIK)

16:50-17:00 Büchner Rita – Attractant and repellent properties of essential oils to insects present in *Agaricus bisporus* cultivation (SZTE-TTIK)

17:00-17:10 Allaga Henrietta - *Optimization and monitoring of the use of spent mushroom compost as a casing layer for mushroom cultivation* (SZTE-TTIK)

17:30 – 19:30 Állófogadásos vacsora koktél kóstolóval

2022.03.19 (szombat)

10:00 – Szálláshely elhagyása

Absztrakt szekció

Recycling spent mushroom compost after microbiological pre-treatment in champignon cultivation

ALLAGA, Henrietta¹; VARGA, András¹; MARIK, Tamás¹; CSUTORÁS, Csaba²; HATVANI, Lóránt¹; KREDICS, László¹; VÁGVÖLGYI, Csaba¹

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In addition to the production of high quality spawn and mushroom compost, the efficient and economical cultivation of white button mushrooms (*Agaricus bisporus*) is based on the provision of high quality casing material. In mushroom growing houses, the mushroom compost, which is spawned by mycelia of white button mushroom, is covered with a casing layer, the role of which is primarily to ensure the formation of fruiting bodies and to provide high water retention. The nutrient-rich fungal compost has a low water retention capacity, so the role of the high water retention capacity of the casing layer is to compensate for this deficiency

of the compost. Due to the depletion of peat mines in Hungary and Europe and the environmental problems resulting from peat mining, there is a growing need to develop alternative options for the production of high quality casing materials. Recycling of spent mushroom compost has been attempted in some cases by vermicomposting, while microbiological recomposting may also be a possible alternative.

Our working hypothesis is that the harvested mushroom compost can serve as an excellent raw material for the development of casing materials due to its high fibre content. To this end, we are selecting and characterising fungal and bacterial strains that are suitable for the controlled processing and transformation of spent mushroom compost, and thus for recycling into casing materials. As part of this, bacterial (*e.g.*, *Bacillus*, *Pseudomonas*) and fungal (*e.g.*, *Rhodotorula*) strains will be isolated from samples obtained from the experimental recomposting process of spent mushroom compost and deposited in a culture collection after molecular identification at the species level. The isolated microorganisms will be tested for properties of high importance in relation with fungal compost colonisation, thus providing an opportunity to select microbial strains that will aid the recomposting and of spent mushroom compost.

Acknowledgement:

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Supported by the ÚNKP-21-4 New National Excellence Program of the Hungarian Ministry for Innovation and Technology from the source of the National Research, Development and Innovation Fund.

The effect of acute adenosine treatment on the blood-brain barrier

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Sleep restriction causes neuronal dysfunctions and enhance blood-brain barrier (BBB) permeability. Adenosine is accumulated during sleep loss and inhibition of A2 adenosine receptor decreased BBB dysfunction caused by sleep deprivation in rats. Our aim was to investigate the presence of adenosine receptors in the cells of the BBB and test the direct effect of adenosine on the BBB.

We examined the expression of adenosine receptors by RT-PCR. Cell viability was measured by impedance. BBB models were prepared from primary rat brain endothelial cells, glial cells and brain pericytes

and were treated with adenosine and A2R antagonist SCH-58261. The barrier function was tested by electrical resistance (TEER) and permeability measurements on cultures and in rats *in vivo*.

Rat brain endothelial cells expressed A2A and A2B receptors, rat pericytes expressed A1, A2A and A2B receptors, while astroglial cells expressed all four types. We demonstrated significant increase in impedance values in adenosine treatment groups in the first 2 hours. Luminal adenosine treatment decreased the permeability in monoculture and co-culture BBB models, and decreased BBB permeability in rats treated intracardiac injection. Abluminal adenosine treatment increased the permeability in the triple co-culture model. Adenosine given to the CSF increased BBB penetration of marker molecules. SCH-58261 inhibited effects of adenosine.

We demonstrated the presence of adenosine receptors on all cell types of BBB. Acute adenosine treatment from the luminal side tightened the barrier in BBB culture models and in rats. Brain pericytes may mediate the barrier opening effect of acute adenosine treatment from the abluminal side.

Acknowledgment:

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Isolation and identification of fungal and bacterial strains from sweetpotato plants for the development of a microbial-based foliar treatment formulation

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MONOSTORI, Tamás²; VÁGVÖLGYI, Csaba¹

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In the frame of the work we isolated more than 150 fungal and *bacterial* strains from the surface (epiphytes), plant tissues (endophytes) and rhizosphere of sweet potato (*Ipomoea batatas*) plants from different plantations. Among them, about 50 isolates have been identified by sequencing and subjected to various ecophysiological tests (temperature and pH optimum, water activity test, enzyme activity measurements, IAA producing ability, siderophore and ammonia production, phosphorus solubilization).

We are currently working on detailed studies of some *Bacillus licheniformis* strains (e.g. *in vitro* confrontation tests, depsipeptide production capacity,

germination tests) and also isolation work is ongoing from further sweet potato samples.

