PRESS RELEASE

Mushroom Nutrition: Prebiotic Implications for Neurodegenerative Conditions?

New research suggests that mushroom nutrition might act as a prebiotic. This finding provides further evidence supporting the hypothesis that mushroom nutrition might have a role in the future management of neurodegenerative conditions.

Background

Over the past 10 years, Mycology Research Laboratories has focused on exploring the role of mushroom nutrition (*Coriolus versicolor* and *Hericium erinaceus*) in slowing the onset and progression of neurodegenerative conditions. This role is now becoming more widely understood. Researchers at the Universities of Catania and Messina (Italy) have disclosed that mushroom nutrition can reduce neuroinflammation in rats by upregulating Lipoxin A4 (a potential endogenous anti-inflammatory mediator)[1,2] and, more recently, researchers at the Faculty of Medicine at the University of Coimbra (FMUC) and in the Center for Neuroscience and Cell Biology (CNC) (Portugal) demonstrated that mushroom nutrition can increase neurologic reserve (generate new neurons) in mice.[3]

An important question raised regarding the use of mushroom nutrition is '*How* does mushroom supplementation increase neurological health?' While there is evidence to suggest that mushroom nutrition has a direct effect on the neuronal network,[3] there is also an increasing body of evidence to suggest that it might also act indirectly via the gut microbiota.[4,5] The theory is that **mushrooms act as a prebiotic in the gastrointestinal tract**: they nourish beneficial bacteria in the gut with their non-digestible ingredients, stimulating selective growth of the microbiota, with a beneficial effect on host health and decreased dysbiosis (microbial imbalance or maladaptation)[6]. This has the potential to evoke a clinically relevant effect on brain function via the gut–brain axis (see box to the right; also see *Additional information* below).

The Gut–Brain Axis

- *The bidirectional communication between the gut and the central nervous system*
- *Often refers to the role of the microbiota in sending biochemical signals to the brain*
- *The microbiota produces many neuroactive molecules. Changes in the microbiota can correlate with changes in neuroinflammatory chemicals, and can directly stimulate the vagus nerve.*
- *Likewise, stressful situations can cause changes in the microbiota and intestinal lining*
- *An unbalanced microbiota can, by implication, lead to compromised brain function*

The prebiotic theory was evaluated in a poster presented at the 6th World Congress on *Targeting Microbiota* by researchers from Faculty of Biotechnology, Universidade Católica Portuguesa. The poster is summarised below.

Evidence

Evaluation of the prebiotic potential of *Coriolus versicolor* –
Effect on the human gut microbiota.
C.M. Costa, S. Silva, L. Pimentel and M.M. Pintado

Click on the URL to access the poster: https://www.mycologyresearch.com/articles/view/129

It has been observed that the human gut microbiota has become increasingly relevant when studying human health and disease due to its connection with the immune system and metabolism. Several factors are known to shape the microbiota composition, such as age, diet and genetic markers. Furthermore, the gut microbiota can be actively modulated by prebiotic nutrients, which pass through the gastrointestinal tract and are fermented by colonic bacteria, leading to the production of short chain fatty acids (SCFA) and metabolites, and changes in the microbial population dynamics.[6]

Coriolus versicolor ('turkey tail') is a mushroom known for its immunomodulatory properties,[5] but has also displayed prebiotic-like activity,[4,7] which has been attributed to its specific β-glucans (a naturally-occurring glucose polysaccharide).[4] Although edible, it is generally not eaten as a foodstuff due to its tough texture, but it is widely used in traditional medicine.

The main goal of the present work was to evaluate the prebiotic potential of a commercial supplement of *Coriolus versicolor* biomass through *in vitro* faecal fermentations, using fresh faecal samples from five healthy donors, and to perform the subsequent analysis of changes in the bacterial population and the production of SCFA.

The conclusions were:

1. ***Coriolus versicolor* biomass induced changes in the gut microbiota**. There was enhanced growth of potentially beneficial bacterial (*Bifidobacterium)* populations vs negative controls. The effect was similar to, if less intense than, that observed with a positive control containing a well-known prebiotic, fructo-oligosaccharides (FOS) (in an *in vitro* system).
2. The pH values decreased throughout the 48 h fermentation, indicating that *Coriolus versicolor* was fermented.
3. The fermentation led to SFCA production and glucose consumption.
4. **This behaviour may open the possibility for the establishment of *Coriolus versicolor* biomass as a prebiotic nutrient.**

Further research is planned by Professor Manuela Pintado *et al.* to more fully determine the impact of mushroom nutrition on the microbiota.

While this and previous work suggests a potential future role for mushroom nutrition in ameliorating a variety of chronic inflammation-mediated human conditions, there are, as yet, no clinical data to confirm any beneficial effects. As Professor Tito Fernandes, a researcher from the Faculty of Veterinary Medicine, Lisbon University states: "***In vivo* work with rodents has revealed that mushroom (*Coriolus* and *Hericium*) supplementation stimulates lipoxin production, reducing excessive tissue injury and chronic inflammation, and promoting a neuroprotective action. Clinical work and studies on the aetiology are now required.**"

Notes to editors

Researchers: Universidade Católica Portuguesa - Faculty of Biotechnology, Porto Portugal
The Faculty of Biotechnology (ESB) is part of the Asprela Campus (Hospital of S. João) of the Universidade Católica Portuguesa, and was founded in 1984. At ESB, a variety of academic activities are carried out, with emphasis on Higher Education (Undergraduate, Masters, PhD and Postgraduate), Research and Development (fundamental and applied) and Extension to the secondary and tertiary sectors (provision of services, and continuing training).

