Suillus granulatus (L.) Roussel as a new macrofungus for southern Uzbekistan

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Abstract. This article provides information about the macrofungus Suillus granulatus (L) Roussel which was new one for South Uzbekistan. The identified macrofungus was found near the trees of Pinus eldarica Medw. The hymenium layer, basidiosporous basidia layer, spores and spores form small bodies (subfusiform) in the inner part of the spores in the shape of a drop.

1 Introduction

The fungus Suillus granulatus (L.) Roussel is an ectomycorrhizal fungus belonging to the division Basidiomycota, class of Agaricomycetes, order or Boletales, family of Suillaceae, and in the external ectorotrophic mycorrhiza, fungal hyphae surround only the surface of the root tips it does not enter the cell spaces and performs the function of root hairs.

Mycorrhizae play important role in trees nutrition such as oak, birch, spruce and pine, play an important role in tree nutrition. They cannot grow and develop without mycorrhizae. The fungus S. granulatus is widespread in Great Britain and Ireland, in most parts of Europe and in some parts of North America.

The fungus S. granulatus was first described in 1753 by Carl Linnaeus as a species of Boletus. Its current name was given by the French naturalist Henri Francois Anne de Roussel in 1796.

Suillus species are ectomycorrhizal fungi that are distributed in Mediterranean pine forests. S.granulatus ectomycorrhizal species have been found in Montenegro forests.

Mycorrhization of seedlings is an effective tool for improving the quality of seedlings and scientists have studied the effectiveness of growing S. granulatus ectomycorrhizal seedlings of Pinus trees in open field conditions in Montenegro forests.

The ectomycorrhizal fungus S. granulatus initially spreads via spores and forms mycorrhizal symbioses with specific plant roots. It forms a fungus after mycelial colonies in the soil. Ectomycorrhizal symbioses in forest soil are usually formed by two processes: with newly grown vegetative mycelium from spores or with vegetative mycelium that is continuously growing in the soil and with S. granulatus of white pines (Pinus strobus).

Suillus (Maslyata) is one of the tastiest mushrooms. The pepper mushroom, similar to good oil mushrooms - a representative of the genus Suillus, grows in coniferous forests,

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mosses of pine forests, sandy soils and edges. The maslenok zernistyy – S. granulatus type is lighter with granular oil and all inhabitants of the forest consum this sweet mushroom.

The dry matter and protein content of the mushroom S. granulatus and the antioxidant and antimicrobial activities of the ethanolic extract of Suillus granulatus were investigated. The antimicrobial activity of S. granulatus extract was determined against Staphylococcus aureus, Escherichia coli, Salmonella Typhimurium, Listeria monocytogenes and Pseudomonas fluorescens microorganisms.

In the autumn of 2012, S. granulatus was collected from the forests of Lipovica near Braganza (north-east Portugal) and Belgrade (Serbia). Chemical description of S. granulatus species and the, antioxidant and antimicrobial properties of their methanolic extracts are shown. It is a source of nutritional and biologically active compounds.

S. granulatus macrofungus has been studied for its biologically active compounds in the last decade, in addition to its nutritional content. At the same time, it is a new and little-known type of fungus with potential for biological activity and industrial applications.

Several scientists have conducted mycological research on macrofungi in Uzbekistan. Petrova (1985), Baltaeva (1991), Khalikova (1989), Iminova (2009), Gaffarov (2020), Mustafoev (2017), Eshonkulov et al. (2022).

However, species of the Suillus family have not been recorded in Uzbekistan. In this study, we used S. granulatus (L.) Roussel. This is the first ropert of Uzbekistan from Karshi pine groves and describe the morphological features of the collected specimens. The territory of South Uzbekistan includes the Kashkadarya and Surkhandarya regions located in southern Central Asia. It borders the Samarkand and Bukhara regions of Uzbekistan to the north, Tajikistan to the east, Turkmenistan to the west, and Afghanistan to the south. The southern border of the province runs along the Amudarya, the border between Uzbekistan and Afghanistan. Southern Uzbekistan covers an area of 48,500 km² (18,800 sq mi).