The long-term objective of our work is to create a high depsipeptide content foliar fertilizer formulation stabilised with chitosan nanoparticles using fungal and bacterial strains with biocontrol capabilities, which we would like to test extensively under greenhouse and field conditions.

Acknowledgment:

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Szója és borsó fehérjenövények termesztésben betöltött szerepének vizsgálata, piaci helyzetük értékelése

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Hazánkban a pillangós (hüvelyes) fehérjenövények közül kiemelendő jelentőséggel bírnak a szója (*Glycine max* L.) és a borsó (*Pisum sativum* L.) növények, azonban vetésterületük nem korrelál ezzel, ugyanis rendkívül kis területen termesztjük őket. Termésük és a teljes növény is fehérjében gazdag, ezáltal rendkívül fontos szerepet töltenek be a humán élelmezés, valamint az állati takarmányozás terén egyaránt. Kiváló vetésforgónövények, megfelelő módon történő vetésszerkezetbe illesztésük növelhetik egyéb szántóföldi kultúrák termésbiztonságát, illetve hozamszintjét. Vetésforgóban betöltött szerepük figyelemre méltó, hiszen javítják a talaj szerkezetét, vízgazdálkodását, továbbá a tápanyagok harmonikus tárolását. Az ökológiai gazdálkodásban betöltött szerepük is folyamatosan bővül, hiszen a bio-szója iránti kereslet egyenes arányban növekszik az európai adottságok között nemesített fajták térhódításával. A témaválasztás aktualitását és létjogosultságát mi sem bizonyítja

jobban, minthogy az Európai Unió állam- és kormányfői által 2018-ban elfogadott, a fehérjenövények termesztésének ösztönzésére irányuló európai stratégiáról szóló irányadó nyilatkozat közölte, a fehérjenövények között kiemelt jelentőségű pillangós virágúak hozzájárulnak a növénykultúrák sokféleségéhez, a biodiverzitás fenntartásához.

A fehérjenövények termesztésben betöltött szerepének tanulmányozása elengedhetetlen a vetésterületük arányának növelése szempontjából, ugyanis a Nemzeti Fehérjeprogram előirányzatainak köszönhetően prognosztizálható a hüvelyes növények vetésterületének erőteljes növekedése. Munkánk szakmai-gyakorlati célja elmozdítani a magyar gazdálkodókat a helyes mezőgazdasági termelés és földművelés irányába, előtérbe helyezve a kímélő talajművelést és a talajvédelmet, összefüggésben a termesztett fehérje növényeink ökológiai hatásával. A választott téma időszerűsége megkérdőjelezhetetlen, tekintettel arra, hogy az intenzív állattenyésztés több, magas fehérjetartalmú takarmányt igényel. Ebből is következik, hogy az elméleti megalapozottság ellenére a gyakorlati alkalmazás során akadnak olyan kérdések, amelyek indokoltá teszik a terület vizsgálatát, igazolják annak fontosságát, valamint a mindenkori aktualitását. A kutatás alapvető célkitűzése a fehérjenövények talajtermékenységre gyakorolt hatása, valamint vetésforgóban betöltött szerepük vizsgálata, ugyanis ahhoz, hogy vetésterületüket folyamatosan növeljük hazánkban, meg kell ismernünk azok hatásait a talajok minőségére és szerkezetük változására. Magyarországon napjainkig – különböző okok miatt –

kis figyelmet kapott a fehérjenövények talajtermékenységre gyakorolt hatásának vizsgálata, ebből adódóan kevés hazai eredmény áll rendelkezésünkre. Mindezek mellett hiányos a talajművelési rendszerekre kialakított, gazdaságilag hatékony összehasonlító, fehérjenövények termesztésére irányuló gyakorlat.

A szántóföldi tartamkísérletek tervezett módszereinek köszönhetően új és újszerű tudományos eredmények várhatók a fehérjenövények tápanyagfeltárási hatásainak megismerésében. Úgy véljük, az értékelés folyamatában kapott eredmények jól számszerűsíthetők és jól közzétehetők, ezáltal a szakma szélesebb köreibben is megismerhetők lesznek. További elméleti haszna a kutatásnak a vonatkozó kísérletek bemutatása az érintetteknek, valamint a felmerülő szakmai kérdések megvitatásának lehetősége minden érintettel, illetve szakmabelivel.

Attractant and repellent properties of essential oils to insects present in *Agaricus bisporus* cultivation

