

Mycelium Macromorphology and Growth Characteristics of Culinary–Medicinal Mushroom *Flammulina velutipes* (W.Curt.: Fr.) Singer

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Recent advances in biotechnology increased the role of different groups of organisms for obtaining biologically active compounds (BAC) in the development of health-enhancing biopreparations and dietary supplements. Medicinal Basidiomycetes mushrooms are promising in the production of new biopharmaceuticals and as food additives. However, the screening of macro- and micro-morphological characteristics and optimal growth conditions of mycelium of these species, selection of fast growing strains/active producers of BAC are preliminary steps in their biotechnological cultivation protocol.

The object of our study is a well known wood-inhabiting, culinary–medicinal mushroom known as

Flammulina velutipes. Based on bibliographic data and our own observations, this species contains different groups of active compounds (polysaccharides, protein/glucan complexes, sterols, lectins, phenolic compounds, etc.) and substrate-specific enzymes. The large spectrum of pharmacological activity (immune-modulating, antitumor, antifungal, antiviral, antibacterial, fibrinolytic, thrombolytic, hypolipidic, antioxidant, spasmolytic, etc.) of *F. velutipes*' metabolites was reported.

The 21 strains of *F. velutipes*, separated from different geographical regions (Armenia: 17 strains, France: 3, and Russia: 1) and from different wood substrates (poplar: 1 strain, oak: 8 strains, grapes rod: 1 strain, ash-tree: 1 strain, pin-tree: 2 strains,

and leaves-tree stumps: 8 strains) were involved in the screening of growth and macro-morphological characteristics. Two formulas were used to calculate the colony growth rate (GR) and growth coefficient (GC): $GR = \Delta d / \Delta t$ and $GC = dgh / t$, where d = a diameter of colony growth, t = time, g and h represent the density and height of colony, respectively. The mycelial growth characteristic and morphology were analyzed after incubation of cultures on 2% malt-extract agar medium (MEA, pH = 5.5) at 25 °C. The measurements were taken for 11 days. The observations continued 2 months until primordia or fruiting body formation.

Based on GR indicators, all screened *F. velutipes* strains were divided into three main groups: I: GR <12 mm/day (9.5%), II: 12–14.5 mm/day (47.6%), and III: GR >14.5 mm/day (42.9%). The first group involved one Russian (R-9) and one Armenian (II-4) strains. The French strains possessed average GR and belonged to the second group.

Two morphological types of colony A and B within *F. velutipes* strains were described. Type A colony is farinaceous and white and later turns yellowish. The agar has yellow-brown pigmentation. Fruiting body formation was mentioned for all strains during 1–1.5 months of observation. Type A is typical for *F. velutipes* and includes average- (10 strains) and fast-growing (4 strains) separated from fruiting bodies from Armenia and France. They formed two colony “subtypes” with dense (A1) and sparse (A2) mycelium, respectively. Type

B is a slowly growing morphotype of the *F. velutipes* colony with wadded and dense mycelium. The pigmentation of agar is nearly absent. The fruiting of this mycelial type was not mentioned during our observation. Type B was observed in one Russian (R-9, ash-tree) strain. However, a mixed A-B type of colony was also observed in three French and three Armenian (II-2, II-3, II-4) strains, separated from fruiting bodies collected on ash-tree and oak, respectively.

All screened strains on the 6th day of mycelial growth were divided into three groups based on GC indicators: I: GC <30 (28.5%), II: GC = 30–60 (38.1%), and III: GC >60 (23.8%). The first group involved Armenian strains with type A2, whereas group II was composed of the strains with A1 morphotype. French, Armenian (II-4), and Russian (R-9) strains were involved in group III.

We concluded that two A and B species-specific morphological types or ecotypes of colonies described in our collection of *F. velutipes* correlated with their substrate nature and geographical origination.

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