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INFLUENCE OF TEMPERATURE AND RELATIVE HUMIDITY ON THE STUDDED *AGARICUS BLAZEI* MURRILL MUSHROOM COMPOST

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Abstract
Almond mushroom, Agaricus blazei Murrill, is the so-called secondary saprophyte, developing on partially processed substrate, in which microorganisms reduced complex ligno-cellulose compounds. Numerous authors have shown that due to the similar life cycle in the cultivation of almond mushroom technologies developed for white button mushroom may be applied. However, almond mushroom requires high temperature and high humidity as well as access to light to form fruiting bodies. In Brazil, due to the advantageous climatic conditions this species is frequently grown outdoors; however, in other countries - mainly due to its high temperature requirements - such cultivation system is risky and may only be successful during very warm summers.
In this study, we analyzed four kind of compost studded by Agaricus blazei Murrill mushroom mycelium. We recorded every hour the air and compost temperature and the air relative humidity.
The best studded compost was the classical, followed by synthetic and then by the mixt compost.

Keywords: Agaricus blazei Murrill, compost stud, mycelium.

1. INTRODUCTION

Current and future climate changes make specialists find new sources of food for the ever-growing population. Obtaining edible mushrooms throughout the year in intensive mushrooms is an alternative to these goals. (Manzi et al., 2004).
In addition to their food value, the mushrooms are also a cost-effective crop, which ensures high production, which is obtained on the surface unit used, in spaces arranged for this purpose. It is also worth noting that the cultivation of mushrooms does not use agricultural land. The advantages of a mushroom culture are many, both economic, occupational, medicinal, and reconversion of ligno-cellulosic waste. (Stamets, 2000).
The origin of the *Agaricus blazei* Murrill mushroom is near the mountainous Piedade, Brazil, located 200 km southeast of Sao Paulo. For centuries, the inhabitants of the city and surrounding area enjoyed a mushroom called "Cogumelo de Deus", "Cogumelo do Sol", "Cogumelo Princesa" or "Cogumelo da Vida" ("the mushroom of life"). (Stijve, 2001).
Numerous authors have shown that due to the similar lifecycle, the culture technologies of *Agaricus bisporus* can also be applied to the cultivation of *Agaricus blazei* Murrill mushrooms. However, mushrooms of *Agaricus blazei* Murrill require high temperatures and high humidity, as well as

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access to light to form mushrooms. (Chen 2003, Dias et al. 2004, Siwulski and Sobieralski 2004, Mantovani et al. 2007, Dias 2010).

Attempts to cultivate the *Agaricus blazei* Murrill mushrooms with biotechnologies have not yielded satisfactory results until about 2000. The native tropical medium of *Agaricus blazei* Murrill is very difficult to reproduce in culture. (Ellertsen, 2005).

Agaricus blazei Murrill mushroom, has high temperature, light and humidity requirements (Park 2001, Chen 2003, Siwulski and Sobieralski 2004). According to Chang (2008), mycelium of this species grows over a relatively wide range of temperatures, ie from 15 to 35 °C, while Colauto et al. (2008) mentions temperatures between 22 and 34 °C.

In contrast, optimal temperature data are relatively divergent and fall within the following values: 28-31 °C (Colauto et al., 2008), 28-30 °C (Neves et al., 2005), 25-30 °C (Siwulski and Sobieralski 2004), 25-28 °C (Mendonca et al. 2005), 23-27 °C (Chang 2008) and 20-33 °C (Huang 1997).

During the incubation period of the mycelium, ie in the first stage of cultivation, the temperature should be between 23 and 27 °C (Huang 1997, Iwade and Mizuno 1997). In turn, Stamets (2000) recommended a range of slightly wider temperatures, ie from 21 to 27° C. Mendonca et al. (2005) noted that during the period of mycelium growth, the temperature should be kept within the range of 25-30 °C.

