

Possibility of modernization of *Ganoderma lucidum* strains substrate

Maszlavér P.¹, Kovácsné D.², Ferenc K.² and Fehérvári-Póczik E.¹

¹Corvinus University of Budapest Faculty of Horticulture Science
Department of Vegetable and Mushroom Growing H-1118 Budapest Villányi street 29–43.
²Vegetable Research Institute, H-6000 Kecskemét

Summary: *Ganoderma lucidum* (Reishi mushroom), the object of our experiments, is also known to contain medicinal compounds. This fungus has been used for many centuries as medicine in China. The fruiting body of the fungus contains carbohydrates, amino acids, little protein, fat, alkaloids, vitamins and minerals. Two groups of its substances are reported to be effective particularly. One of them is constituted by the polysaccharides, whose antitumor and immunostimulating effects are well demonstrated, and the other is constituted by the triterpenes. The latter include ganoderic acids, ganolucidic acids and lucideric acids. These acids have been reported to suppress liver hyperactivity (Lelley 1999). The experiment was carried out with 8 Reishi mushroom strains in 3 repetitions. Experiments were performed on 3 different substrates. The spawn run period took approximately 2 weeks, the first fruiting bodies appeared on the 33rd day from inoculation, but the formation of the fruiting bodies took almost 70 days on the different substrates. Spawn run presented a diversified picture as influenced by the specific substrates. No spawn run was seen with any of the strains on the substrate composed of 100% wheat straw. Among the strains the fastest spawn run was produced by GA02 and GA06. The earliest start of spawn run was registered for substrate 1 after 1 week.

Key words: fungi, mushroom, reishi

Introduction

Phytotherapy is a long established concept indicating medical treatment with plant materials. Mycotherapy, however, is a quite novel term, used for the first time by Lelley (1999). Mycotherapy is the designation of healing with substances obtained from fungi. Though the term is new, the possibility of healing with fungi had been discovered long before. The major part of our knowledge about medicinal fungi originates from the Far East, from China and Japan in particular. In China, the use of medicinal fungi has been a part of the traditional therapies since time immemorial and several higher fungi of large size have been considered for centuries as efficient medicine. In Europe, the curative effect of fungi has gradually fallen into oblivion, even though the popular therapy used to apply several fungi with success. A number of tests have demonstrated that fungi contain some therapeutical compounds as well as those trace elements essential to human life (Lelley 1999). *Ganoderma lucidum* (Reishi mushroom), the object of our experiments, is also known to contain medicinal compounds (Jakucs, 2003). This fungus has been used for many centuries as medicine in China. Its Chinese name is ling zhi or ling chih, meaning 'herb' of immortality and magical herb. The Japanese name is reish (Stamets, 2000). The application of *Ganoderma lucidum* extends beyond two millenniums. The earliest report dates back to the first emperor of China and from then on it is

frequently described in the whole Chinese literature and art as well. The fruiting body of the fungus contains carbohydrates, amino acids, little protein, fat, alkaloids, vitamins and minerals. Two groups of its substances are reported to be effective particularly. One of them is constituted by the polysaccharides, whose antitumor and immunostimulating effects are well demonstrated, and the other is constituted by the triterpenes. The latter include ganoderic acids, ganolucidic acids and lucideric acids. These acids have been reported to suppress liver hyperactivity (Lelley, 1999). *Ganoderma lucidum* mushroom occurs also in nature, such it can be collected in Hungary too, its production under artificial conditions, however, is reported almost exclusively in foreign literature. It can be found in nature in calcicolous and thermophilous oak and hornbeam groves, in parks or on pine species as well. The mushroom is conspicuous, having sometimes even a strange appearance. The cap of the Reishi mushroom is generally kidney-shaped and the stem may occasionally be elongated and have a similar appearance to an antler. Often, concentric growth zones are observed on caps. Cap colour can range from dark red to black, but may even be yellow. The outer rim of the cap and that of the elongated antler are white. That is the location of the growth zone. The new growth on the cap is whitish and then turns to yellowish brown during ripening and generally to dark red (Chen, 2000). The elongated stem has a shiny surface and often it seems as if it were lacquered. Due to the exotic

appearance the utilisation for exclusive plant ornaments is becoming more and more popular. *Ganoderma lucidum* has a number of strains. Therefore, it is important to know the characteristics of the strain intended for cultivation.

Material and method

The experiment was set up in the mushroom research laboratory of the Vegetable Research Institute in Kecskemét under the guidance of Dr. Melinda Gyenes. The experiment was carried out with 8 Reishi mushroom strains in 3 repetitions. 6 of the strains were kindly put at our disposal by Prof. Jan Lelley, and 2 strains by István Szili. Fungus germs for the experiment were produced on cereal grains by István Szili. Experiments were performed on 3 different substrates, which had the following designations and compositions:

1. (70% beech chippings, 20% bran, 10% lime)
2. (80% beech chippings, 15% cornmeal, 5% bran)
3. (100% wheat straw)

