# MUSHROOM BIOTECHNOLOGY EDUCATION FOR SUSTAINABLE DEVELOPMENT IN KYRGYZSTAN

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The role of forest ecosystems is impossible to overestimate since forest equals health; forest biological resources are food for local communities, social and ethnic groups. Mushrooms are an important food item among forest resources. Their nutritive value is determined by the protein content and amino acid composition. In addition, mushrooms contain fats, carbohydrates, a number of vitamins, and large amount of minerals and microelements, often in the concentration higher that that in the best food products of plant and animal origin. In the recent years in Kyrgyzstan, mushrooms became a popular protein source and are actively used as a food item by the local population. There are about 100 species of edible wild mushrooms in the republic [1]. The most commonly collected for food are *Agaricus* spp., *Lepista saeva*, *Pleurotus eringii, P. ostreatus*; in the southern part of the country, also *Morchella conica* and *Gyromitra esculenta.* Mushrooms are collected from early spring to late fall. Due to the poor knowledge of mushroom species diversity and lack of information on this valuable resource, the local population uses only about ten species of mushrooms as food.

Demonstration of teaching techniques on mushroom cultivation and sharing some valuable experience in their biotechnology will not only contribute to poverty alleviation but will serve as powerful science educational tool. It is important to educate the local population in correct ways of mushroom collection and role in nature, identification, and in mushroom cultivation (farming).

We compiled a brochure about edible and poisonous mushrooms in Kyrgyzstan [2]. Artificial cultivation plays significant role in conservation of mushroom diversity. The system of educational events towards population for conservation and sustainable use of mushroom resources is enclosed below this text (Table 1).

As a result of our research we have established the best technological conditions for productive growing of fungi. We provide recommendations for individuals and farmers on mushroom farming. Involvement of rural farmers, local women's NGOs and schoolchildren in education sessions is essential for dissemination of knowledge and experience on mushroom farming.

The successful process of mushroom cultivation is facilitated by the existence of pure cultures of highly productive strains [3, 4, 5]. The artificial growing of mushrooms allows avoiding some negative factors connected to the environmental pollution. In Kyrgyzstan, as well as in Russia, Belarus and Ukraine, where environmental conditions deteriorated in the recent years, the situation is alarming since there have been mass poisonings by wild mushrooms. Our collection has more than 100 mushroom strains, characterized by to their rate and character of their growth on liquid and solid media of various composition; accumulation of the biomass and protein content; reaction to the

temperature and the sources of carbon, nitrogen and phosphorus ; character of utilization of plant substrates; formation of fruiting bodies; cultivation conditions; and productivity [6].