After Mendonca et al. (2005), the formation of fructification primordia is induced by increased air exchange, increased relative humidity and increased substrate humidity. During the formation of the fruiting primordia, the relative humidity should remain at 80-90% (Huang 1997, Stamets 2000, Largeteau, et al., 2011), while during the development of the fructification bodies, it should be 75-85 % (Iwade and Mizuno 1997, Stamets 2000). In turn, Chang (2008) recommended a 70-85% humidity during the training and growing of the fruit bodies.

2. MATERIALS AND METHODS

To study the influence of compost recipes on substrate quality and mushroom production, a bifactorial experience has been organized, factor A was the culture substrate with 4 graduations: classical, synthetic, mixed and red with horse manure, and factor B was the protein addition with 3 graduations: without addition, wheat bran 3% and corn flour 3%. (Variants 1-12).

In order to be able to look in detail at the compost studding with mycelium, a sample was made in a 1 kg PVC box and Petri dishes. After sowing the sample, the PVC box was covered with aluminium foil. (Figure 1).

Figure 1. Compost sowing with Agaricus blazei Murrill mushroom mycelium

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During the incubation period (figure 2), the microclimate conditions in the culture space, were provided by the Fancom 765.xl computerized system.

Figure 2. Agaricus blazei Murrill mushroom mycelium studding

In order to record the experimental temperatures in the culture rooms, the DT-171 thermo-hygrometer with data memory and USB transfer was used.

3. RESULTS AND DISCUSSIONS

Data on relative air temperature and relative humidity as well as the compost temperature recorded during the incubation period are shown in table 1.

Table 1. Microclimate conditions registered at incubation, days 1-15

Characteristics	Day														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Air temp. °C	22.1	23.2	22.1	22.5	23.1	22.8	23.8	22.2	21.2	23	23.1	22.2	23.4	22.2	21.5
Air RH %	81	81	82	82	82	82	83	83	85	85	82	82	84	82	82
Variant	Compost temperature °C														
V1	26.2	26.1	25.8	25.4	25.1	25.4	25.5	24.8	24.9	25.3	25.4	24.9	24.9	25.2	25.1
V2	27.2	27.1	27.1	26.8	26.4	26.5	26.2	26.1	25.8	25.9	26.1	25.8	25.4	25.5	25.8
V3	26.8	26.7	26.7	26.5	26.2	26.5	26.8	25.9	25.8	25.9	26.3	26.5	25.7	25.9	26.2
V4	27.1	27.2	27.3	26.5	26.2	26.5	26.8	26.5	26.8	26.4	26.1	25.7	26.2	25.5	26.4
V5	27.3	27.2	27.4	27.6	27.5	27.8	27.2	26.5	27.1	26.8	27.4	26.1	27.2	27.4	26.8
V6	26.8	26.8	26.7	26.7	26.9	27.1	27.4	27.1	27.1	27.4	27.5	27.3	27.2	27.2	26.9
V7	26.5	26.4	26.4	26.8	26.9	27.2	27.2	27.3	27.3	27.2	27.4	26.8	26.8	26.7	26.6
V8	26.4	26.5	26.4	27.1	27.2	27.3	27.1	27.1	27.1	26.5	26.9	26.4	26.5	26.9	26.8
V9	26.9	26.8	26.8	26.9	27.1	27.1	27.3	27.4	27.3	27.4	27.4	26.9	26.4	26.8	26.7
V10	27.1	26.8	26.7	26.8	26.7	26.6	26.4	25.5	25.4	26.1	26.4	26.8	26.4	26.3	26.4
V11	26.7	26.8	26.9	26.9	26.9	27.2	27.2	27.1	27.1	26.8	26.9	26.8	26.9	27.2	26.9
V12	26.5	26.5	26.5	27.1	27.2	27.3	27.1	27.1	27.2	26.9	26.9	26.8	26.4	26.5	26.8

The air temperature during the incubation period was in the range of 21.2-23.8 °C, the minimum value of 21.2 °C being recorded on day 9 and the maximum value of 23.8 °C being recorded on the 7th day.