A total of 215 species of trees and shrubs belonging to 113 and 52 genera, respectively, were introduced in the southern territory of Uzbekistan. Among them, there are many trees belonging to the Pinaceae Lindl family. Macrofungi grow on a variety of substrates, such as manure, live or dead tree trunks, and humus soils, and form ectomycorrhizal associations with broadleaf and deciduous trees.

Information on some macrofungi has been provided. However, to date, no species of S granulatus have been found in thise area.

2 Materials and methods

The material for this article was taken in November 2022 from the place where the Karshi pine tree of the republic is growing. The samples were collected in the following order: First, photographic research methods were used. Then 2-3 were cut with a pocket knife and cleaned thoroughly, and attention was paid to what kind of plants the fungus grew. The appearance (color, smell and taste) of the fruiting body was determined as soon as it was cut. Some macromycetes have soft, slimy fruiting bodies that can quickly change color after being cut. They were then placed in a sterilized package. Both fresh and dried. The collected samples were then air dried. Identification of this fungus was carried out using a B-382PHiALC DC6V1000mA, 34914538 - Trinocular microscope, 34914549- Polarizing microscope digital microscope and detectors. Modern nomenclature of fungi was determined using at database.

3 Results and Discussion

It was noted that the pine (Pinus) Pinus eldarica Medwd trees in Karshi city in the Kashkadarya region grew close to each other (Figure 1 a,b). This fungus Suillus granulatus (L.) Roussel, Fl. Calvados: Identified as type 34 (1796). Synonyms: Boletus granulatus L. 1753 basionym, Agaricus granulatus (L.) Lam. 1783 year, Rostkovites granulatus (L.) P. Karst. 1881, Ixocomus granulatus (L.) Quel . 1888.

Fig. 1. Suillus granulatus a,b,c,d – collected fruit stem (Photo by Sherkulova).

The diameter of the cap of the fungus is 5 - 18 cm and its shape is round, convex or flattened, smooth, slimy and the color is variable, but typically brown. It was found to have a light and pleasant aroma and a mild taste. In young mushrooms, the hymenophore is pale yellow and is, easily separated from the cap. The holes were round, small, and had the same size and shape, with smooth edges. Young mushrooms, often forms drops of opaque light - yellow liquid in their hymenophores. Stems are 4 - 8 cm length, thickness is 1.5 - 2 cm, hard, yellowish-white and ringless. S small dots were observed on the lower part of the stem (Figure 1 c,d)

