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Studies on Nutritional and Physiological Requirement for Growth and Biomass of *Hypsizygus ulmarius*

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A B S T R A C T

Mushroom is a cash crop grown worldwide on small as well as commercial scale for domestic consumption and export. It is a rich source of proteins, minerals and vitamins with low calorie value with no cholesterol. It is well known alternate source of good quality protein which has higher concentration of amino acid *viz.*, tryptophan and lysine in comparison to vegetable protein. The present investigation was carried out to know the nutritional and physiological along with growth and biomass of *H. ulmarius*. Among the tested media potato dextrose agar medium was found most suitable medium for the growth (89.00mm) and biomass (fresh mycelium weight: 13.93gm and dry mycelium weight 0.57gm) of *H. ulmarius*. Optimum temperature required 26°C was most suitable. Maximum relative humidity for radial growth was observed at 75% relative humidity. Complete darkness or zero hrs light was excellent for mycelial growth and biomass of *H. ulmarius*. Maximum growth of *H. ulmarius* was obtained at pH 8.0 on potato dextrose agar medium.

Introduction

Mushrooms are valuable health food in modern society. Human beings have constantly searched for new substances than can improve biological functions and make people fitter and healthier. Recently, human beings have increasingly turned to plants, mushrooms, herbs and foods as sources of these enhances, with increasing experimentally based confirming many empirical observations throughout history relating to the beneficial effects of mushrooms on a wide range of human ailments. Furthermore, the value of mushrooms has recently been promoted to tremendous levels with clinic trials for HIV / AIDS patients in Africa, generating encouraging results. Blue oyster mushroom is a novel species with very large fruit body, blue coloured pinheads

becoming light white on maturity, high yielder, palatable with meaty flavor and attractive keeping quality. This new mushroom variety has attractive shape and fleshy with excellent taste. In Chhattisgarh blue oyster mushroom first time cultivated by Annon (2005) and Chandrawanshi (2006). But the data pertaining to nutritional and physiological requirements for growth and spawn development and influence of prevailing environmental conditions on growth.

Materials and Methods

Effect of different media on growth of *H. ulmarius*

Three different media i.e. Potato dextrose agar, Malt yeast extract agar, Wheat extract agar media were studied to find out suitable medium for radial growth and biomass of *H. ulmarius*.

Effect of temperature

Different levels of temperature (20°C, 22°C, 24°C, 26°C and 28°C) were used to study their impact mycelial growth of *H. ulmarius*.

Effect of relative humidity

Four different levels of relative humidity (25, 50, 75 and 100 percent) were maintained to see their effect on growth of *H. ulmarius*. The relative humidity was maintained in desiccators by mixing the different quantities of concentrated H_2S0_4 and distilled water in different proportions.

Effect of duration of light

The petriplates and flasks were exposed in light for different time intervals *i.e.* (i) 0 hrs light (ii) 6 hrs light (iii) 12 hrs light (iv) 18 hrs light (v) 24 hrs light. Each treatment had 4 replications. The observations on redial growth, fresh and dry mycelium weight were recorded after completion of growth in any treatment.

Effect of pH

Different levels of pH (4, 5, 6, 7, 8 and 9) were studied to find out the optimum pH for growth of *H. ulmarius*. The pH was maintained in Potato dextrose agar medium and broth with the help of pH meter using 0.1 N, HCl and 0.1 N, NaOH solution.

In all experiment the plates and flask containing 20 ml and 75 ml PDA liquid medium respectively were inoculated pure culture 5mm disc of each strains of *H. ulmarius*. The incubated plates and flask were incubated for 15 days at 30°C. The observation was recorded for radial growth, fresh and dry biomass when the mycelium growth in any treatment reached at the periphery of the plates.

Results and Discussion

Effect of different media on growth and of *Hypsizygus ulmarius*

Among the tested media, significantly higher (89.00 mm) radial growth of *H. ulmarius* was recorded in potato dextrose agar medium and next was wheat extract agar medium (81.50 mm), however least (69.75 mm) growth was noticed in malt-yeast extract agar medium. The biomass production of *H. ulmarius* was in accordance with that of radial growth. The fresh and dry mycelial weight of *H. ulmarius* differed significantly in different liquid media studied. Significantly higher fresh and dry mycelial weight (13.93 and 0.573 g respectively) was obtained in potato dextrose liquid medium (Fig. 1). Whereas it was lowest fresh (10.72 g) and dry (0.240 g) mycelial weight was found in malt-yeast extract agar

medium and wheat extract agar medium (12.80 g fresh and 0.510 g dry). The above findings are in agreement with the results of Kumar *et al.*, (2016) who reported potato dextrose agar medium suitable for growth of *H. ulmarius* (Table 1).

