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## Criterion of Preservation of Shiitake Mushroom (*Lentinula Edodes* (Berk.) Pegler) In the Primorsky Krai

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### ABSTRACT

In the paper it is referred to the shiitake mushroom that is known under different names (shiitake, siitake, lentinula, etc.). Peculiarities of its distribution also on the territory of the Primorsky Krai are revealed, characteristic of its curative properties is provided. In the Primorsky Krai as well as within the walls of the Agricultural Academy the research works on artificial propagation of the lentinula mushroom on logs of hard-wooded broadleaved species are already being performed.

**Keywords:** shiitake, wide range of revitalizing action, Mongolian oak, substrate, Red Book of the Primorsky Krai.

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## INTRODUCTION

Due to its nutritional and curative properties the shiitake mushroom that is also known under different names - shiitake, siitake, lentinula, etc. – was introduced to the human culture over 2000 years ago. Today it comes second (after champignons) in the world scope of mushroom production. The largest producers of these mushrooms are countries of the South-Eastern Asia where Japan, China and Korea dominate. Of course, this mushroom is also found on the territory of the Russian Far East – in the Southern regions of the Primorsky Krai and in the Sakhalin region. In the Primorsky Krai it is widespread on the Myravyov-Amursky Peninsula, in the Lazovsky, Partizansky, Shkotovsky, Ussuriisk and Khasansky districts, i.e. in the Southern middle of the Primorsky Krai the Northern border of its range is drawn [1, 5, 6, 8-10]. It grows on dead fallen wood and cut rests of the Mongolian oak, very rarely – on other broadleaved species (Fig.1).

## PROCEDURE

Production and storage of pure cultures and grain spawn. In the experiments the strains of *Lentinula* species was used that were obtained in testing laboratories of the Primorsky State Agricultural Academy. Pure spawn cultures were isolated from the fruit bodies on stubs and dead fallen Mongolian oak. Methods of chemical analysis of the substrate fruit bodies: prior to chemical analysis the substrate and fruit bodies samples were dried out to air-dried state and grinded with the use of electrical mill.

## MAIN PART



**Fig. 1. Shiitake mushroom on cut rests of the Mongolian oak (South Primorye)**

Sometimes shiitake can also be found on growing oak trees that have damages in the bottom stem part in the form of fire wounds, frost clefts, mechanical injuries, etc. (Fig.2).

The Japanese mushroom (*lentinula*, shiitake) features a wide range of curative action [2, 10]. It reduces the blood cholesterol level, regulates cardiovascular pressure, and prevents formation of malignant cells. Upon the regular use of this mushroom in reasonable amounts the protective-immune properties are activated, ageing process is decelerated, anti-virus, antibacterial, противогрибковые and other protective functions of the organism are enhanced, stress situations are overcome easier. Similar to the legendary ginseng, the shiitake mushroom is rightly called the elixir of life.

In the Primorsky Krai secondary cedar-broadleaved forests selective logging of the Mongolian oak have been performed for a long time, on its slash the fruit bodies of *lentinula* appear by the 3d-4<sup>th</sup> year already. On semi-

decomposed substrates the mushroom fruits annually and has the maximum fruiting season. The first fruit bodies appear in the middle of May already, the latest harvest may be collected in November when there are ground frosts already (Fig. 3). On the same slashes the mushroom fruits during the entire vegetation period.



Fig. 2. Shiitake mushroom on the growing oak damaged by creeping fire



Fig. 3. Shiitake mushrooms collected on the wood plot of the Primorsky State Agricultural Academy 'Primorye's relict' on November 10, 2014

It takes about 10 days from appearance of the tiny little brownish pin-head-like beads to a well-developed mushroom with the pileus diameter of up to 10 (20) cm and weight up to 80 (100) g. After this period depending on weather conditions the mushroom fruit body begins to lose moisture and is maintained in semi-dry state for a rather long time. In this state it is quite fit for further storage and use both in the natural dry form and in the grinded, powder-like one (Fig. 4). Upon high humidity and frequent precipitations a ripe mushroom in the forest accumulates moisture, gets black and begins to rot quickly. On the same substrate (stub, large and small branches, long butts, wooden stems left) new fruit bodies are formed constantly and on large slashes dozens of mushrooms at different stages of their development can be seen. In shiitake, like in all agaric, spores are located on the bottom side of pileus.



**Fig. 4. Dry shiitake mushrooms collected in natural conditions are quite fit for further use**

Mushroom produce huge amount of spores estimated in billions (ripening period - 10-15 days). Puffed away with the wind, they appear at the new plots with rot slashes and infect them. In the South Primorye, on the territory of the former scientific-experimental forestry station of the Primorye State Agricultural Institute today the significant part of forests is sent over to the federal ownership where selective logging of the Mongolian oak on the areas of dozens of hectares are performed annually. After such felling up to 20-30 m<sup>3</sup>/ha large slashes remain that 3-4 years later will provide the harvest of this mushroom. The growing oak trees are well protected from spores with thick bark and specific response that may be damaged by forest fire facilitating germination of spores of honey fungi (*Armillaria* sp.) and other wood-destroying fungi.

Our preliminary calculations showed that on the average on 1 ha up to 10-15 stacks from large slashes containing 1-2 and more cubic meters of waste oak firewood remain.