The strains examined: Ga01, Ga02, Ga03, Ga04, Ga05, Ga06 (strains of Jan Lelley), GLL and PV1 (strains of István Szili). The basic materials for the experiment were mixed and then moistened and left in this condition for 24 hours. The following day the basic material was centrifuged, set to the desired moisture content (approximately 60%). Then the basic material was packed in heat resistant plastic bags of 0.6 kg. The next step was sterilization for 2 hours under a pressure of 1 bar (with the exception of wheat straw as it had already been subjected to heat treatment in the wet stage). Spawning was carried out the day after the sterilization under a laminar air-flow box. 50 ml grain spawn was used for the inoculation and it was evenly distributed into the growing medium by shaking. Bags were placed then into the spawn run room. Spawn run was performed at 22–24°C. Spawn run of the 8 different strains was followed daily during the spawn run period, taking notes of the process. It was when the substrate in the bags had already been completely covered by the white mycelium tissue that the fruiting stage was initiated and cropping began. The environmental factors were recorded also over the cropping phase after spawn run. We kept daily notes of the temperature and humidity content of the growing room. A constant temperature was maintained at 16 °C to 20 °C and humidity was around 85–95%. We also increased the amount of light during the cropping phase and by removing the taps of the bags we tried to provide more fresh air for the mushrooms, i.e. increased the oxygen content. Later on, with the appearance of the first fruiting bodies, we opened the bags providing even more air for the mushrooms.

Results and discussion

The spawn run period took approximately 2 weeks, the first fruiting bodies appeared on the 33rd day from inoculation, but the formation of the fruiting bodies took

almost 70 days on the different substrates. Spawn run presented a diversified picture as influenced by the specific substrates. No spawn run was seen with any of the strains on the substrate composed of 100% wheat straw. Among the strains the fastest spawn run was produced by GA02 and GA06. The earliest start of spawn run was registered for substrate 1 after 1 week. Figure 1 illustrates the speeds of spawn run of the different substrates. As it is apparent from the figure, substrate 1 had the fastest speed of spawn run and with the strain GA04 in specific. The slowest spawn run was presented by the strains GA03 and GA04. Spawn run was completed in two weeks with both substrates.

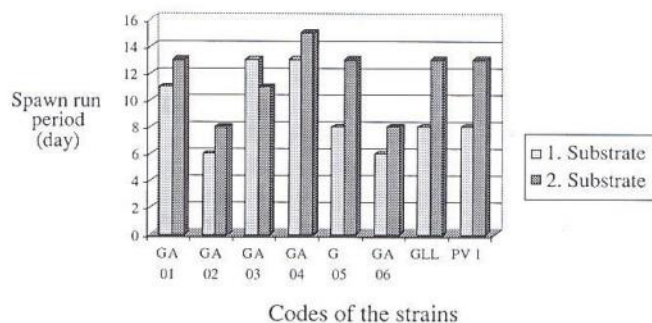


Figure 1 Speeds of spawn run of the various strains on the different substrates

Fruiting of the strains began on the 33rd day. The start of fruiting was almost identical for substrate 1 and substrate 2. For substrate 1, on the 33rd day the strains GA02, GA01 and GLL began fruiting, while for substrate 2, the strains GA01, GA02, GA06, PV1 and GLL. As regards the starting of fruiting, a longer interval followed and none of the strains started to fruit for almost 3 weeks. On substrate 1 on the 56th day, also the strain PV1 started to fruit. During the subsequent phase of the experiment, unfortunately, the other strains did not start to fruit and formed no fruiting body of such quality as to be worthy of evaluation on any of the substrates.

Only 4 of the 8 strains of the mushroom *Ganoderma lucidum* developed fruiting bodies (on substrate 1 and 2), the other strains did not start to fruit though each strain showed a positive occurrence of spawn run. On substrate 3, the process did not even manage to get as far as spawn run, no mycelium growth was seen even after 4 weeks, with no colonization of the wheat straw. This substrate, therefore, was subsequently excluded from the experiment. As it is evident from the data reported in the table (Table 1), substrate one proved superior from the 2 different substrates tested in the experiment, this substrate produced a greater quantity of fruiting bodies and of a higher quality that was more appealing to the senses.

On the other hand, not all the strains produced fruiting bodies. As the requirements of the strains are hardly known, further experiments are necessary. Similarly, no data are available on what environmental requirements the different strains have during the initiation of fruiting. Nor it is clear what humidity and temperature fruiting bodies require for

Table 1 Yields of the different strains on the various substrates

CODE of the strains	1. Substrate g/bag	2. Substrate g/bag
GA 01	15 g	7.2
GA 02	40.2 g	13.1
GA 03	–	0
GA 04	0	0
GA 05	0	0
GA 06	0	0
GLL	10.4	12.4
PV 1	7.25	6.8

their development as specific to the species (strain) and we can only hypothesize what wavelength the suitable light should have. Only a small number of data are known in the literature concerning those light conditions that are necessary for fruiting bodies to develop in a species-specific manner. At the moment it is unknown what wavelength light the various strains require and the length of optimal illumination is also unclear. Based on what is reported in the

literature, a longer illumination will favour the development of a cake form as characteristic to wild grown Reishi mushrooms, while under conditions of moderate illumination the so-called antler form is to be expected. In order to be able to answer those questions above, and in particular to determine production technology parameters, further experiments are necessary.

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