Effect of different temperature on radial growth and biomass of *Hypsizygus ulmarius*

The variation in temperature significantly influenced the radial growth and biomass of *H. ulmarius* (Table 2). Significantly higher (88.25 mm) myclial growth of *H. ulmarius* was recorded at 26^0C where as it was significantly lower (51.00 mm) observed at 20^0C, in other temperature the growth was decrease either increasing and decreasing of temperature and it range from 63.75 mm - 85.25 mm. The fresh as well as dry mycelial weight of *H. ulmarius* was significantly higher noticed at 26°C (8.92 and 0.85 g) and next were 24°C (8.77and 0.76 g), 28^0C (8.74 and 0.56 g.) or 22^0C (7.07 and 0.47 g.) while it was significantly lower (5.58 and 0.38 g.) found at 20^0C. In the present investigation more growth and biomass was recorded at 26^OC which are agreeing with findings of Sumi and Geetha (2016) (Fig. 2).

Effect of relative humidity on radial growth and biomass production of *Hypsizygus ulmarius*

There was significant difference in radial growth of *H. ulmarius* at different levels of relative humidity. Significantly more radial growth (87.75 mm) of *H. ulmarius* was noticed at 75 percent relative humidity followed by 100% (77.50 mm) while it was significantly less at (56.25 mm) noticed at 25% and 50 percent relative humidity (61.00 mm). Besides radial growth, fresh mycelial and dry mycelial weight of *H. ulmarius* was also recorded significantly higher at 100 and 75% RH (9.04 g and 8.72 g respectively) and it was less (7.57g) and 25% relative humidity and next was 50% (7.84g) and both were significantly differ from each other. The dry mycelial weight of *H. ulmarius* differ significantly with each other and it was more (0.92 g) found at 75 % RH then other RH.

However, it was least noticed at 25 % (0.40 g) and followed by 50 % (0.55 g) and 100 % (0.83 g). The present investigation closely related with the results of Hilmar (1977) explained that 70-80 % RH more appropriate for growth of *P. florida*. Similar types of studies were also reported by Namdev (2000) *P. flabellatus* (Fig. 3 and Table 3).

Effect of duration of light on radial growth and biomass of *Hypsizygus ulmarius*

The growth of *H. ulmarius* significantly more (89.0) observed in plates were exposed in complete darkness followed by 12 hrs light and 12 hrs darkness and complete light (83.25 mm and 80.25 mm respectively). However significantly less (69.25mm) radial growth was noticed in plates were exposed to 18hrs light+6hrs darkness and 6hrs light+18hrs darkness (79.50 mm). In liquid culture, biomass production of *H. ulmarius* differed significantly with respect to different period of light. The fresh mycelial weight was significantly higher (8.62g) obtained in broth when exposed in complete darkness 12hrs (8.13g) light duration and 24hrs (7.99g) light and at par with each other whereas, it was significantly lower (6.65g) recorded in 6hr. light and 18hrs darkness followed by 18hrs (7.54g) 24hrs (7.99g) light period. The dry mycelial weight of *H. ulmarius* also differed significantly with respect to different period of light. The dry mycelial weight was significantly higher (0.69g) in complete darkness and 24hrs light (0.56g) and 12hrs light (0.51g). Significantly lower (0.32g) dry mycelial weight was recorded in 6hrs light and 18hrs (0.41g) light period and did not differ each other (Fig. 4 and Table 4).

Table.1 Effect of different media on growth and biomass of *H. ulmarius*

S.N.	Media	Radial growth (mm)*	Growth characteristics	Fresh mycelial weight (g.)*	Dry mycelial weight (g.)*
1	**PDA**	89.00	Absolute white mycelial growth, moderately fluffy in nature with prominent concentric rings and regular margin.	13.93	0.573
2	**Malt-yeast extract agar**	69.75	Absolute white mycelium growth, abundant fluffy in nature with prominent concentric rings and regular margin.	10.72	0.240
3	**Wheat extract agar**	81.50	White mycelium submerged in nature with concentric rings and regular margin.	12.80	0.510
	SEm±	0.812		0.561	0.035
	CD (5%)	2.635		1.819	0.114
*** Average of four replications**					

Table.2 Effect of different temperature on mycelial growth and biomass of *H. ulmarius*

S.N.	Treatments	Radial growth (mm)*	Growth characteristics	Fresh mycelial weight (g.)*	Dry mycelial weight (g.)*
1	**20°C**	51.000	White mycelial growth fluffy and scanty growth.	5.588	0.380
2	**22°C**	63.750	White mycelial growth, fluffy with concentric rings and scanty growth.	7.070	0.475
3	**24°C**	85.250	White mycelial growth with prominent concentric rings.	8.773	0.765
4	**26°C**	88.250	Absolute white mycelial growth with prominent concentric rings and fluffy.	8.928	0.850
5	**28°C**	82.000	Absolute white mycelial growth with concentric rings.	8.740	0.565
	SEm±	1.863		0.233	0.060
	CD (5%)	5.667		0.710	0.183