The relative air humidity during the incubation period was in the 81-85% range, the minimum value of 81% being recorded on days 1 and 2 and the maximum value of 85% being recorded on days 9 and 10.

The compost temperature during the incubation period ranged from 24.8-27.8 °C, the minimum value of 24.8 °C being recorded in the classic compost without protein addition on day 8 and the maximum value of 27, 8 °C being recorded on synthetic wheat bran cereal on the 6th day.

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The air temperature and the UR fall within the recommendations on *Agaricus* ssp. mushrooms culture.

Appreciation of substrate smearing was carried out on the 14th day after sowing, following the intensity of mycelium deposition in the substrate (very weak, weak, relatively good, good, very good). The data obtained after the substrate has been evaluated is shown in the table 2.

Table 2. Appreciation of substrate studding

Variant	The degree of studd	Substrate appearance	Mycelium appearance
V1	Good	Substrate coated Mushroom smell	Mycelium hyphae looking fluffy
V2	Good	Substrate coated Mushroom smell	Mycelium hyphae looking fluffy
V3	Good	Substrate coated Mushroom smell	Mycelium hyphae looking fluffy
V4	Good	Substrate coated Mushroom smell	Mycelium hyphae looking fluffy
V5	Very good	Underlayed substrate, weaving appears in a dense braid Strong smell of mushroom	Mycelial hyphae show dense mycelium islets, easy air, fluffy
V6	Very good	Underlayed substrate, weaving appears in a dense braid Strong smell of mushroom	Mycelial hyphae show dense mycelium islets, easy air, fluffy
V7	Good	Substrate coated Mushroom smell	Mycelium hyphae looking fluffy
V8	Very good	Underlayed substrate, weaving appears in a dense braid Strong smell of mushroom	Mycelial hyphae show dense mycelium islets, easy air, fluffy
V9	Very good	Underlayed substrate, weaving appears in a dense braid Strong smell of mushroom	Mycelial hyphae show dense mycelium islets, easy air, fluffy
V10	Weak	Substrate not soaked with mycelium	Mycelial hyphae are less obvious
V11	Relatively good	Substrate studded Mushroom smell	The mycelium hyphae are relatively thin and apart spaced
V12	Relatively good	Substrate studded Mushroom smell	The mycelium hyphae are relatively thin and apart spaced

The color of the compost with a very good studd is entirely white-gray color, both on the surface and inside the substrate in a tissue appears dense and compact mat of mycelium hyphae. Mycelial hyphae show dense mycelium islets, easy air, fluffy. Substrate tear resistance and give off a strong odor of mushrooms (Figure 3).

The color of the compost with a good studd is gray with silvery shades on the surface, mycelial ointment completely streams the substrate, breaking the substrate presents resistance. Mycelial hazels have a fluffy appearance and present instead a white-silver air mycelium, which represents the early primordia (Figure 4).

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Figure 3. Compost appearance with a very good stud

Figure 4. Compost appearance with a good stud

Compost (mushroom-smelling substrate) with a relatively good coating, the substrate is studded, but the mycelium hills are relatively thin and spaced apart. At break, the substrate exhibits resistance and the smell is characteristic of mushrooms. There are certain portions towards less crowded (Figure 5).

The compost with a weak studd, the substrate is studded, but mycelium hyphae are relatively thin and are spaced apart from each other. At break, the substrate exhibits resistance and the smell is characteristic of mushrooms. There are certain portions towards less crowded, but the area has a strong colour tint gray (Figure 6).

Figure 5. Compost appearance with a relative good stud

Figure 6. Compost appearance with a weak stud

Data on relative air temperature and relative humidity, as well as those on composting temperature recorded after coverage, are shown in table 3.