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In Hungary, over 30,000 tons of button mushroom is produced each year including both the white and brown capped varieties. It is among the most popular cultivated mushrooms along with oyster mushroom (*Pleurotus ostreatus*) and shiitake (*Lentinula edodes*). Producers face a lot of challenges during the protection of crops from pests and diseases, which can cause a lot of harm to the mushroom fruiting bodies making them unmarketable. The most common diseases are the result of mold, as well as bacterial, or viral infections, while regular pests include nematodes, mites and flies. Fly species present in mushroom facilities can damage the crops both indirectly and directly. They contribute to

the distribution of the abovementioned diseases by carrying spores and conidia on their bodies within and between mushroom houses. More serious losses are caused by direct damage of fly larvae, which feed on the mushroom mycelia or the organic matter present in the compost. These species belong to the *Sciaridae*, *Cecidomyiidae*, and *Phoridae* families. Control measures are limited, as the use of insecticides should be avoided in mushroom production due to the accumulation of chemical residues in the crops. In most cases, the nematode *Steinernema felitiae* is used in mushroom production to reduce the damage caused by larvae, but other control measures should also be considered. An alternative is trapping adult flies to prevent them from reproduction and laying eggs. To investigate the attractant and repellent properties of essential oils, we have designed fly traps that contain 5 ml 1% suspensions, which were placed in a mushroom house 40 cm apart. Traps were collected after four days, and the captured flies were counted. According to our results, lemon, thyme and citronella scents show repellent properties, while beer and cinnamon are attractants. Interestingly, the essential oil citronella, which is often an ingredient in insect repellent products, has repellent properties when it is mixed into water, but citronella mixed with in beer has attracted more flies than beer alone.

Acknowledgements:

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Ecophysiological characterization of *Rhodotorula* species

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Rhodotorula yeasts belong to the family *Cryptococcaceae*. They are found in a wide range of environmental compartments, such as the skin surface, urine, faeces, but have also been isolated from cheese, milk, mushroom compost and soil. Like other yeasts or yeast-like fungi, *Rhodotorula* is a saprophyte, although it can infect immunodeficient and immunosuppressed patients and cause serious problems (fungemia, keratitis, esophagitis, meningitis). Members of the genus *Rhodotorula* e.g. *Rhodotorula glutinis*, *Rhodotorula mucilaginosa* also have a beneficial side, such as agricultural or industrial usefulness. The potential of agro-industrial wastes (onion peels, potato skin, mung bean husk and pea pods) has been

investigated for carotenoid production by *Rhodotorula mucilaginosa*.

Based on agro-industrial applications, *Rhodotorula* strains may also be applicable for composting of spent mushroom compost. In our ecophysiological studies, 22 *Rhodotorula* strains were investigated from the species *R. mucilaginosa* (17), *R. glutinis* (2), *R. minuta* (1), *R. sloffiae* (1) and *R. laryngis* (1). Two strains of *R. mucilaginosa* were isolated from spent mushroom compost. The strains were tested for their ecophysiological properties (temperature, pH-dependence, salt tolerance and extracellular lipase, protease, cellulase and chitinase activities). The growth optimum of *Rhodotorula* strains was observed at 25°C and 2% salt concentration, pH 4 - 6, suggesting that they could be able to colonize the recycled mushroom compost, which has a pH around 6.5. According to their enzyme activities, two *R. mucilaginosa* strains showed good protease, while two *R. glutinis* strains good lipase production. The tested *Rhodotorula* strains did not show high cellulase and chitinase activities.

Acknowledgment:

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Ecophysiological characterization of *Bacillus* strains isolated from recycled spent mushroom compost

HORKICS, Dóra¹; ALLAGA, Henrietta¹; BORDÉ, Ádám¹; BÜCHNER, Rita¹; CSUTORÁS, Csaba²; BAKOS-BARCZI, Nóra²; BAJZÁT, Judit²; KREDICS, László¹; VÁGVÖLGYI, Csaba¹

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In mushroom farms, the compost colonized by mycelia of white button mushroom (*Agaricus bisporus*) is covered by casing material, the role of which is primarily to ensure the formation of fruiting bodies and to provide a high water retention capacity. A good quality casing layer is influenced by the composition of the containing microorganisms. Microorganisms present in the spent *Agaricus* compost include bacteria (e.g., *Bacillus*, *Alcaligenes*, *Pseudomonas*, *Microbacterium* strains) and fungi (e.g., *Fusarium*, *Trichoderma*, *Lecanicillum*, *Cladobotryum*, *Mortierella*, *Rhodotorula* species) which can be either beneficial or pathogenic. Many representatives of the

genera *Bacillus* and *Pseudomonas* are among the beneficial bacteria.

Our aim is to develop healthy casing layer alternatives from spent mushroom compost. Microorganisms are isolated from spent mushroom compost samples taken during the natural recomposting process, subjected to species-level molecular identification and deposited in the Szeged Microbiology Collection. A total of 21 *Bacillus* strains were isolated from recycled spent mushroom compost samples and identified. The resulting *B. licheniformis* (17), *B. velezensis* (3) and *B. subtilis* (1) strains were tested for their ecophysiological properties (temperature-, pH- and water activity-dependence, extracellular enzyme activities, siderophore production). The examined strains showed good growth abilities at 30 and 37°C, as well as at pH 6 and 8, suggesting that they could be able to colonize the recycled mushroom compost, which has a pH around 6.5. Most of *Bacillus* strains showed the best growth at water activity values of 0.991 and 0.980, although *B. licheniformis* (7), *B. subtilis* (1) and *B. velezensis* (4) showed growth at water activity values of 0.968. The enzyme activities of the strains were measured for lipase, protease, cellulase and chitinase. Three of the examined *B. velezensis* (4) and *B. licheniformis* (5) strains showed the best lipase, chymotrypsin-like protease and β -galactosidase activities, while 5 *B. licheniformis* and 4 *B. velezensis* strains proved to be the best N-acetyl-glucosaminidase producers. Ten strains of *Bacillus* strains also showed siderophore

production, suggesting that they may have good competitive abilities for iron.

