Bulletin of Environment, Pharmacology and Life Sciences
Bull. Env. Pharmacol. Life Sci., Vol 7 [11] October 2018 : 73-77

Online ISSN 2277-1808
Journal's URL:http://www.bepls.com
CODEN: BEPLAD
Global Impact Factor 0.876
Universal Impact Factor 0.9804
NAAS Rating 4.95

ORIGINAL ARTICLE **OPEN ACCESS**

Effect of different pH, Temperature and Media on Redial Growth of Oyster Mushrooms *(Pleurotus djamor)*

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ABSTRACT
Now a days oyster mushrooms are particularly interesting as one kind of popular foods, In India. The present study was conducted with the aim of finding out the most favourable temperature, pH and different media on radial growth rate were assessed on potato dextrose agar medium (PDA). Study was carried out to check the effect of temperature (23 - 28°C), pH (6.9 - 8.1) and different media (Potato dextrose agar, Chickpea extract agar, Pigeon pea extract agar, Barley extract, Black gram extract agar, and Oat extract agar) on the radial growth of Pleurotus djamor. Optimum temperature and pH for growth was 28 °C and 7.5 respectively. Maximum radial growth was observed when Barley extract agar was used as media.
Keywords: *Pleurotus djamor, temperature, pH, media, radial growth*.

Received 13.07.2018 Revised 20.08.2018 Accepted 12.09.2018

INTRODUCTION

Mushrooms are the fruiting bodies of the fungus comprising reproductive part while mycelium is the vegetative part. Mushrooms also called 'white vegetables' or 'boneless vegetarian meat' contain ample amounts of proteins, vitamins and fiber. Mushroom contains 20-35% protein (dry weight) which is higher than those of vegetables and fruits and is of superior quality. Mushrooms are now getting significant importance due to their nutritional and medicinal value and today their cultivation is being done in all over the world. Though 20 mushroom varieties are domesticated about half a dozen varieties viz., button, shiitake, oyster, wood ear and paddy straw mushrooms contribute 99% of the total world production. Mushroom offers prospects for converting lignocellulosic residues from agricultural fields, forests into protein rich biomass. Such processing of agro waste not only reduces environmental pollution but the byproduct of mushroom cultivation is also a good source of manure, animal feed and soil [1].

Oyster mushroom (*Pleurotus* spp.) also called as "Dhingri" or "Abalone", now ranks second among the important cultivated mushrooms in the world [2]. This group got the common name "oyster mushroom" because of the tongue shaped pileus with an eccentric lateral stipe. Unlike other mushroom species, this genus shows much diversity in its adaptation to the varying agro climatic condition. This flexible nature of the genus makes it more cultivated species than any other mushroom.

Among the oyster mushroom, (*Pleurotus florida, Pleurotus djamor, Pleurotus sapidus, Pleurotus sajor caju)* are well known edible species. It is being taken up for commercial cultivation in different parts of the world. There is great potential for increasing mushroom production in the country because of favourable climatic conditions, unemployment and abundant supply of cheap labour and availability of a wide range of substrates which considerably reduces its production cost. The great advantage is that these are easy to cultivate and have fast growth rate and also got the capacity to convert nutritionally valueless substrates into high protein food. In a country like India where vegetarians dominate, every attempt should be made to popularize vegetable protein source like mushroom [3].

Oyster mushroom *(P. djamor)* is a ubiquitous mushroom cultivating worldwide. Variations in environmental factors such as pH, temperature and media have great influence on the growth [4]. In view of this, this research was conducted to identify best pH, temperature and media for oyster (*P. djamor*) mushroom production.

MATERIAL AND METHODS

Experimental site

The experiments were conducted during 2014-2015 in Mushroom Laboratory Department Plant of Pathology, S. V. P. University of Agriculture and Technology, Meerut, UP, India, which is situated on the Western side of the Delhi-Dehradun high way (NH-58) at a distance of 10.0 km away in the north of Meerut city.The district Meerut is situated between 29° 01'N latitude and 77° 45'E longitude at an altitude of 237 meters above the mean sea level.

Establishment of pure culture

Culture of *Pleurotus djamor* were purified and maintained by single hyphal tip method. For this purpose, the culture was grown in sterilized Petri plates on Potato Dextrose Agar Medium (PDA) for 8-10 days. Single branched hyphae from the periphery of the growing colony were marked under low power (10x) in the compound microscope and transferred to PDA slants. These tubes were incubated at 21-24^{0}C for about a week, again sub cultured on PDA and then stored in a refrigerator at 5-10^{0}C for further use [5].

Optimizations of Culture Conditions on redial Growth of *Pleurotus djamor* given below:

Effect of Temperature

The culture of *Pleurotus djamor* was inoculated into Petri plates (9mm) containing 20 ml of sterilized PDA medium under aseptic conditions and incubated at six different temperature viz. 23, 24, 25, 26, 27, and 28^{0}C for 8th days. Four replications were maintained for each treatment. The observations of radial growth and growth rate were observed at each 48 hrs till the colony covered the full plate.