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Table 3. Microclimate conditions recorded after coating, days 16-30

Characteristics	Day														
	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Air. temp. °C	21.5	21.8	22.1	21.9	20.5	20.1	19.5	19.1	18.9	18.8	18.1	18.1	17.8	17.7	17.7
Air RH %	82	85	86	86	86	87	87	87	85	85	86	86	86	87	87
Ventilation	25% fresh air+75% recirculated air (1.5+4.5 $m^3/h/m^2$)				50% fresh air+50% recirculated air (3+3 $m^3/h/m^2$)						75% fresh air+25% recirculated air (4.5+1.5 $m^3/h/m^2$)				
Variant	Compost temperature °C														
V1	25.1	25.1	24.9	24.9	24.8	24.2	24.2	24.1	23.9	23.8	23.9	24.2	24.3	24.2	24.1
V2	25.8	25.9	25.8	25.7	25.5	25.5	25.3	25.3	25.1	24.8	24.6	24.2	24.3	24.4	24.4
V3	26.2	26.2	25.9	25.9	25.9	25.8	25.7	25.6	25.6	25.3	25.2	24.9	24.9	24.8	24.7
V4	26.4	26.4	26.5	26.5	26.2	25.9	25.8	25.8	25.6	25.4	25.1	24.8	24.8	24.7	24.6
V5	26.8	26.7	26.7	26.5	26.5	26.1	25.9	25.9	25.8	25.4	25.4	25.2	24.9	24.9	24.8
V6	26.9	26.7	26.5	26.5	26.6	25.8	25.8	25.7	25.6	25.6	25.7	25.6	25.4	25.3	24.9
V7	26.6	26.4	26.4	26.1	26.1	25.9	25.8	25.8	25.5	25.3	25.1	24.8	24.7	24.5	24.5
V8	26.8	26.8	26.7	26.4	26.3	26.2	26.2	26.1	25.8	25.4	25.4	25.1	24.9	24.9	24.8
V9	26.7	26.8	26.8	26.7	26.6	26.1	26.1	25.8	25.9	25.9	25.7	25.4	24.9	25.1	24.9
V10	26.4	26.4	26.3	26.1	25.8	25.7	25.4	25.3	25.2	25.1	25.1	24.8	24.6	24.2	23.8
V11	26.9	26.8	26.8	26.5	26.1	25.8	25.6	25.5	25.1	25.1	24.8	24.7	24.5	24.2	23.9
V12	26.8	26.5	26.1	26.2	26.1	25.9	25.7	25.4	25.2	25.1	24.9	24.5	24.3	24.1	23.7

The air temperature during the coverage was in the range 17.7-22.1 °C, the minimum value of 17.7 °C was recorded on day 29, and the maximum value of 22.1 °C was recorded on day 18.

The relative air humidity in the post-coverage period ranged from 82-87%, with a minimum of 82% being recorded on day 16 and a maximum of 87% on day 21.

The temperature of the compost during the after-cover period ranged from 23.7-26.9 °C, with the minimum value of 23.7 °C being recorded in the reed compost with the addition of corn flour (V12) on day 30, and the maximum value of 26.9 °C for synthetic compost with protein of corn flour admixture (V6) and reed compost with wheat bran protein (V11) on day 16.

Following the data from Table 3, it can be observed that each experimental compost variant is active, the composting temperature being higher by 2-5 °C relative to the air temperature.

The evaluation of the mycelium coating in cover layer was performed for each experimental variant, the results being presented in the table 4.

Table 4. Appreciating the degree of the mycelium studded coating

Variant	Degree of studd	Variant	Degree of studd
V1	B	V7	B
V2	FB	V8	FB
V3	FB	V9	FB
V4	B	V10	S
V5	FB	V11	B
V6	FB	V12	B

S - satisfactorily, B - good, FB - very good

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The degree of coverage of the coating substrate is in direct relation to that of the incubation period, being very good for classical, synthetic and mixed composts with proteinaceous additions and very low on reed compost without proteinaceous additions.
The relative air temperature and humidity, as well as the temperature of the compost, recorded after inducing the fructification, are shown in table 5.