Acknowledgment:

This work was supported by project 2020-1.1.2-PIACI-KFI-2020-00111 (Hungarian Ministry for Innovation and Technology).

Investigation of the potential roles of survival factor genes in *Mucor circinelloides*

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In recent years, the incidence of mucormycosis (i.e., invasive fungal infections caused by members of the order Mucorales, such as *Mucor circinelloides*) has significantly increased worldwide. Such infections are considered as the third most frequent type of invasive mycoses after candidiasis and aspergillosis in patients

with hematological malignancy, haematopoietic stem cell- and solid organ transplantation and diabetes mellitus. There is also an increasing incidence of mucormycosis following COVID-19 infection.

Survival factor protein (SVF) plays an important role in the protection of cells from oxidative and other stresses (e.g., cold stress) in *Saccharomyces cerevisiae*. Furthermore, this protein seems to participate in the sphingolipid biosynthesis of the fungal cells. Transcriptomic studies showed the upregulation of the encoding genes in several human pathogenic fungi during the host-pathogen interactions. Additionally, this protein was described in other species for instance in *Fusarium fujikuroi* or in *Fusarium graminearum*. However, the function and regulation of the SVF proteins and the encoding genes are still unknown in Mucorales fungi.

In the *M. circinelloides* genome, two hypothetical *svf* genes were identified and named as *Svf1a* and *Svf1b*. We have studied the expression of the genes after culturing the fungus under different conditions by real-time quantitative reverse transcription PCR. Using the CRISPR/Cas9 technique, single gene disruption mutants were constructed for each gene and we have started the characterization of the resulting strains. Macromorphology and sensitivity to different stressor chemicals (e.g., acetate, H₂O₂, Congo red and Calcofluor white) were tested. Mutants showed altered characteristics compared to the original strain suggesting that the cellular integrity may be damaged in the mutants. Pathogenicity of the mutants was also examined in alternative *Drosophila*

melanogaster model and a decreased virulence was detected. Moreover, we studied the pathogenicity in *Galleria mellonella* model too and we could observed increasing virulence. We also carried out susceptibility test of our strains against various antifungal drugs (e.g. different azoles, amphotericin B). The sphingolipid metabolism of the knock-out strains was also investigated with HPLC techniques. Our results showed significant differences in the sphingolipid content of the strains.

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Investigation of the CotH kinase protein family in an opportunistic human pathogenic fungus, *Mucor lusitanicus*

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The CotH protein mediated interaction proved to be crucial for the fungal invasion during mucormycosis. Moreover, IgG antibodies produced against the *Rhizopus* CotH3 protein protected mice with diabetic ketoacidosis (DKA) from mucormycosis and anti-CotH3 antibodies were proposed promising for immunotherapy treatment of human mucormycosis. Thus, our research is mainly focused on the extensive analysis of this kinase family and the clarification of their role in the virulence of *Mucor*. We performed the functional analysis of the CotH proteins, which involved tracking the phenotypic alterations of genetically stable *cotH* mutants.

Ten putative spore-coat genes were disrupted in *M. circinelloides* by an *in vitro* plasmid-free CRISPR/Cas9 method. Growth tests were performed under different conditions (stressors, hydrogen peroxide). Inner spore structure was investigated by transmission electron microscopy. Structure of the sporangias and sporulation capacity were observed under light microscope. Possible changes in cell wall structure were monitored using fluorescence microscopy and flow cytometry analysis. Pathogenicity of the mutants was examined in *Drosophila melanogaster*, *Galleria mellonella* and a murine model of mucormycosis.

Cell wall stressors affected differently the *cotH* mutants. Deletion of some of the *cotH* genes resulted in variances in the structure of the inner spore coat, differences in spore size distribution, fungal growth and

sporulation. Acidification of phagosomes is not affected by the examined CotH proteins, and the absence of CotH proteins did not affect the survival of spores after *in vitro* interaction with macrophages. The *cotH3*, *cotH4* and *cotH5* knock-out mutant strains showed reduced virulence. Sporulation ability was reduced after disruption of the *cotH4* and *cotH5* genes.