Effect of pH

For studies of suitable pH, seven different pH level viz. 6.9, 7.1, 7.3, 7.5, 7.7, 7.9 and 8.1were used. Required pH of the culture media were adjusted with N/10 solutions of NaOH or HCl used before sterilization, it was measured by a digital pH meter. After sterilization at 121^{0}C (15 lbs pressure) for 20 minutes in autoclave, sterilized PDA media were poured into the Petri plates (90 mm @ 20 ml/plate). The plates were inoculated with culture of *Pleurotus djamor* centrally and incubated at 27±1^{0}C. The observations of radial growth and growth rate were taken at each 48 hrs till the colony covered the full plate.

Effect of media

For the effect of different media studies, six media Potato dextrose agar, Chickpea extract agar, Pigeon pea extract agar, Barley extract agar, Black gram extract agar, and Oat extract agar were used. The ingredients and methods of their preparation are given below:

Oat Extract Agar (OEA) Medium

Oat Grain	200gm
Agar-Agar	20gm
Distilled Water	1000ml

Two hundred gram oat grains were washed with water 2-3 times and soaked overnight in clean water and then boiled with 500 ml distilled water for 20 minutes, allowed to cool, the grains were separated and the liquid suspension passed through a muslin cloth. The 500 ml volume of extract was made up by adding required amount of distilled water. Twenty gram agar-agar was melted separately in 500 ml of distilled water and mixed with oat grains extract. The total volume was made up to 1000 ml by adding distilled water.

Pigeon pea extract agar, Barley extract agar, Black gram extract agar media, Chickpea extract agar were also prepared by same methods as described above for Oat extract agar medium. All the six prepared media were sterilized by autoclaving at 121^{0}C (15 lbs pressure) for 20 minutes. The test media were poured to Petri plates and culture tubes then inoculated with culture of *Pleurotus djamor* under aseptic conditions. The plates (90 mm @ 20 ml/plate) were inoculated with culture of *Pleurotus djamor* centrally and incubated at 27±1^{0}C. Radial growth and growth rate were determined at each 48 hrs till the colony covered the full plate.

Statistical analysis

The suitable statistical design (CRD) was applied and the data thus obtained were analyzed statistically. Analysis of variance (ANOVA) technique and critical difference (CD) was calculated at five percent level of significance for comparison with other treatment.

RESULT AND DISCUSSION

In the present investigation of suitable pH, temperature and different media results shows that:

Effect of temperature

Different temperature ranges (23-28^{0}C) were arranged in different BOD incubators. The *Pleurotus djamor* was inoculated into potato dextrose agar medium Petri plates. The Petri plates were incubated for 8 days and radial growth and growth rate were determined at each 48 hrs. Maximum growth (88.33mm) and

growth rate (11.15 mm/day) were present at 28^{0}C temperature after 8 days of incubation. Results are shown in Table 1.

Table-1: Effect of different temperature on radial growth (mm) of oyster mushroom (*Pleurotus djamor)*

Temp. (^{0}C)	2nd day		4th day		6th day		8th day	
	Radial growth (mm)	growth rate (mm/day)	Radial growth (mm)	growth rate (mm/day)	Radial growth (mm)	growth rate (mm/day)	Radial growth (mm)	growth rate (mm/day)
23	12.00	6.00	18.25	4.56	28.00	4.66	54.00	6.75
24	12.50	6.25	22.50	5.62	30.00	5.00	56.87	7.10
25	11.75	5.87	23.00	5.75	38.75	6.45	58.87	7.35
26	13.00	6.50	24.00	6.00	39.25	6.54	61.00	7.62
27	13.00	6.50	25.25	6.31	41.75	6.90	72.50	9.06
28	14.00	7.00	25.50	6.37	44.50	7.41	89.25	11.15
SE	0.57	_	1.09	_	1.62	_	2.53	_
CD at 5%	1.21	_	2.32	_	3.57	_	5.59	_

Chang [6] reported that *P. ostreatus* grow well at higher temperature of 28^{0}C. The *P. ostreatus* grow at the temperature range of 25-30^{o}C. Baliyan [7] found also a range of temperature (25-30^{0}C) to be suitable for mycelial growth of five *Pleurotus* species. Radial growth of *P. florida* and *P. sapidus* were found maximum at 30^{0}C where, as the growth of *P. sajor caju*, *P. fossulatus* and *P. flabellatus* was maximum5 at 25^{0}C. Zharare [8] studied the sensitivity of *Pleurotus* mycelium to different temperature range Eight *Pleurotus* spp., which included *P. sajor caju* and *P*. eryngii were cultured aseptically on agar at 25, 30 and or 35^{0}C. Mycelial growth was maximam at 25-30 ^{0}C, whereas a temperature of 35^{0}C was detrimental to mycelial growth except in one strain.

Effect of pH

In the study of different pH (6.9 - 8.1) were measured by a digital pH meter. The *Pleurotus djamor* was inoculated into pH adjusted PDA medium Petri plates. The Petri plates were incubated at 27±1^{0}C for 8 days and observations were recorded at each 48 hrs. Maximum growth was observed at pH 7.5 (89.00mm) and growth rate (11.12 mm/day) after 8 days of incubation. Results are shown in Table-2.