Table 5. Microclimate conditions recorded after switching to fructification, days 31-45

Characteristics	Day														
	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
Air temp. °C	17.7	17.5	17.6	17.4	17.2	17.1	16.9	17.1	17.5	17.8	18.1	18.1	17.8	17.7	17.7
Air RH %	87	89	90	94	96	95	94	94	95	95	96	94	95	96	94
Ventilation	75% fresh air+25% recirculated air ($4.5+1.5\ m^3/h/m^2$)														
Variant	Compost temperature °C														
V1	25.1	24.8	24.6	24.2	23.9	23.5	23.3	23.1	23.4	23.3	23.1	22.9	22.9	23.2	23.1
V2	25.8	25.4	25.1	24.7	24.1	23.8	23.5	23.4	23.5	23.6	23.2	23.2	22.8	22.9	23.3
V3	26.2	25.8	25.4	25.1	24.5	24.1	23.9	23.2	23.1	23.3	22.9	22.8	23.2	23.1	23.1
V4	26.4	26.1	25.5	24.8	24.2	23.8	23.7	23.4	22.9	22.2	22.2	22.6	22.1	22.6	22.5
V5	26.8	26.1	25.4	25.1	24.5	24.1	23.8	23.5	23.1	22.9	22.5	22.6	22.8	22.1	22.4
V6	26.9	26.7	26.1	25.9	25.5	25.1	24.8	24.5	24.3	23.9	23.5	23.5	23.1	22.9	22.8
V7	26.6	26.4	25.9	25.5	25.1	24.8	24.7	24.5	24.1	23.8	23.2	23.3	23.1	22.8	22.8
V8	26.8	26.2	25.8	25.4	24.9	24.3	23.9	23.9	23.2	22.9	22.8	22.5	22.2	22.1	22.1
V9	26.7	26.7	26.1	25.5	25.2	24.8	24.4	23.9	23.8	23.5	23.1	22.9	23.1	23.1	22.9
V10	26.4	26.1	25.9	25.5	25.8	25.1	24.8	24.3	23.8	23.2	22.9	22.5	22.1	21.9	21.8
V11	26.8	26.5	26.2	25.8	25.2	24.7	24.2	24.1	23.4	23.5	23.1	22.8	22.7	22.5	22.5
V12	26.8	26.1	25.8	25.2	25.1	24.7	24.1	23.9	23.5	23.5	23.2	22.9	22.8	22.7	22.4

The air temperature in the culture area at the fructification transition was in the range of 16.9-18.1 °C, the minimum value of 16.9 °C being recorded on day 37 and the maximum value of 18.1 °C registering on day 41.
The relative humidity of the air at the fructification was 87-96%, the minimum value of 87% being recorded on day 31 and the maximum value of 96% on days 35, 41 and 44.
The compost temperature was in the range of 21.8-26.9 °C, the minimum value of 21.8 °C being recorded in reed compost without additional protein supplement (V10) at day 45, and the value with a maximum of 26.9 °C being recorded on the synthetic compost with added wheat flour (V6) on day 31.

4. CONCLUSIONS

In terms of composting conditions and the quality of the substrate, synthetic compost composed of wheat straw, poultry manure, plaster and urea are best treated.
In the preparation of synthetic compost, the fermentation factors with the anaerobic and aerobic phases meet the most favorable indicators, which ensure the physical, chemical and biological characteristics of a best quality compost compared to the other compost variants.
During aerobic composting, temperatures are slightly higher in synthetic and mixed compost than in conventional compost, indicating a more active fermentation process.
Mixed compost, made up of manure (47.5%), bird litter (19%), wheat straw (28.5%), plaster (4.5%) and urea (0.5%), ensures fermentation and physical, chemical and biological indicators in the anaerobic, aerobic and pasteurization phases, during mycelium incubation and fructification, close to those of synthetic compost.

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In the growing and harvesting period, synthetic compost provides the best level of mycelium peeling and more favorable conditions of temperature and humidity, necessary to trigger the fructification and the evolution of the crop, compared to the other compost variants.