* Average of four replications

Table.3 Effect of different levels of RH % on mycelial growth and biomass of *H. ulmarius*

S.N.	Treatments	Radial growth (mm)*	Growth characteristics	Fresh mycelial weight (g.)*	Dry mycelial weight (g.)*
1	**25%**	56.25	Absolute white mycelial growth and irregular margin.	7.575	0.405
2	**50%**	61.00	Absolute dense white mycelial growth, regular margin.	7.843	0.553
3	**75%**	87.75	Absolute dense white mycelial growth, regular margin.	8.720	0.923
4	**100%**	77.50	Absolute dense white mycelial growth, regular margin.	9.040	0.830
	SEm±	1.598		0.279	0.043
	CD (5%)	4.977		0.871	0.134

* Average of four replications

Table.4 Effect of light duration on mycelial growth and biomass of *H. ulmarius.*

S.N.	Treatments	Radial growth (mm)*	Growth characteristics	Fresh mycelial weight (g.)*	Dry mycelial weight (g.)*
1	**Complete darkness**	89.00	Absolute white mycelia growth suppressed growth in the centre and raised growth from concentric region, smooth margin with and concentric rings.	8.62	0.69
2	**6hr. light + 18 hr. darkness**	79.50	Absolute white mycelia growth, fluffy in nature with concentric rings with regular margin.	6.65	0.51
3	**12 hr alternate dark and light**	83.25	Absolute white with concentric rings raised margin.	8.13	0.51
4	**18 hr. light + 6 hr. darkness**	69.25	Dirty white with three concentric rings, raised growth on concentric rings and peripheral slight raised growth.	7.54	0.32
5	**24hr. light**	80.25	Absolute white fluffy mycelia growth with concentric rings irregular margin.	7.99	0.56
	SEm±	0.649		0.421	0.035
	CD (5%)	1.973		1.279	0.107

* Average of four replications.

Table.5 Effect of different levels of pH on mycelial growth of *H. ulmarius.*

S.N.	Levels of pH	Radial growth (mm)*	Growth characteristics
1	**4**	-	No growth
2	**5**	58.000	Absolute white fluffy growth with concentric rings and margin irregular.
3	**6**	69.000	Absolute white mycelial growth with concentric rings and margin irregular.
4	**7**	75.750	White mycelial growth with concentric rings and margin irregular.
5	**8**	88.750	White mycelial growth with concentric rings and margin regular.
	CD (5%)	5.711	
	SEm±	1.877	

* Average of four replications

Fig.1 Effect of different media on mycelial growth of *H. ulmarius*

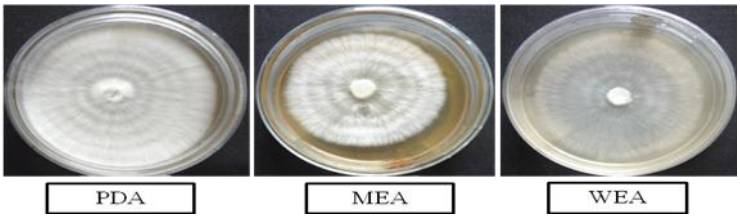


Fig.2 Effect of different temperature on mycelial growth of *H. ulmarius*

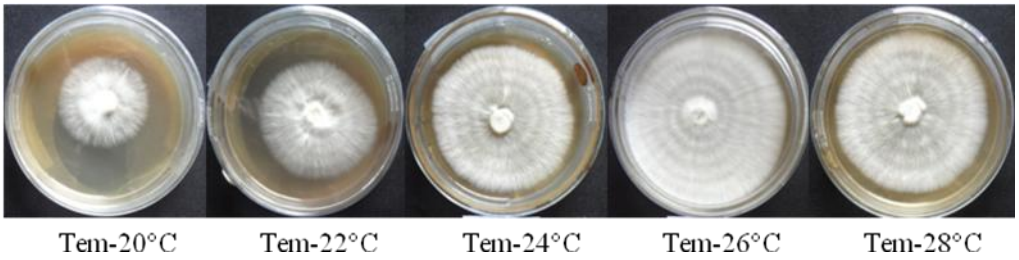


Fig.3 Effect of different levels of relative humidity on mycelial growth of *H. ulmarius*

