

Diversifying edible wild mushroom cultivation with new native species in Catalonia, Spain

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Although Catalonia, Spain had strong mushroom traditions, edible mushroom cultivation focuses only on a few mushroom species, mainly of non-native origin. EIP-Agri Operational Group “Diversificació del cultiu de bolets comestibles amb noves espècies autòctones” (Diversification of edible wild mushroom cultivation with new native species) aimed at diversifying cultivation and commercial production of edible wild mushrooms with new lignicolous fungi native to Catalonia. Although the species investigated in the project link to local traditions, they were not cultivated in the region before the project. Development of cultivation of new native mushroom species was regarded as a possibility for a competitive advantage for local producers, a possibility for new export opportunities, and a possibility for increased diversity and range of edible mushrooms for the producers.

This EIP-Agri Operational Group was lead by a cooperative Bolet Ben Fet (TEB Verd SCCL) and the other partners were Bolets de Soca (Tresseras Multimèdia SL), the Catalan Mycology Society, the Wood and Furniture Guild, and the Institute of Agrifood Research and Technology (IRTA). Also two lecturers from the University of Barcelona joined the team of researchers at the project. The project took place with a total budget of 199850 euros between July 2019 and September 2021.

Development process of the new edible mushroom species cultivation

The project developed cultivation methods and protocols for eight edible fungal species from native strains in Catalonia, Spain. New species for which cultivation methods and protocols were developed are *Agrocybe aegerita* (poplar fieldcap), *Fistulina hepatica* (beefsteak fungus), *Lyophyllum decastes* (clustered domecap), *Meripilus giganteus* (giant polypore), *Pleurotus eryngii* (king trumpet mushroom) and *Polyporus squamosus* (dryad's saddle). Cultivation methods and protocols were also developed for well-known species of *Ganoderma lucidum* (reishi) and *Grifola frondosa* (hen-of-the-woods) using native strains in Catalonia.

The development stages included gathering of wild mushroom specimens from field, isolation in pure culture and maintenance of the collected strains, development of seed (inoculum) production methods, development of the most suitable cultivation conditions for each species in order to have good production levels, mushroom cultivation pilot tests under industrial conditions, assessment of nutritional and organoleptic characteristics, and development of new products, and dissemination and knowledge transfer for stakeholders.



Figure 1. Industrial culture medium with *Lyophyllum decastes*. Photo: Carles Diaz / Bolet Ben Fet.

Gathering of wild mushroom specimens from field

Field collection of mushroom specimens took place during autumn months of the project. Specimens from in total 18 different native mushroom species were collected in field. The species were *Agrocybe aegerita*, *Albatrellus pes-caprae*, *Auricularia* sp., *Calocybe gambosa*, *Fistulina hepatica*, *Ganoderma lucidum*, *Ganoderma resinaceum*, *Grifola frondosa*, *Infundibulicybe geotropa*, *Laetiporus sulphureus*, *Lentinellus ursinus*,

Lyophyllum decastes, Meripilus giganteus, Pleurotus eryngii, Pleurotus dryinus, Polyporus squamosus, Sparassis crispa, and Volvariella sp. Although some of the species (Ganoderma lucidum, Ganoderma resinaceum, Infundibulicybe geotropa, Lentinellus ursinus, and Pleurotus dryinus) were not on the initial list of candidate species for diversification of edible wild mushroom cultivation, they were considered interesting for other applications due to their characteristics and, thus, were collected as well.

Isolation in pure culture and maintenance of the collected strains

In total 120 strains from 14 fungal species were isolated from the specimens collected in the field. The isolated species were Agrocybe aegerita, Calocybe gambosa, Fistulina hepatica, Ganoderma lucidum, Ganoderma resinaceum, Grifola frondosa, Infundibulicybe geotropa, Laetiporus sulphureus, Lyophyllum decastes, Meripilus giganteus, Pleurotus eryngii, Polyporus squamosus, Sparassis crispa and Volvariella caesiointacta. The obtained fungal strains will remain available for future research and development after the project.

Development of seed (inoculum) production methods

To produce inoculum (seed), a mixture of wheat, rye and sorghum grains in equal parts on volume were used as the culture medium with a water content adjusted to 50-60% and sterilisation in the autoclave (120°C, 60-90 minutes depending on the volume). The optimal incubation temperature was 23°C (with a range of $\pm 2^\circ\text{C}$). This process was successful with 87 different strains of 11 fungal species. Inoculum incubation time ranged between 4 and 16 weeks depending on the growth rate of the specific species with major part being between 8 and 10 weeks.



Figure 2. Industrial test cultivation of *Fistulina hepatica*. Photo: Carles Diaz / Bolet Ben Fet.

Development of the most suitable cultivation conditions for each species

Most suitable cultivation conditions were developed with small-scale trials with all mushroom strains for which viable inoculum production was achieved. The culture medium used in these trials was based on hardwood sawdust with 52% chestnut, 12% holm oak, 12% beech, 23% cereal and 1% gypsum with 60-65% humidity levels. A temperature of 20-25°C was found to be suitable for all the mushroom species. This culture medium was successful with varying degrees with *Agrocybe aegerita*, *Fistulina hepatica*, *Grifola frondosa*, *Meripilus giganteus*, *Pleurotus eryngii* and *Polyporus squamosus*. In the case of *Lyophyllum decastes*, the culture medium had to be modified with replacing a large share of the hardwood sawdust with compost from heather (*Erica* sp.) for normal growth and consistent production level. Although *Laetiporus sulphuresus* grew fast with standard culture medium and growing conditions, no fruit were formed. In the case of *Sparassis crispa*, culture medium based on conifer sawdust needs to be tested.

