DEVELOPMENT OF PEAT-FREE CASING SOILS FOR MUSHROOM AND OTHER CULTIVATED MUSHROOMS - MYKODECK

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FNR
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Motivation

Good reasons for peat alternatives

Ecological aspects

- Peat is being imported
- Peat extraction destroys peatlands and habitats of plants and animals
- Peat as a valuable reservoir for the greenhouse gas is lost
- Climate change is worsened by the release of CO_2 during peat extraction and transport
- Peat substitutes not available on the market and alternative materials not explored

Biological aspects

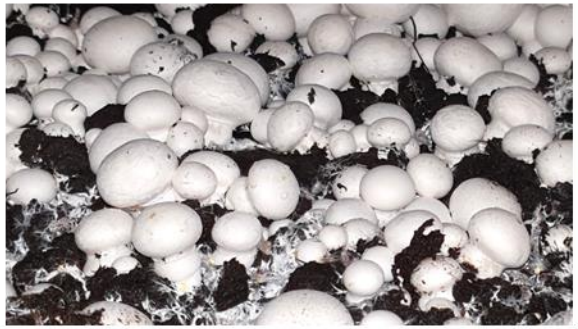
- No species-specific casing soils available
- Diagnostics of the microbial load is not incomplete
- Effect of individual foreign germs (fungi and bacteria) on reference fungi unknown
- Synergisms and antagonists of the reference fungi hardly researched

Chemical aspects

- Composition of the components in the casing materials varies depending on the manufacturer
- Quality assurance of casing materials not satisfactory
- Species-specific recommendations for mushroom cultivation are missing / incomplete

Mushroom cultivation

World and Germany



Agaricus bisporus (IHD)

Pleurotus eryngii (IHD)

Lentinula edodes (IHD)

Pleurotus ostreatus (IHD)

World

- Production capacity 51.2 million t/a
- China is the most important production county with 75 %
- 40 % of which are button mushrooms (*Agaricus bisporus*)

Germany

- Production capacity 90,050 t/a
- 91 % *Agaricus bisporus,* 9 % other mushrooms
- → ~50.000 t/a of peat casing soil

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Development of peat-free casing soils for mushroom and other cultivated mushrooms

MykoDeck

- Development of different formulations for casing soils
- Lab-scaled cultivation tests for two reference strains and other cultivated mushrooms

- Development of composting processes for additives and peat substitutes
- Microbiological disintegration and disinfection trough standardized composting

- Selection and physical characterisation (e.g. water storage, gas exchange, particle size distribution, pore volume, nutrient availability) of possible raw materials and casing soils
- Adoption and testing of the production processes / technologies on a technical scale

Scale-up and transfer partner

Project breakdown

Where are we on the project runway

MykoDeck		2021		2022				2023				2024		
Work Packages		3.	4. QT	1. QT	2. QT	3. QT	4. QT	1. QT	2. QT	3. QT	4. QT	1. QT	2. QT	3.
1	Assessment of the current state of mushroom production and casing soils													
2	Providing the reference mushrooms and other cultivated mushrooms for cultivation													
3	Development and testing of manufacturing processes for peat substitutes													
4	Development of a variety of casing soil formulations													
5	Up-scaling manufacturing processes as well as cultivation experiments													
6	Economic viability, ecological assessment													

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Finding and pre-selection of raw materials (LAV)

Classify available materials

Find commercially available materials

- Availability check
- Pre-test of raw materials (salts concentrations, pH, …)
- Mixing raw materials
- Composting
- Separating and sieving
- Preparation of samples
- Screening mixtures and composts
- Sampling for laboratory analysis

Material treatment and on-site pre-tests (LAV)

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Classification and material screening