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The role of student employment in persistence and efficiency in STEM higher Education

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The high dropout ratios that characterize STEM fields can be explained by several factors, one of which is the employment of students during their studies. Our research aims to explore the impact of student employment on persistence in STEM fields, which are significantly more closely intertwined with labour market compared to other fields. We used the PERSIST 2019 database (N=2199). The data collection was carried out in the academic year of 2018/19, in Central and Eastern Europe. In the present analysis, the data of the Hungarian subsample (N=1045) were used. According to our data, IT trainings are more resistant to the negative effects of employment than other trainings, as students working in this field did not differ from their non-employed peers in terms of either persistence or academic progress. Concerning the science, engineering and non-STEM training, the proportion of students following the standard, traditional path was significantly lower in the group of employees (7-9%),

but this was primarily compensated by being employed in study-related jobs in science training, which also had a favourable effect in non-STEM training courses. In the case of science courses, we also found interesting results. Concerning this area, the data again showed that employment on its own does not have a significant effect on student persistence. In comparison, the results are somewhat contradictory in the case of pathways, according to which the proportion of employed students learning in science training and following the non-standard route is 9% higher compared to non-employed students. However, the proportion of students having a job related to their studies (75%) surpassed that of non-workers, so in this case, it can be said that the horizontal integration of work and studies can significantly compensate for the negative effects of employment. As science courses mean the theoretical components of the STEM discipline that are less clearly identifiable with specific jobs compared to the engineering and informatics fields, it is conceivable that labour market experience has a strengthening effect on career socialisation and commitment in this field. Based on our results, we think it is worth considering the broader spread of dual training courses in higher education, during which students can complete an internship at a company in addition to theoretical training. For this reason, it would be possible for students to work under conditions controlled by higher education institutions, and their work could be compatible with their studies.

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Decreased R:FR ratio in incident white light affects the composition of barley leaf lipidome and freezing tolerance in a temperature-dependent manner

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The winter cereals showed 30-40% higher yields than the spring ones. However, the extent of frost resistance of winter barley is significantly influenced by the temperatures of October and November, among the others. Over the past 110 years, the number of days when temperature suddenly drops below -4 °C in

October and November has increased, which is fatal for winter barley crops that are not yet frost-resistant. The development of frost resistance is a genetically determined process that is influenced by the temperature, the length of the day, and the spectrum of light that illuminates the plants. It is known from previous research that supplementation of white light with far-red light in both the Arabidopsis model plant and cereals increases frost resistance even at relatively high temperatures (15 °C). Under the conditions we examined, we sought to answer whether the far-red light supplement prepares winter barley against a sudden drop in temperature. As well as how it affects the lipid composition and frost resistance of the plant. The combination of cold treatment with various light spectrum affected the expression of genes determining lipid biosynthesis and consequently the lipid composition of barley leaves. Significant changes were observed in composition and distribution of the different lipid families responsible to maintain the optimal membrane fluidity. The expression of some of the genes involved in lipid metabolism was increased as high as 15 °C due to the enrichment of white light in far-red. Lipid changes induced by cold acclimatization and exposure to modulated light spectrum correlate well with the development of frost tolerance.

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Using peptaibols instead of *Trichoderma* as potential biocontrol agents

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Trichoderma species are ecologically and agriculturally beneficial, but certain species can be harmful and cause damage in the commercial production of mushrooms or may be the causal agents of human infections. Studying the bioactive secondary metabolites of *Trichoderma* species is important for the better understanding of the processes that occur during their interactions with phytopathogens throughout their biocontrol activity, or during infections of mushrooms, plants, or even humans. Peptaibols are short (6-20 residues) secondary metabolites which are capable of forming ion channels in host bilayer membranes. They contain unique amino acids like α -aminoisobutyric acid (Aib), isovaline (Iva), and the C-terminal 1,2-amino alcohol. Studies on their bioactivities against various

bacterial and fungal plant pathogens, their positive effects on plants, and the induction of systemic resistance have pointed towards their potential to become novel biocontrol agents.

In the present study, *Trichoderma reesei* – a species commonly used in biotechnology due to its ability to produce hydrolytic enzymes that degrade cellulose or hemicellulose – and *T. longibrachiatum* f. sp. *bissettii* – an opportunistic human pathogen – were selected to examine the direct effects of *Trichoderma* peptaibols on plant growth. The sequences produced by these species are reported by Marik et al. 2019.

After the HPLC-ESI-MS investigation of the crude extracts deriving from *T. reesei* SZMC 22616 (Rut-C30) cultures, 21 paracelsin-like peptaibol compounds could be identified, while *T. longibrachiatum* SZMC 12546 produced 12 longibrachin-like peptaibols. The extracts were purified by preparative HPLC. Bioactivity tests against *Micrococcus luteus* revealed different bioactivities; the extracts of *T. longibrachiatum* were more effective than *T. reesei* peptaibols. Plants were treated with a dilution series from 1 mg ml⁻¹ to 0.01 mg ml⁻¹ of the purified peptaibol extracts. The treatment with high peptaibol concentrations of *T. longibrachiatum* proved to be deterrent for the germination and growth of tomato saplings, although, more intensive growth could be observed after a certain level of dilution. However, the quantification of photosynthetic pigments extracted from the second leaf of the treated tomato seedlings showed no significant difference compared to the control ones. Consequently, the saplings were

cultivated in field experiments which led to increased fruit production and less sensitivity to fungal diseases. The peptaibol solutions used at the same concentration were also observed to directly inhibit the growth of many plant- and human pathogenic filamentous fungal species *in vitro*.