Table-2: Effect of different media pH on radial growth (mm) of oyster mushroom (*Pleurotus djamor)* on PDA.

Media pH	2nd day		4th day		6th day		8th day	
	(Radial growth (mm)	growth rate (mm/day)	Radial growth (mm)	growth rate (mm/day)	Radial growth (mm)	growth rate (mm/day)	Radial growth (mm)	growth rate (mm/day)
6.9	12.67	6.33	19.67	4.91	30.33	5.05	60.00	7.50
7.1	12.00	6.00	21.33	5.33	33.67	5.61	69.67	8.70
7.3	12.00	6.00	22.00	5.55	37.33	6.22	79.67	9.95
7.5	15.33	7.00	25.67	6.33	49.67	8.27	89.00	11.12
7.7	14.00	6.50	25.33	6.41	44.67	7.44	81.33	10.16
7.9	14.00	7.67	24.00	6.00	42.67	7.11	80.00	10.00
8.1	13.00	7.00	22.33	5.58	37.33	6.22	78.33	9.79
SE	0.79	_	1.08	_	1.55	_	2.14	_
CD at 5%	1.72	_	2.18	_	3.36	_	4.64	_

Singh *et al.* [9] Studied effect of different initial pH value of nutrient medium on *P. flabellatus, P. ostreatus, P. sapidus* and *P. sajor caju* and found pH 5-8 most suitable to Pleurotus species. Ram and Pant [10] recorded the best mycelial colonization of both *P. sajor caju* and *P. flabellatus* at pH 6.0 on all the three substrate media. Han *et al.* [11] reported that the most suitable pH value for *P. flabellatus* ranged 4.0 to 7.0 with an optimum pH of 5.5-6.0.

Effect of Media

For study of media, various media viz. Potato dextrose agar, Chickpea extract agar, Pigeon pea extract agar, Barley extract agar, Black gram extract agar, and Oat extract agar were used for the growth of *Pleurotus djamor*. Maximum growth (88.33mm) and growth rate (11.04 mm/day) were observed in Oat extract agar medium after 8 days of incubation. The results are shown in Table-3.

Table. 3. Effect of different media on radial growth (mm) of oyster mushroom (*Pleurotus djamor).*

Media	2nd day		4th day		6th day		8th day	
	Radial growth (mm)	growth rate (mm/day)	Radial growth (mm)	growth rate (mm/day)	Radial growth (mm)	growth rate (mm/day)	Radial growth (mm)	growth rate (mm/day)
Oat extract agar media	10.00	5.00	31.33	7.83	47.33	7.88	88.33	11.04
Barley extract agar media	13.00	6.05	29.33	7.33	44.00	7.33	83.00	10.37
Black gram extract agar media	12.00	6.00	25.67	6.41	39.67	6.61	76.33	9.54
Pigeon pea extract agar media	9.33	4.66	24.33	6.08	39.00	6.50	71.33	8.91
Chickpea extract agar media	10.00	5.00	29.00	7.25	43.33	7.22	75.33	9.41
Potato Dextrose Agar media	8.33	4.16	26.67	6.66	45.33	7.55	65.67	8.20
SE	0.98	_	1.36	_	2.00	_	2.44	_
CD at 5%	2.16	_	2.99	_	4.42	_	5.37	_

These results were found in proximity with the research findings Bhadana (2014) [12] studied to four species of *Pleurotus* (i.e. *Pleurotus. florida P. djamor, P. flabllatus and P. eryngii*). Which were grown in eight different media .The results revealed that maximum radial growth (90.00 mm) was found in Oat extract agar medium and potato dextrose agar medium and pear millet extract agar medium in *P. djamor*, *P. florida*, *P. eryngii* and *P. flabellatus* respectively. Mohd (2012) [13] among the evaluation of six media, maximum radial growth was found in malt extract agar medium followed by potato dextrose agar medium and minimum in water agar medium. In potato dextrose agar medium on 8th day full radial growth of mycelium (9.00 cm) was observed in *P.sapidus* and *P.florida* and malt extract agar medium on 6th day full radial growth of mycelium (9.00 cm) was observed in *P.sajor caju*.

CONCLUSION

Thus it can be concluded that maximal mycelial growth and growth rate of *Pleurotus djamor* can be achieved by cultivating the fungus at temperature of 28°C and in case pH maximal mycelial growth and growth rate obtained at 7.5 pH. The mycelial mass can also be enriched by growing in a medium containing Oat extract agar and thus it's recommended for *Pleurotus djamor* culture conditions to be use.

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CITATION OF THIS ARTICLE

Satpal Singh, Gopal Singh.Effect of different pH, Temperature and Media on Redial Growth of Oyster Mushrooms *(Pleurotus djamor*). Bull. Env. Pharmacol. Life Sci., Vol 7 [11] October 2018: 73-77