

MYCELIUM CASING - NEW EXPECTATIONS

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The end of the period in cultivation technology and research development in the Netherlands promotes re-examination of the factors affecting the development of mushroom production. The primary source of knowledge in Poland is a Dutch-based manufacturing practice and satellite system cultivation on the shelves. It allows us to reach in three flushes on average, per year, about 30 kg/m² of high quality mushrooms targeted at the fresh market.

Knowledge which explains the technological processes is drawn from the book *Cultivation of mushrooms*, edited LLD van Griensven, published in 1988. Back then, the yield did not exceed 20 kg/m² in three flushes, the substrate was produced using traditional methods, and hybrid breeds were used which were obtained by classical breeding methods.

Two elements: practical experience and scientific knowledge define the level of knowledge when it comes to mushroom cultivation and they are treated as unchangeable laws governing its cultivation technology.

However, technology is constantly changing. Manufacturing practice in Poland shows that average yields could rise to 32 kg/m², and the top limit may be 34 kg/m², 85 kg/m² using a substrate with a 1.5-percent protein supplement. Occasionally there are crops of 40-42 kg/m² in three flushes. Also there is an increase in the use of the substrate to 45% in mushrooms growing on the substrate phase III, which is used in an amount of 75kg/m² with 1% of protein supplement. These results can be achieved in facilities with a balanced air flow, with efficient and modern air-conditioning system control, with a very good substrate and casing loading system, with highly skilled staff responsible for the technology and the crop and with the absence of losses caused by pests and diseases.

It turns out that sometimes you have to revise your knowledge and completely change the approach to technology. This is largely due to the yield achieved on the open market and expectations of further increases in yields and the use of the substrate. The aim to strive even further increase in yields still results from adverse economic conditions: a decline in price received by producers of mushrooms with a simultaneous increase in production costs.

There is a fundamental question: will the development of technology and the level of crop yields obtained be shaped by scientific discoveries and basing on them will a new technology to cultivate mushrooms be developed?

The reason for the need to revise the knowledge is the casing and the use of feeding product - Mycronutrient . The assumptions adopted so far - that the optimum casing reaction is pH 6,6-7,7, and that it should contain as little nutrients as possible- do not coincide with the results of testing and production. Using Mycronutrient as a nutritional ingredient at a dose of 165 g/m² (liquid) or 270g/m² (granular) with CACing from the substrate the highest increases in yield and quality of fruiting bodies is obtained with the alkaline reaction (even at pH 8).



Mycronutrient granules after mixing in the casing in a farm near Poznan, Poland

New opportunities arise for mushroom farming using a genetic engineering method in connection with deciphering of its genome by researchers at INRA in France. As a result of this work, the knowledge of peroxidase's role in the nutrition of mushroom has been extended. This enzyme is involved in the breakdown of organic matter on which mushrooms live. Also an important issue, which can be used in further breeding work and mushroom cultivation technology is the ability to adapt to environmental conditions. In this situation, it should be considered when the introduced changes will result in mushrooms being recognised as "genetically modified", this will lead to a reduction of consumption.

In practice, agents in a liquid form - Liquid Gold (lipid) are being implemented to feed the mushrooms. This creates new opportunities to influence the yield of mushrooms.

Using new achievements, a theoretical model for feeding mushrooms has been developed and verified in a specially prepared new yielding environment.

The theoretical model

This model is based on the following assumptions:

1) The nutrients are created in the composting process in the hot and cold phase under oxygen conditions.

2) Mushrooms absorb nutrients in two ways:

a) directly - using its enzyme system (peroxidase) during the growth of the mycelium, in the vegetative phase. Easily absorbent water-soluble nutrients are taken in this way. They are accumulated in the mycelium and are responsible for the yield in the first and partially second flush. The amount of yield is proportional to the substrate being rich in nutrients following the hot composting phase without mushrooms, the rate of mycelium growth and the spawn and case running period (time to absorb). It is not known whether the periods between flushes, when the

temperature rises in the compost, we do not deal with repeated, brief period of the start in this feeding method;

b) indirectly - in symbiosis with microorganisms present in the substrate difficult to digest nutrients which are insoluble in cold composting phase. This mechanism which starts with the mushrooms generative phase transition (inter flush) is responsible for yielding in the second flush, and is the basis of nutrition in the subsequent flushes. Its effect depends on the amount of nutrients that are not easily available - mainly lignin, the level straw defibration (the surface of the substrate, from which nutrients can be absorbed), the degree of substrate overgrowth (surface mycelium capable of absorption) and the availability of oxygen (structure and substrate moisture). The size of the obtained yield is much lower and does not normally exceed 5 kg/m².

3) The transport of the nutrients depends on the availability of water and evaporation from the surface and fruiting pins (no gaps in the mycelium skin).

The use of the model in the production process

Primary objective: to obtain the same yield of mushrooms in three consecutive flushes.

How to obtain: provide mushrooms with readily available nutrients during the yield in all three flushes.

Alternative objective: increased use of the substrate to 50% or even higher at a constant yield of 30-34 kg/m² and a medium of smaller amounts in two crops.

How to obtain: increasing the amount of easily digestible nutrients in the casing and the compost.

Hardware

A classic metal box for mushroom growing was used to carry out the tests in the area of about 2 m². A perforated hose was used to aerate (used for land improvement), connected to a pump feeding air, which was placed at the bottom of the box lined with foil. On the bottom a layer of a ceramic aggregate (LECA) was placed, which was covered with liquid nutrient. In the layer of aggregate a heating cable was placed to maintain the temperature that would keep the mycelium in the vegetative state. In the future, there is a possibility to feed a liquid nutrient between the flushes or its circulation. It is also intended to test the effects of mixtures with microelements.

The course of verification - a test to check the impact of aeration (without the ceramic layer and the substrate without any additives and feeds).

The effect of aeration of the phase III substrate on a shelf:

1. The appearance of mycelium smell before the start of the shock after aeration.
2. The acceleration in the appearance of mycelium by one day.

3. The increased activity of the substrate to start yielding by about 1 °C.
4. The improvement in the quality of mushrooms from the middle of the second to the end of the third flush.
5. The extension of the yield period to 5 days on the second and third flush compared with a 3-day crop of fruiting bodies on the substrate considered as poor.
6. No overgrowth and perforation clogging in the aeration pump.
7. No significant increase in yields, no full assessment due to the fact that the mushrooms have not been weighed and the distortion in the 1st flush timing, earlier by one day, the start of shock.



Pinning normal without any MycroNutrient



Taken at the same time as above with MycroNutrient

Currently tests are being carried out with a liquid feed (Liquid Gold from Nutrigain) and a ceramic layer

For further information please contact me Nikodem Sakson (n.sakson@wp.pl) or visit my website on <http://www.nikodemsakson.pl>. Also addition details about *Mycronutrient* and *Liquid Gold* can be found at www.nutrigain.com.