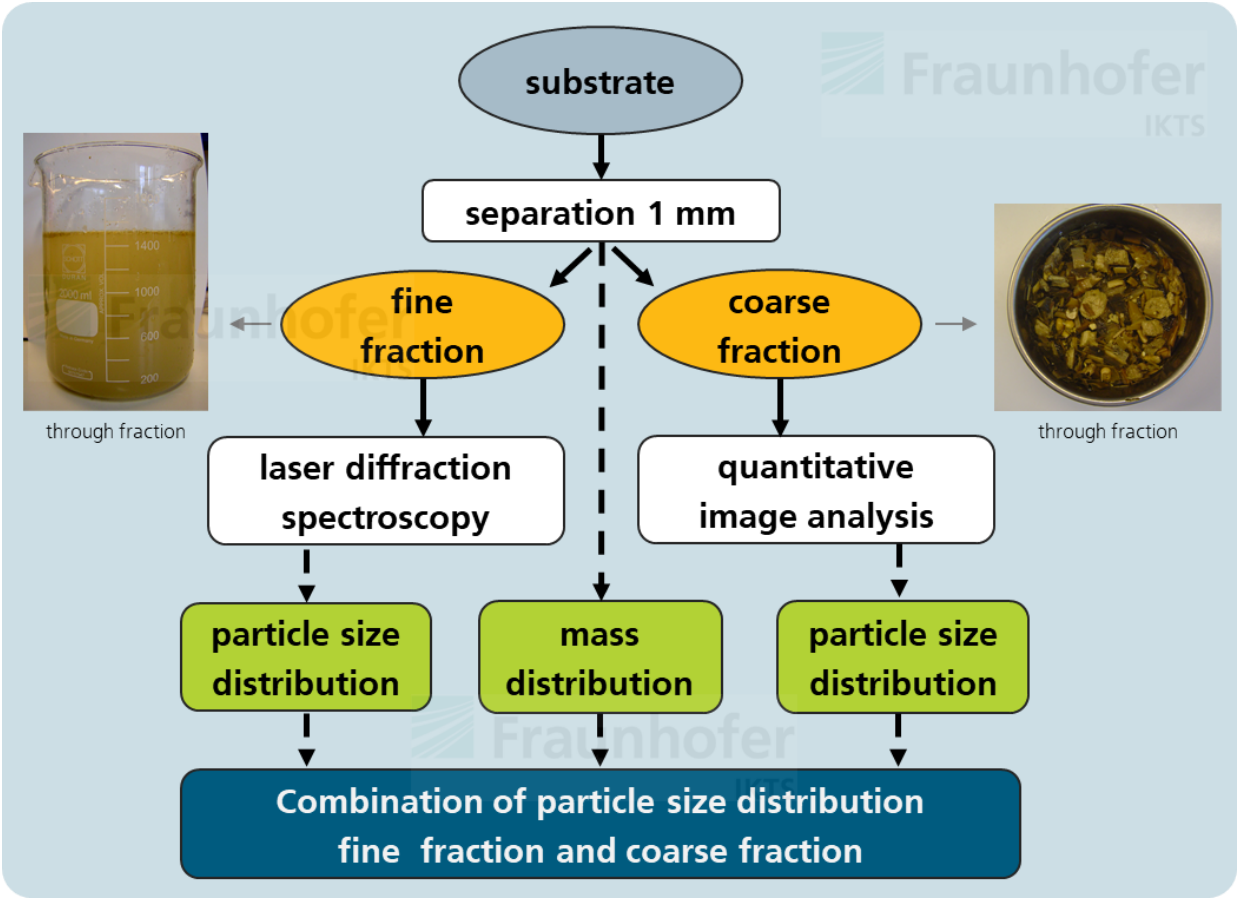
Understanding physical and chemical properties

Physical analytics

- Granulometic evaluation (particle and pore size distribution)
- Water uptake / release / water holding capacity
- Dry mass / organic dry mass

Chemical analytics

- Nutrient content, potential interfering substances, salinity, pH



Granulometric evaluation process (IKTS)

Material treatments

Tailored material characteristics

Data-based mixture determination

- Target parameter derivation from casing soils in production and from growers experience / expectations
- Application of mechanical, thermal, and biological treatments to condition materials
- Analytical data of the untreated and treated starting materials and reference casing soils fed in a database

  → **allows informed recipe development**

Different stages of material conditionings (IKTS)

Komponente 1	Komponente 2	Komponente 3	Komponente 4	Komponente 5	Komponente 6	Komponente 7
Grünschnittkompost 0/80	Sand 0/2	Strukturmat. extr.				

Volumenanteil 1	Volumenanteil 2	Volumenanteil 3	Volumenanteil 4	Volumenanteil 5	Volumenanteil 6	Volumenanteil 7	Summenkontrollfeld
40	20	40					100

	Volumengewicht [g/l]	Salzgehalt (als KCl) [g/l]	pH-Wert	Leitfähigkeit Eluat [mS/cm]	Wasserhaltevermögen [%]	Wasserabgabe [min]	PGV	Agglomerationsfähigkeit	N [mg/l]	P [mg/l]	K [mg/l]	Ca [mg/l]	Mg [mg/l]	Cl [mg/l]	Schwermetall Cadmium [mg/kg]	Schwermetall Blei [mg/kg]	Risiko konkurrierender Fremdpilze	Risiko wachstumshemmende Stoffe
Mischung	645	4,19	6,9		55	35			183	208	2212	84	277	239				
Benchmark	440	0,92	7,4		86	37			140	120	62	62	189	1				
Abweichung	205	3,27	-0,5	0	-31	-2			43	88	2150	22	88	238				
Wertung																		