Mushroom cultivation pilot tests under industrial conditions

Mushroom cultivation pilot tests under industrial conditions were arranged after establishing suitable seed production and cultivation methods. After tests, the industrial cultivation methods were fully developed for *Agrocybe aegerita*, *Ganoderma lucidum*, *Grifola frondosa*, *Meripilus giganteus*, *Pleurotus eryngii* and *Polyporus squamosus*. In the case of *Fistulina hepatica*, production was improved with incubation under dark conditions. The production of *Lyophyllum decastes* was improved with the culture medium being modified with composted heather. Some species such as *Fistulina hepatica*, *Lyophyllum decastes* and *Polyporus squamosus* were cultivated the first time during this project.

Assessment of nutritional and organoleptic characteristics

The nutrient composition for studied mushrooms were as expected for the type of mushrooms they presented. Chemical composition of cultivated and wild mushroom specimens was possible to be compared only for *Fistulina hepatica* as it was one the species for which there were enough wild specimens to be able to perform the comparison. The results showed no significant differences in total protein or fat content, no differences in vitamin C content, and no differences in the relative proportions of different fatty acids between cultivated and wild *Fistulina hepatica*. Only slightly higher polyphenol content was detected in the cultivated *Fistulina hepatica* than in the wild one.

Organoleptic characteristics of the mushrooms were evaluated by chefs. In total 12 restaurants were sent specimens of *Meripilus giganteus*, *Pleurotus eryngii*, and *Polyporus squamosus*. In total 3 out of 12 restaurants responded the survey on organoleptic characteristics of the mushrooms. The results showed that *Meripilus giganteus* was perceived to be fibrous with young specimen being able to be consumed as food, the browner *Pleurotus eryngii* showed

more aroma than the whites one, and *Polyporus squamosus* was considered an interesting mushroom for food use. Due to low number of respondents to the initial survey, mushroom tasting was organised at two culinary events in Catalonia in 2021. Three mushrooms were studied: *Agrocybe aegerita*, *Fistulina hepatica* and *Polyporus squamosus*. A major part of respondents regarded the characteristics of all these three mushrooms interesting or very interesting for food use.



Figure 3. *Meripilus giganteus* in test cultivation. Photo: Carles Diaz / Bolet Ben Fet.

Development of new products, and knowledge transfer for stakeholders

As a result of the project, new native mushroom species increased and diversified the range of cultivated edible mushrooms on market in Catalonia. Whereas *Agrocybe aegerita*, *Fistulina hepatica*, *Ganoderma lucidum*, *Grifola frondosa*, *Lyophyllum decastes*, *Meripilus giganteus*, *Pleurotus eryngii* and *Polyporus squamosus* were previously only available by picking them in forests, after the project they can be grown on industrial scale. In the case of *Agrocybe aegerita*, *Grifola frondosa*, and *Pleurotus eryngii* the strains imported previously from abroad can be replace with local strains developed in the project contributing to overall productivity of mushroom farmers. Three of the studies eight

species are already in production. Cultivation methods of species such as *Laetiporus sulphureus* and *Sparassis crispa* need to further studied in order have solid cultivation procedures. Successful industrial cultivation of *Laetiporus sulphureus* and *Sparassis crispa* could reduce environmental impacts of picking them in forests and support the role of these fungi in natural ecosystems and biodiversity.

Besides new mushroom species, culture medium used in growing the mushrooms promotes recycling forestry and agricultural residues such as sawdust.

What may the future hold?

A large share of the new mushroom for which cultivation methods were developed are not included in the mushrooms authorised to be sold in Spain. The process of including new marketable species started at the beginning of 2021. The focus is on three species *Fistulina hepatica*, *Lyophyllum decastes* and *Polyporus squamosus* as they are considered to have the best commercial possibilities.

If you are interested to learn more about the operational group “Diversification of edible wild mushroom cultivation with new native species” contact TEB VERD, SCCL (info@boletbenfet.com) or visit the project website at <https://bolets.net/>.

About FOREST4EU project

The article has been produced in FOREST4EU project as a part of capacity building materials directed to stakeholders across Europe. Whereas innovations developed in the operational groups are typically available locally, FOREST4EU project aims at transferring knowledge and best practices on forestry and agroforestry to stakeholders and operational groups across Europe.

What may the future hold?

EU CAP Network. nd. Diversification of edible wild mushroom cultivation with new native species. Available at: https://eu-cap-network.ec.europa.eu/projects/diversification-edible-wild-mushroom-cultivation-new-native-species_en [Accessed 29 January 2025].

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Further information

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4 February 2025

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Funded by the European Union (Grant n. 101086216). Views and opinions expressed are however those of the authors only and do not necessarily reflect those of the European Union or REA. Neither the European Union nor the granting authority can be held responsible for them.








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