- Contact: Manuela Pintado
- Email: mpintado@porto.ucp.pt
- Website: www.esb.ucp.pt

Sponsor: Mycology Research Laboratories Ltd.
Funding was provided by Mycology Research Laboratories Ltd, along with the biomass of *Coriolus versicolor* (www.mycologyresearch.com).

Luton-based Mycology Research Laboratories Ltd. was founded in the United Kingdom in 1997 with a focus on developing mushroom-based nutrition products. Over the past 15 years, Mycology Research Laboratories has had several collaborations with hospitals and universities based in the Netherlands, United Kingdom, Italy and Portugal.

- Contact: William Ahern
- Email: info@mycologyresearch.com
- Website: http://www.mycologyresearch.com/

References

1. Trovato A, Siracusa R, Di Paola R, Scuto M, Fronte V, Koverech G, Luca M, Serra A, Toscano MA, Petralia A, Cuzzocrea S, Calabrese V. *Redox modulation of cellular stress response and lipoxin A4 expression by Coriolus versicolor in rat brain: relevance to Alzheimer's disease pathogenesis*. Neurotoxicology 2016;53:350-358. doi: 10.1016/j.neuro.2015.09.012.
2. Trovato A, Siracusa R, Di Paola R, Scuto M, Ontario ML, Bua O, Di Mauro P, Toscano MA, Petralia CCT, Maiolino L, Serra A, Cuzzocrea S, Calabrese V. *Redox modulation of cellular stress response and lipoxin A4 expression by Hericium erinaceus in rat brain: relevance to Alzheimer's disease pathogenesis*. Immunity & Ageing (2016) 13:23. doi: 10.1186/s12979-016-0078-8.
3. Ferreiro E, Pita IR, Mota SI, Valero J, Ferreira NR, Fernandes T, Calabrese V, Fontes-Ribeiro CA , Pereira FC , Rego AC. *Coriolus versicolor biomass increases dendritic arborization of newly-generated neurons in mouse hippocampal dentate gyrus.* Oncotarget. 2018;9(68): 32929–32942. doi: 10.18632/oncotarget.25978.
4. Yu Z-T, Liu B, Mukherjee P, Newburg DS. *Trametes versicolor extract modifies human fecal microbiota composition in vitro*. Plant Foods for Human Nutrition 2103;68(2):107-112. doi: 10.1007/s11130-013-0342-4.
5. Cruz A, Pimentell, L, Rodríguez-Alcalá LM, Fernandes T, Pintado M. *Health benefits of edible mushrooms focused on Coriolus Versicolor: a review*. Journal of Food and Nutrition Research 2016;4(12):773781. doi: 10.12691/jfnr4122.
6. Ferrão J, Bell V, Calabrese V, Pimentel L, Pintado M, Fernandes TH. *Impact of mushroom nutrition on microbiota and potential for preventative health*. Journal of Food and Nutrition Research 2017;5(4):226–233. doi: 10.12691/jfnr-5-4-4.
7. Wang B, Yao M, Lv L, Ling Z, Li L. *The human microbiota in health and disease.* Engineering 2017;3:71-82. https://doi.org/10.1016/J.ENG.2017.01.008.

Additional information

For more information, please consult the following article:

Host-Microbial Gut Interactions and Mushroom Nutrition. Victoria Bell, Jorge Ferrão, Eusébio Chaquisse, Tito Fernandes. *Journal of Food and Nutrition Research*. **2018**;6(9):576-583. doi:10.12691/jfnr-6-9-6. Tito Fernandes is lead researcher from the Faculty of Veterinary Medicine, Lisbon University, Lisbon, Portugal Email: profcattitofernandes@gmail.com

Quotations from this publication:

The gut is inextricably linked to health

"Most people do not realize that 80 percent of human immune system lies in the gastrointestinal mucosa and 20 percent in the back of our mouth (the tonsils which serve as the first line of defence in the immune system) enhancing the fact that an optimal health starts in your gastrointestinal tract."

Impact of diet on the gut microbiota and routes of communication involved in the gut–brain axis

"Diet is one of the most crucial factors in the development of the human gut microbiota. Different dietary patterns can change the gut microbiota composition by keeping a balanced diversity of the gut microbiota (symbiosis) or causing a state of dysbiosis which is characterized by an overgrowth of potentially pathological organisms (pathobionts)."

"A state of dysbiosis leads to an increased inflammation and leaky gut. Many mechanisms have shown to be involved in this bidirectional pathway between the gut microbiota and brain including vagus nerve signalling, immune activation, tryptophan metabolism and production of microbial metabolites and neurometabolites."