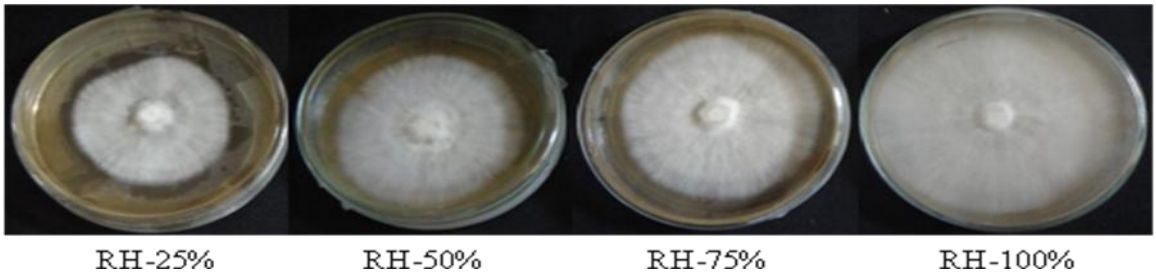


Fig.4 Effect of light duration on mycelial growth of *H. ulmarius*

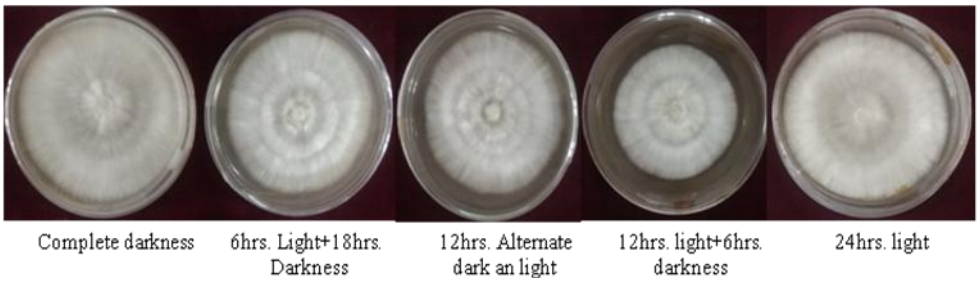
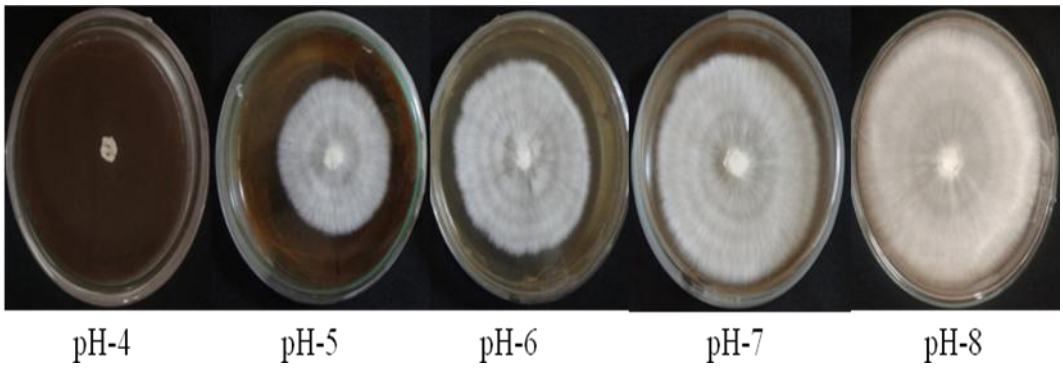


Fig.5 Effect of different levels of pH on mycelial growth of *H. ulmarius.*



The present results are corroborating with the findings of Sharma (2004) who reported significantly higher radial growth of *P. djamor* under complete darkness.

Effect of pH on radial growth of *Hypsizygus ulmarius*

Different levels of pH showed significant difference in radial growth of *H. ulmarius*. Among the evaluated pH, pH 8.0 gave significantly more (88.75 mm) radial growth of *H. ulmarius* and next was 7.0 pH (75.75 mm) while it was significantly least noted at pH 5.0 (59.00mm) and 6.0 pH (69.00) but they were significantly differ with each other. No growth was observed at pH 4.0 (Fig. 5).

The mycelial growth was white growth with concentric ring and margin regular at pH 8.0, but in case of pH 5.0 and 6.0 mycelial growth was absolute white with concentric rings and

irregular margin, whereas at pH 7.0 mycelial growth was white with concentric ring with irregular margin (Table 5). The present findings are partially in agreement with the work carried out by Sumi and Geetha (2016), Kumar *et al.*, (2016) and Kushwaha *et al.*, (2011).

Potato dextrose agar medium was found most suitable medium for the growth and biomass of *H. ulmarius*. The temperature 26°C found as most appropriate for maximum radial growth and biomass of *H. ulmarius*.

Maximum radial growth and biomass was observed at 75% relative humidity. Complete darkness and 12hrs light duration were excellent for mycelial growth and biomass of *H. ulmarius*. Maximum mycelial growth of *H. ulmarius* was obtained at pH 8.0 in PDA medium.

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