Studies on the bioactivities of peptaibols against various bacterial and fungal plant pathogens, their positive effects on plants, and the induction of systemic resistance have pointed towards their potential to become novel biocontrol agents. These observations suggest that purified peptaibol extracts may have potential in plant disease management.

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New peptaibol compounds from *Trichoderma* species

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Nowadays, more than 415 species from genus *Trichoderma* are known, and the number is growing steadily. The genus *Trichoderma* is the largest group in the order Hypocreales within the Sordariomycetes class of the Ascomycota strain. The lifestyle of *Trichoderma* species is characterized by diversity. Early members of the genus developed parasitic and saprophytic relationships with inferior plants, their symbiotic relationships with higher plants and their parasitic lifestyles with animals (opportunistic pathogens) and fungi (mycoparasites) are supposed to have developed later.

Trichoderma species produce a number of secondary metabolites, including peptaibols. These biologically active metabolites are produced by non-ribosomal peptide synthetase (NRPS) enzymes. Their structure is linear oligopeptide of up to 20 amino acids in length, often containing non-proteinogenic amino acids like isovalin (Iva) or α -aminoisobutyric acid (Aib). They are also characterized by an acetylated N-

terminal and a C-terminal amino alcohol group. Due to their characteristic structure, peptaibols are able to form ion channels in phospholipid bilayer membranes, thereby destroying the cells of the parasitized organisms. In addition to the antibiotic and cell toxic effects of peptaibols, research over the past two decades has shown a positive effect of peptaibols on plant growth and the development of resistance against plant pathogens.

In our experiment, six previously untested strains of *Trichoderma* species (*T. estonicum* TUCIM 1518, *T. camerunense* TUCIM 1720, *T. tomentosum* TUCIM 2696, *T. cerebriforme* comb. nov. TUCIM 1657., *T. rossicum* TUCIM 3235 and *T. rossicum* TUCIM 889) were selected to identify new peptaibols. High performance liquid chromatography - high resolution mass spectrometry (HPLC – HRMS) was used to determine the amino acid sequence of the peptaibols through quantitative and qualitative investigations. Based on our results, a total of 103 peptaibols from six strains were identified, of which 96 sequences proved to be completely new peptaibols. The minimum inhibitory concentration (MIC, mg ml⁻¹) values of the peptaibol extracts were determined by bioactivity tests against commonly known Gram-positive and Gram-negative bacteria. The connections between structural characteristics of peptaibol sequences and their bioactivity were examined. Our research showed the relationship between the antibiotic effect and the amino alcohol group of peptaibols, furthermore we observed the relationship between the length and bioactivity of these molecules.

Our results provide further insight into the diversity of peptaibols and their bioactivity, further expanding the literature data. Further investigation of the structures, antibiotic properties and positive effects of peptaibols will facilitate the future use of these molecules in the agricultural industry and biotechnology.

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Development of sweet potato (*Ipomoea batatas* (L.) Lam.) cultivation technologies and examination of its possible uses

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In the course of our work, we set up small-plot experiments with the yield of sweet potato variety 12 in Ásotthalom, Domaszék and Deszk production sites in three growing years (2016, 2017 and 2018). On sandy soil, we sought the answer to determine the optimal row and plant to plant spacing. On clay loam soil, we analyzed the effect of different nutrient doses, compared the yields production of ridges and without ridges cultivation methods, we compared of the origin effect of planting primary or secondary cuttings, and we also performed content tests in laboratory. After our analyses, we evaluated the results from several aspects. Several of our results proved to be new and/or results in our experiments. In our experiments, we looked for the answer to how much the origin of the cuttings (primary or secondary) influenced the yield. In small-plot experiments, no difference was obtained between the results. However, in terms of hectares, we found a significant difference. The application of different nutrient doses at the Deszk site significantly affected the size of the tendril in case of application of ridges and without ridges cultures. That is, the significant

difference in the effect of the two production method regarding the size of the tendril is independent of the presence or absence of the ridges. For the Domaszék site, we found that plant spacing plays a much larger role in ensuring yield than row spacing. According to this, the use of a plant spacing of 20 cm compared to 30 cm is definitely recommended, and the use of a row spacing of 80 cm compared to 100 cm is second in order of importance. Of course, the question arises as to what is the role of plant physiological processes in this result and what is the role of the quantitative factor resulting from plant density planting. This is an interesting question that needs further investigation to answer. For the Ásotthalom production site, we found that the smaller plant distance is a more important predictor of the yield compared to the smaller row spacing. This is a novel information, and it is worth putting this knowledge into practice in the future.