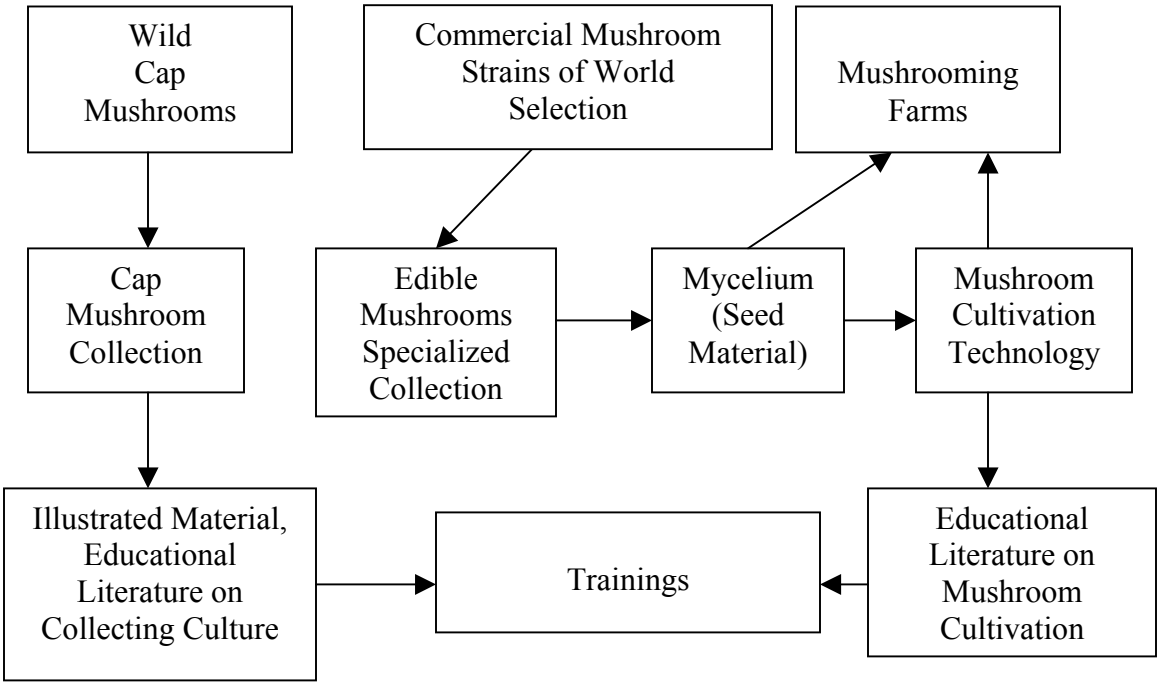


**Table 1. Educational events towards population on conservation and sustainable use of mushroom resources.**

Among fungi that are widely used commercially are *Agaricus bisporus, Pleurotus ostreatus, Flammulina velutipes, Lentinus edodes* and others. Screening of mushroom strains according to their industrial features (rate of substrate colonization, fast ripening, quality of fruiting body, and yield) demonstrated that the individual selection of substrate components was one of the major factors on strain selection. Certain wild strains could be used for industrial mushroom cultivation; the most promising strains could be used for further selection.

We developed the following technological elements for cultivation of the mycelium and fruiting bodies of edible mushrooms such as oyster mushrooms (*Pleurotus* spp.), champignons (*Agaricus* spp.), and shiitake (*Lentinus edodes*): selection of substrate formulas, techniques of preparation and treatment of the substrates, optimization of the regimes and conditions. We conducted these studies in the lab as well as in the small and medium urban and countryside farms using local buildings, infrastructure and equipment (Figure 1).

Our projects so far do not have a commercial scale as their main goal was to test the efficiency of mushroom farms. We obtained good results in the introducing technologies of cultivation of oyster mushrooms (Figure 2), champignons, and shiitake (Figure 3). Under our recommended cultivation conditions, the productivity was 15 to 17 kg per sq. m. for champignons, and 1,0 to 1.2 kg of fruiting bodies of oyster mushroom and 0,5-0,7 kg of shiitake from 1 kg of dry substrate. One of the examples of successful cooperation was cultivation of the oyster mushroom by the At-Bashi chicken farm.

A very promising culture for Kyrgyzstan is shiitake mushroom - a delicacy food object, valuable also in prophylactics of heart disease, cancer and viral infections. It has been used as food and medicine in Japan over 1000 years, and is now used worldwide, with world production of 500,000 tons a year, and price at $ 10-12 per kg. Shiitake is cultured on sawdust obtained from leaf trees, in Kyrgyzstan poplar sawdust is optimal, with nutrient and mineral additives.

**Figure 1. Substrate inoculating process.**

Substrate is packed into thermostable plastic bags, sterilizied, and inoculated with mycelium. Incubation at 20-22°C lasts for two months until fruiting starts. Shiitake requires light for eight hours a day, and humidity of 80-85%. The yield constitutes 25-30% of the substrate mass.

Educating local communities in mushroom cultivation can be of significance, as this industry does not require large investment and can be conducted on the waste products of forest industry (stumps, sawdust). Mushroom cultivation is connected to the biological recycling of vegetation and waste products of agriculture, food industry and forestry [7], which makes this area of biotechnology especially attractive.

**Figure 2.**
**Oyster mushrooms.**

**Figure 3.**
**Shiitake mushrooms.**

Among our further plans is production of illustrative material and conducting training sessions for women's NGOs, schoolchildren, and farmers in order to (a) educate the local population in correct ways of mushroom collecting, recognition of the edible species, and ways of mushroom processing for food, for their sustainable use in nature; and (b) educate population in mushroom farming in order to create jobs and obtain profit. The local population should play the central role in the conservation of biological and genetic diversity of mushrooms. This has to be achieved through the ecological education of the local population on use of mushrooms through consulting, TV broadcasts, and publications in local newspapers. Informing and educating the population will be most important in addressing social and ecological problems, to achieve the sustained

conservation of mushrooms in natural ecosystems as well as obtain profit by the population while collecting and processing this important biological resources.

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