5. REFERENCES

Chang, S.T. (2008). Overview of mushroom cultivation and utilization as functional foods. *Mushrooms as functional foods. Cheung P.C.K. (ed.). J. Wiley & Sons Inc*.

Chen, A. (2003). A practical Guide to the Cultivation of Agaricus blazei, a Mushroom of Culinary and Biomedical Importance. *MushWorld website, http//www.mushworld.com*.

Colauto, N.B., Aizono, P.M., Carvalho, L.R.M., Paccola-Meirelles, L.D., Linde, G.A. (2008). Temperature and pH conditions for mycelial growth of Agaricus brasiliensis on axenic cultivation. *Semina, Londrina, 29(2)*, 307-312.

Dias, E.S. (2010). Mushroom cultivation in Brazil, challenges and potential for growth, *Cienc. agrotec. Lavras,* 34(4), 795-803.

Dias, E.S., Abe C., Schwan, R.F. (2004). Truths and myths about the mushroom Agaricus blazei, *Sci. Agric., 61*, 545-549.

Ellersten, L.K. (2005). Effect of a Medicinal Extract from Agaricus blazei Murrill on Gene Expression in Human Monocytes. Poster 1454, *World Allergy Congress, Münich, Germany, June* 26-30.

Huang, N.L. (1997). Brazilian mushroom (Gee Song Rong) in Huang (ed.) Cultivation of eighteen rare and precious gourmet mushrooms. *Chinese Agricultural Press, Beijng, China*, 95-101.

Iwade, I., Mizuno, T. (1997). Cultivation of Kawariharatake (Agaricus blazei Murill). *Food Rev. Int., 13(3)*, 338-390.

Largeteau, M.L., Llarena-Hernandez, R.C., Regnault-Roger, C., Savoie, J.M. (2011). The medicinal Agaricus mushroom cultivated in Brazil, biology, cultivation and non-medicinal valorisation. *Appl. Microbiol. Biotech. DOI 10.1007/s00253-011-3630-7*.

Mantovani, T.R.D., Linde, G.A., Colauto, N.B. (2007). Effect of addition of nitrogen sources to cassava fiber and carbon-to-nitrogen ratios on Agaricus brasiliensis growth. *Can. J. Microbiol. 53*, 139-143.

Manzi, P., Marconi, S., Aguzzi, A., Pizzoferrato, L. (2004). Commercial mushrooms: nutritional quality and effect of cooking, *Food Chem. 84*, 201-206.

Mendonca, M., Kasuya, M.C., Cadorin, A., Vieira, A.J.(2005). Agaricus blazei cultivation for a living in Brazil, Mushroom grower's handbook 2, Shiitake cultivation, *Seul Korea, MushWorld*, 247-257.

Neves, M.A., Kasuya, M.C.M., Araujo, E., Leite, C.L., Camelini, C.M., Ribas, L.C.C., Mendonca, M.M. (2005). Physiological and genetic variability of commercial isolates of culinary-medicinal mushroom Agaricus brasiliensis *S. Wasser et al. (Agaricomycetidae) cultivated in Brazil. Int. J. Med. Mushr., 7*, 553-563.

Park, J.S. (2001). Characteristics and Cultivation Technology of Agaricus blazei. *MushWorld website*, http//www.mushworld.com

Rózsa, S. (2017). Study of some technological aspects of Agaricus blazei Murrill mushroom culture. PhD thesis. University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca, Faculty of Horticulture Cluj-Napoca, Romania.

Siwulski, M., Sobieralski, K. (2004). Uprawa grzybów jadalnych i leczniczych w warunkach naturalnych. *Kurpisz, Poznan*. 158 pp.

Stamets, P. (2000). Growing Gourmet and Medicinal Mushrooms. *Third edition, ten Speed Press Berkeley, CA*.

Stijve, T., M.A.L. de A. AMAZONAS. (2001). Agaricus blazei Murrill, un nouveau champignon gourmet et medicament qui nous vient du Brésil, *Miscellanea Mycologica, 69*, 41-47.

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