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Investigation of the effects of *Candida albicans* on the progression of oral squamous cell carcinoma using *in vivo* mice model

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Tumors of the oral cavity cause serious medical challenges worldwide. According to the WHO, there were 350.000 new registered cases in 2018, and approximately 170.000 deaths could be attributed to malformations in the oral cavity. 90% of the oral cavity tumors are oral squamous cell carcinoma (OSCC). According to many researches, OSCC can develop oral candidiasis due to the unique immune-suppressive

environment and the applied tumorthrapy. Oral candidiasis is most commonly caused by *Candida albicans*. During our research we examined the effect of *Candida albicans* on the progression of OSCC. Based on our *in vitro* results, we developed an *in vivo* xenograft model, in which we injected HSC-2 human tumor cells into the tongue of immunosuppressed mice (OSCC xenograft), and after that we caused oral candidiasis (OC-OSCC xenograft). Histological staining of epithelial-mesenchymal transition markers were carried out, and then transcriptomic examination was prepared to explore the molecular mechanisms. Our results showed, that we successfully developed an *in vivo* xenograft mice model to examine the effect of oral candidiasis on the progression of OSCC. Based on the results of histopathological examination and transcriptomic analysis we suggest that oral candidiasis increase the progression of OSCC.

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Effect of essential oils on the fungal growth and morphology of *Aspergillus nomius* and *Aspergillus parasiticus*

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Currently, natural substances like essential oils (EO) are in focus, due to their proved antimicrobial, antifungal effect and/or antioxidant properties. EOs and their components are effective in foods against food polluting pathogens *in vitro*.

In our work, five essential oils (juniper, lemon, cinnamon, marjoram and clary sage) were tested in sublethal concentration against the growth of *Aspergillus nomius* and *A. parasiticus*, which were cultivated in liquid media. EOs in the vapour phase of the cultivation flasks induced changes in the morphology of moulds, they influenced the sporulation and the growth of hyphae. All investigated EOs resulted in altered spore colour. By increasing different EO concentration in the vapour phase of *A. nomius* and *A. parasiticus* containing flasks, the spore production

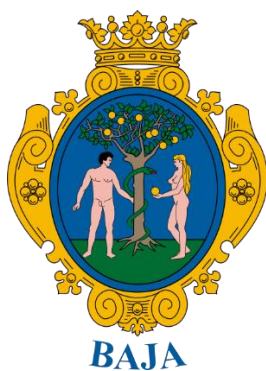
was decreased in most cases. Cinnamon EO caused the elongation of hyphae in the case of both *Aspergillus* species.

The antifungal effect of EOs was concentration dependent. Results showed, that EOs might be stress factors. The chemical character of the EOs (determined by their composition), the concentration, and the experimental conditions are important factors.

Results suggested, that EOs affect the sexual cycle of moulds. In our experiments, the conidiogenesis were forced back, the number of conidia was decreased and the hyphae were stretched at the same time.

Contrary to other authors' claim, EOs should be applied at sufficiently higher concentrations to achieve significant inhibition of growth of *Aspergillus* species.

Baja város bemutatása



Bevezetés és történet

Baja (németül: Frankenstadt) város, Magyarország déli részén, a Duna bal partján. Bács-Kiskun megye második legnagyobb települése, a Bajai járás központja. Jelentős kikötőváros és közlekedési csomópont. Magyarország 25. legnépesebb városa. Gazdasági, kulturális, oktatási központ.

A város mai területe már az őskorban lakott hely volt, és a vaskort leszámítva folyamatosan az is maradt; a régészeti feltárások újkőkorszaki, bronzkori és népvándorláskori (szarmata) leleteket találtak. A 6. századtól avarok lakták a területet.

A honfoglalás után fontos folyami átkelőhelyé vált. Első írásos említése 1323-ból származik. Neve török eredetű lehet; valószínűleg első birtokosáról, Bajáról kapta. A közismert „bika” jelentés kevésbé valószínű, mivel az ótörökben buka, és egyetlen török nyelvben sincs palatális változata. Az ótörökben csak a bay szótó rengeteg jelentésének valamelyike jöhet szóba. Legkorábbi ismert birtokosa a Bajai család volt, majd 1474-ben Mátyás király a Czobor családnak adományozta.

Baja a török hódoltság alatt a Bajai nahije központja, az időszakban jelentős erődítmény és kikötő volt, több száz házzal, mecsettel és fürdővel. A 16. század végi török adóösszeírások szerint 18–22 adózó ház volt a városban. A török idők végére azonban a település elnéptelenedett. Baján 1686–1690 között a török elől menekülő bosnyákok telepedtek le. A város népessége a 17. században a horvát (bunjevác, sokác) és szerb,

majd a 18. században a német (sváb) és magyar betelepülőknek köszönhetően emelkedett meg ismét.

A város a török uralom alól Buda visszavétele után szabadult fel, és kincstári tulajdonba került. A török elleni háborúkban fontos szerepet játszott, különösen az utánpótlás biztosítása révén, ezért 1696. december 24-én I. Lipót császár mezővárosi rangot adott neki. (Címere ezen dátum miatt ábrázolja a bibliai Ádámot és Évát, hiszen december 24-én van mindkét név névnapja.) Az ezzel járó jogokat III. Károly 1714-ben megerősítette. Később újra földesúri tulajdonba került: birtokosa 1727–1741 között a Czobor család volt, majd a zálogba csapott uradalom – a Czobor család kihalása után – 1750-től Grassalkovich Antal tulajdonába került. Baja végül 1858-ban váltotta meg magát Zichy Ferraris Félix-től, majd 1862-ben 722 ezer forintért megvette Zichy Ferraristól a bajai uradalmat és a Grassalkovich-kastélyt, amiből városháza lett.