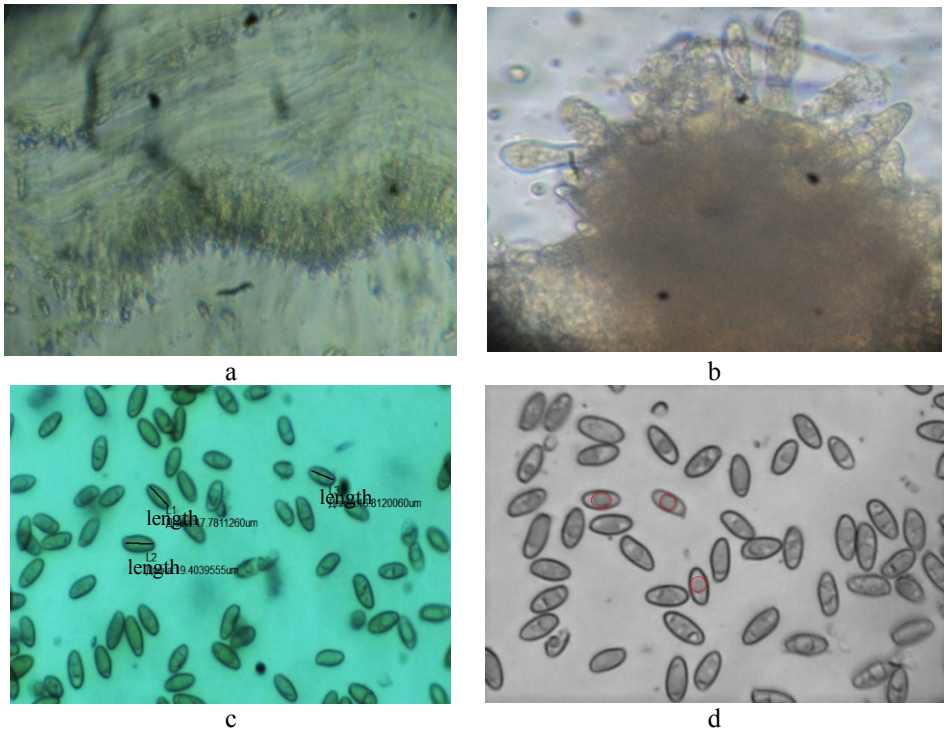

Fig. 2. Suillus granulatus fungus: a- hymenium layer; b - layer of basidia with basidiospores: c - spores; d - small bodies in the form of drops in the interior of spores (subfusiform) (Photo by Sherkulova).

The fruiting body of the fungus Suillus granulatus forms a hymenium layer consisting of basidia and paraphyses. The paraphyses are flexible and separate the hymenial layer from basidia. (Figure 2 a, b)

Cystid cells in the hymenial layer are rare in this type of fungi.

The function of Cystids is to protect the hymenial layer.

Spores weare 16-19 × 3,5 -5 µm, ellipsoid, smooth and yellow-brown (Figure 2 c, d). In the inner part of the spores, there weare small bodies in the form of a drop (subfusiform), spherical and colorless. (figure 2. e)All morphological characteristics and external and internal structures of this collection were compatible S. granulatus. The diameter of the cap is 30-100 mm, convex and yellow-brown in the young fruiting body. Cap 40~110 mm, basidiospores 5-shaped and smooth, 6~10.6 × 2.4~3.8 µm. The orange-brown to brownish-yellow cap is sticky (sticky) when wet, shiny when dry, and usually 4 - 12 cm in diameter. The hat is 7 cm, wide convex, sticky, brown, or orange-brown. Spores 8–10 x 2.5–3.5 µm.

Bibliographic information on reported specimens of S. granulatus with comparison of micromorphological characteristics is presented. The identification of Suillus granulatus species is primarily based on the shape of the fruit body and the size of the basidiospores. The caps of S. granulatus found in Uzbekistan are smooth and hemispherical on brown fruiting bodies. Our specimens weare morphologically very similar to the specimens of S. granulatus in Europe.

Thus, it should be noted that S. granulatus is widespread in the territory of our republic. This fungus has great innovative potential, as it is an ectomycorrhizal fungus, that is important in the life of trees such as spruce and pine It can be used as a producer of

biologically active food additive, and there is a possibility of creating a production technology in the conditions of Uzbekistan.

4 Conclusion

The following tasks were defined: isolation of pure cultures of fruiting bodies from natural samples of S. granulatus fungus, study of their morphological and cultural characteristics, and determination of optimal growth temperature:

- Growing in liquid environments with different contents.
- Selection of the most promising strain as a biomass producer and the most favorable composition of the environment.
- To study the physiological characteristics of the strain, its relationship with temperature, pH, carbon and nitrogen sources, to build technological environments based on them using renewable agricultural raw materials, and to study the growth dynamics and morphology of the culture, including microscopic signs.
- study the influence of cultivation conditions and regimes on the productivity of the strain.
- To study the biochemical properties of dry biomass in environments with different composition.
- Development and testing of the technological process for obtaining dry mycelial mass of the selected strain under experimental conditions of industrial production.

It should be noted that at the moment, in the laboratory of mycology and microbiology, work is being carried out to extract pure cultures from this fungus collected from different regions and substrates, and to develop the technology of cultivation underin local conditions.

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