Data base frontend (screenshot IKTS)

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Reference mushrooms and material screening

Casing soils vs. alternative raw materials

Unique fast-track screening method at IHD

- Laboratory tests of possible raw materials and casing soils in 6-well plates and in small boxes
- Cultivation and selection in direct comparison
- „Selection funnel“ starting with 10 g samples (high number of plots)
- Continued monitoring in 100 g boxes for most promising samples
- Biological and chemical evaluation of peat substitutes and covering materials
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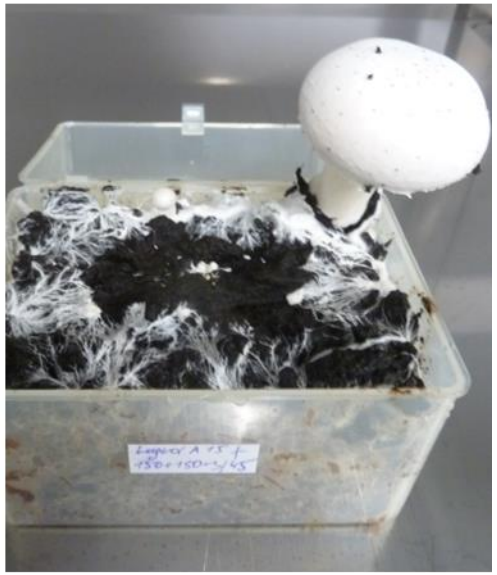
Laboratory tests in the 6-well plates, 10 g (IHD)



Laboratory tests in small boxes, 100 g (IHD)

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From lab-scale to technical-scale

Stage 1 - Development

Development of composting processes for additives and peat substitutes

- Depending on the type of mushroom
- Occupancy of 10 l boxes with substrate and casing soil
- Cultivation under controlled climatic conditions
- High-resolution monitoring, care, and documentation

Preparation of the boxes, 6 kg (IHD)

Cultivation in climate chambers (IHD)

Fructification, stem A14 (IHD)

Assessing quality and quantity (IHD)

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From lab-scale to technical-scale

Stage 2 - Valuation

Lab-scaled cultivation tests

- Cultivation of two reference strains in big boxes (32 l)
- Documentation of cultivation time, addition of water, and climatic parameters
- Laboratory tests assessing quality and quantity of yields
- Microbiological assessment and analysis of germs (bacteria and moulds)
- Laboratory tests to reduce pest and disease pressure in mushroom cultivation

Laboratory tests in big boxes (13 kg) (IHD)

Microbiological assessment (IHD)

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From lab-scale to technical-scale

Stage 3 – Evaluation (ongoing)

IHD preliminary results of yields of two reference strains in big boxes (13 kg substrate + casing soil)

Casing soil	1st flush [g]	2nd flush [g]	Σ yield [g]	Relative yield
15.02.2023	**03.03 - 10.03.23**	**15.03 - 27.03.23**	**1 + 2 flushes**	**[% / 13 kg]**
Champignon substrate, brown (Pilzhof)				
NL peat , control (Pilzhof)	1 728	711	2 439	18.8
PL peat, control (Pilzhof)	1 153	1 157	2 310	17.8
IHD M1 peat-free	1 836	645	2 481	19.1
IHD M2 (1 peat : 1 peat-free)	1 829	809	2 638	20.3
IHD M3 peat-free	1 505	911	2 416	18.6
Champignon substrate white (Pilzhof)				
NL peat control (Pilzhof)	1 975	503	2 478	19.1
PL peat control (Pilzhof)	2 346	1 793	4 139	31.8
IHD M1 peat-free	1 707	1 493	3 200	24.6
IHD M2 (1 peat : 1 peat-free)	1 721	1 393	3 114	24.0
IHD M3 peat-free	2 586	1 107	3 693	28.4