Baját pestisjárvány (1739), árvíz (1751) és tűzvész (1840) pusztította. Ennek ellenére a 18-19. században a vízi szállítás révén az Alföld egyik legjelentősebb kereskedelmi központjává vált, így gazdasági és kulturális téren is a környék központjává fejlődött. 1828-ban kezdték kövezni az utcákat, aminek folytán a város 1830-ban kövezetvámszedési jogot kapott, 1833-tól pedig – megszakításokkal – közvilágítása is van a településnek. 1839-ben megindult a magyar nyelvű oktatás, 1845-ben pedig megnyílt az első helyi gőzfürdő is.

1848-ban hozzácsatolták Istvánmegyét, 1873-tól pedig törvényhatósági joggal ruházták fel. A 19. század

utolsó harmadában fejlődésnek indult a közművesítés is. 1886-ban az augsburgi Riedinger L.A. cég gázgyárat épített, emiatt már a következő évtől, 1887-től gázzal – akkori nevén légszesszel – világították az utcákat. 1892-ben elkészült el a bajai telefonhálózat, 1898-ban pedig artézi kutat fúrtak a főtéren; vízvezeték- és csatornahálózata azonban még a 19. század végén sem volt a városnak.

Az első világháború után, 1918-ban szerb megszállás alá került, és az új délszláv állam igényt formált rá. Bár Trianonban Magyarországnak ítélték, a délszláv csapatok 1921. augusztus 19-ig nem ürítették ki, és néhány napra a Baranya–bajai Szerb–Magyar Köztársaság nevű szerb bábállam része lett. 1930-ban hozzácsatolták Bajaszentistván nagyközséget.

1921 és 1941 között a megcsonkított Bács-Bodrog vármegye székhelye lett. Ezt a rangot a Délvidék visszafoglalásával a korábbi megyeszékhely, Zombor visszakapta. A második világháborút követően, az 1950-es megyerendezésig ismét megyeszékhely volt.

Nevezetességek

A Szentháromság tér a Sugovica folyóval, a Városházával és a Szentháromság-szoborral

Városháza

Türr István Múzeum: Észak-Bácska, az egykori Bács-Bodrog vármegye északi részének tájmúzeuma,

elsősorban e terület muzeális értékeit gyűjti, dolgozza fel és mutatja be a látogatóknak.

Nagy István Képtár

Kálvária-kápolna

Bajai zsinagóga: A Városi Könyvtár a város egyik legszebb műemlék épülete, az 1845-ben épült késő klasszicista zsinagógában, valamint a mellette lévő egykori zsidó óvoda-iskolában működik. Az eredeti állapotra a '80-as évek eleji felújításkor kiemelt figyelmet fordítottak, így a belső tér és a kettős galériarendszer is megmaradt régi formájában. A Zsinagóga beépített rituális tárgyait, például az előcsarnok kézmosóját, a díszes perselyt, a mizrah-emelvényt mellvéd rácszatáival együtt, valamint a tóraszekrényt is gondosan helyreállították. A frigyszekrényben néhány eredeti kegytárgyat is őriznek, pl. tóra-tekerceket, hanuka-gyertyatartót, imakönyveket.

Éber Emlékház – Galéria

Bunyevec Tájház

Bagolyvár- Miskolczy Ferenc emlékház: Baja szívében, a Szentháromság tér alatt, a Sugovica – magas-parton áll az 1930-as évektől Bagolyvárként közismert bauhaus épület, mely egykor Miskolczy Ferenc (1899-1994) festőművész otthonaként szolgált. A kiállítóhely az 1920–1990 közötti időszak baja várostörténeti, művészettörténeti korszakainak helyi sajátosságait, a Bácska polgárváros hétköznapijait mutatja be.

Bácskai Kultúrpalota

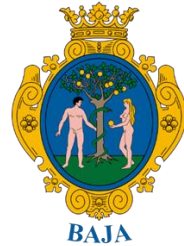
Deák Ferenc Zsilip – Zsilipmúzeum

Természeti értékek

Baja határában – a Duna túlsó partján – terül el a vadregényes Gemenci erdő. A terület a Duna-Dráva Nemzeti Park része, azaz természetvédelmi oltalom alatt áll. Európa legnagyobb ártéri erdeje egyedülálló értékekkel, gazdag növényvilággal, változatos és különleges állatállománnyal büszkélkedhet. Itt fészkel például a ritka fekete gólya.

A páratlan fekvésű város és környéke valósággal hívogat a természetbe, az ott eltöltendő szabadidős programokra: erdei sétákat, kerékpártúrákat lehet tenni, a számos vízfelület pedig valódi horgászparadicsom. Nyáron a Duna, valamint a Baja belvárosában kanyargó Sugovica csábít vízi sportok élvezetére, evezésre, kajakozásra, úszásra és napfürdőzésre.

TÁMOGATÓINK



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