3-4 years later on stubs, large and small rot slashes the first *Lentinula* mushrooms appear that depending on weather conditions of the vegetation period will fruit from May until November, i. e., almost seven months. The *Lentinula* yields are not equal throughout the vegetation period. In spring, in May the first yield burst is observed. All slashes are soaked with water from snow melting; the mushroom mycorrhiza easily splits the tainted oak cellulose and spends the obtained nutritive substances on the fruit bodies' growth. During this period from 1 ha of forest for selective logging of the Mongolian oak was performed a few dozen kg of the valuable nutritional and medical product can be collected. Further yield of this mushroom will depend on summer and autumn weather conditions. Upon frequent and heavy rains the *Lentinula* fruit bodies will appear on the same slashes more or less regularly, upon the dry weather the germs of fruit bodies dry out without having reached the necessary sizes. Thus, regular mushroom picking on the areas of selective logging of the Mongolian oak may reach 100 kg per 1 ha annually.

## SUMMARY

Shiitake is listed in Red Book of the Primorsky Krai [9] which means that collection, use and sales of fruit bodies of this mushroom are prohibited. All 'Red-Book' plant species (a mushroom is also a plant) require special attention of the state and are objects of legal protection. Collection of these mushrooms may cause arrest, penalty or other punishment. To designate the status of object protection the species categories have been adopted and are used according to the concept of the International Union for Conservation of Nature and Natural Resources (IUCN). Today there are 9 IUCN categories used for assessment of the species protection status. According to these categories all species are characterized (plants, animals, insects, etc.) on the specific territory (region, district, republic, country, and continent), using the following international symbols [7]:

1. «NE – not evaluated». Taxa that have not been subjected to evaluation by criteria;
2. «DD – Data deficient». Taxa included in analysis but not providing complete information about the number (or area) for assessment of direct or indirect danger of extinction. The first two taxa categories require additional comprehensive research and due to this fact the taxa featuring such criteria cannot be listed in Red Books;
3. «EX - Extinct». A taxon is referred to this category provided there are no grounds to doubt that the last individual is dead;
4. «EW – Extinct in the Wild». Taxa preserved by human in the artificial environment (botanical gardens, zoos, aqua parks, etc.);
5. «CR – Critically endangered, nearing extinction». A taxon appears in conditions of extremely high degree of risk of extinction in the nearest future;
6. «EN – Endangered». Very high degree of risk of taxon extinction in the nature in the nearest future;
7. «VU - Vulnerable». The degree of the taxon extinction in nature in the future is rather high;
8. «NT – Near threatened». The degree of the extinction risk is insignificant;
9. «LR – Low degree of risk». Taxa of this category are divided into «Dependent on protective measures», «Nearly threatened», «Slightly vulnerable».

*Lentinula edodes* (Berg.) Pegler is listed in Red Book of the Primorsky Krai under the status VU – vulnerable. The mushroom featuring valuable nutritional and medical properties is completely legally protected from the use by local population. Today the regional authorities set a course for active development of the regional economy which will inevitably result in increase in load on the environment. The increased demand for food and medicinal plants of the Primorsky Krai including the wood-destroying fungi featuring these properties appeared. As far back as millennia ago *Lentinula* was artificially cultivated and сохраняла здоровье of many generations of people in most countries of the South-Eastern Asia but in the Primorsky Krai where natural mushroom stock is estimated at hundreds kg, the fruit bodies are not accessible to collection, processing and use.

Let's briefly remind the biology of this fungus plant. In the Primorsky Krai *Lentinula* infects and is developed primarily on the semi-decomposed wood of the Mongolian oak, slashes, wooden residues that remained unburnt after forest fires, etc. Contamination with this fungus proceeds through numerous spores; it takes 3-4 years from spore germination to appearance of the first fruit bodies. Therefore, a human indirectly participates in propagation of this edible and medicinal fungi species performing different kinds of felling in pure or mixed oak or coniferous-broadleaved forests as well as originator of the forest fire break-out. How does collection of fruit bodies of this mushroom affect preservation of its population? A ripe mushroom has a very steady stipe that cannot be destroyed and torn off from the substrate; mycelium penetrates the sap-wood so tightly that stipe may be cut with a knife only. Therefore, by mushroom picking mycelium is not damaged at all. *Lentinula* fruit bodies appear during the entire vegetation period – from May till November this is why on the oak slashes there are always fruit bodies left that will fulfill the role of seed bearers. Therefore, timely picking of good (without signs of ageing and rotting) *Lentinula* fruit bodies shall not affect extension of area and increase in the fungus productivity.

Thus, collection of shiitake fruit bodies does not have significant effect on reduction in yields during the next years. So why the inhabitants of the Primorsky Krai cannot use the gifts of nature, collect mushrooms using them either in fresh or dry, powder-like, vinegar pickled, frozen or other form for nutritional and medical purposes? A ripe mushroom will remain marketable for a few days only (from 3 to 5), then it dries up or (upon high humidity) gets black and turns into black jelly.



## CONCLUSION

We propose to move the shitake mushroom in the Primorsky Krai to the «LR – low degree of risk» status, allow collection and processing of fruit bodies of this mushroom to the local population, to organize at the Institute and forest husbandry at the Primorye State Agricultural Academy monitoring of its status on the territory of the South Primorye, to design projects of performance of sanitary and other felling of forests with prevalence or presence of the Mongolian oak with further use of the oak slashes as the substrate for increase in the area and yield of this valuable species of wood-destroying fungus. In the Primorsky Krai as well as within the walls of the Agricultural Academy the research works on artificial propagation of the *lentini* mushroom on logs of hard-wooded broadleaved species are already being performed.

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