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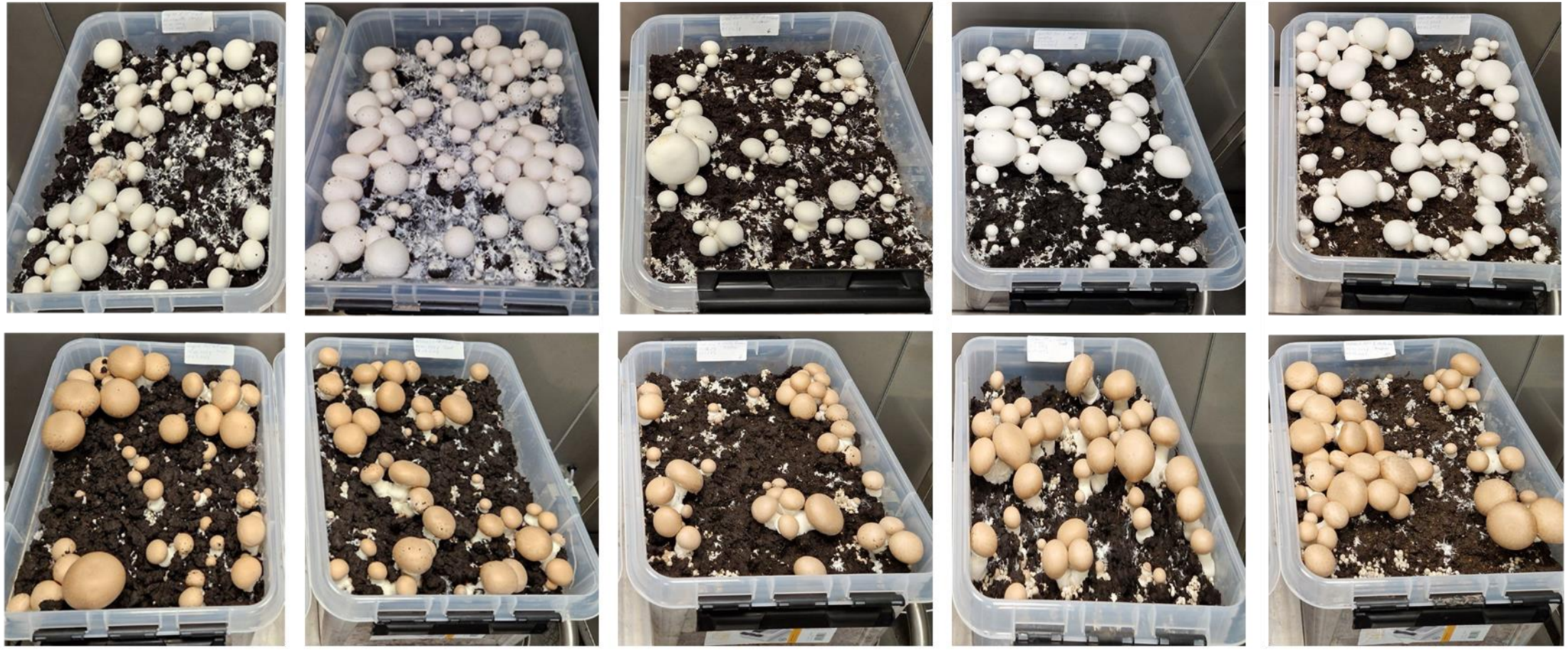
From lab-scale to technical-scale

Stage 3 – Evaluation (ongoing)

IHD preliminary results of yields of two reference strains in big boxes (13 kg substrate + casing soil), 1st flush



NL peat, control (Pilzhof) (IHD) | PL peat, control (Pilzhof) (IHD) | IHD M1 peat-free (IHD) | IHD M2 (1 peat : 1 peat-free) (IHD) | IHD M3 peat-free (IHD)

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From lab-scale to technical-scale

Stage 3 – Evaluation (current)

Evaluation of results

- Assessment of quality and quantity of mushroom yields (3 flushes)
- Optimisation of different formulations for casing soils (M4)
- Selection of first formulations for peat-free casing soils to be tested at technical scale
- Investigation and evaluation of peat substitutes and cover soil with regard to storage stability

IHD M1 peat-free casing soil, 2nd flush

IHD M4 peat-free casing soil, 1st flush

PL, peat-containing casing soil, 1st flush

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Outlook

Next steps

Up-scaling production technology and cultivation studies

- Up-scaling of peat substitute manufacturing process and casing soil to technical scale in cooperation with our partner Pilzhof Pilzsubstrat Wallhausen GmbH (June 2023)
- Operational trials in cooperation with our partner Roland Münzner GmbH (July 2023)
- Development of peat-free covering soil for other mushrooms (March 2024)

Economic and ecological evaluation

- Ecological assessment
- Economic valuation

Himematsutake
(ABM - *Agaricus blazei*) (IHD)

Shaggy Mane (*Coprinus comatus*) (IHD)

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Cooperation with partners







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