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Studies on physiological and nutritional requirements for growth and biomass of *P. djamor*

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Abstract
The present investigation was carried out to find out the best suited physiological and nutritional requirement for growth and biomass of *P. djamor*. Among the studied different media, Potato Dextrose Agar Medium Potato Dextrose Agar medium, Temperature 26ºC, pH 7 and Relative humidity 100 were found most suitable for growth and biomass of *P. djamor*. In different light wavelength red light was found more inducive for mycelial growth. In the midst of c different Carbon observed in sources sorbitol, mannitol and sucrose substituted carbon sourced were found most appropriate to enhance the growth and biomass of *P. djamor* than other sources of carbon. Similarly, different nitrogen sources were evaluated, among them PDA (Control) was superior for growth and biomass but at par with Ammonium sulphate and L. arginine while significantly least was observed in barium nitrate amended medium.

Keywords: Pleurotus djamor, physiological requirements, nutritional requirements, temperature, pH levels, relative humidity, potato dextrose agar, light wavelength, carbon source and nitrogen source.

Introduction
Mushroom cultivation in India has a historical background dating back to ancient times, as referenced in the sacred scriptures such as the 'Rig Veda' and 'Atharva Veda'. In Indian dietary practices, vegetarianism is widely embraced, with a predominant focus on cereal-based staples such as wheat, rice and maize, which are inherently low in protein content (Gupta *et al.*, 2018) [7].

In India, Chhattisgarh is a major contributor to the oyster mushroom supply in India, especially from the Ambikapur, Bilaspur Raipur, Durg, Bhatapara and Balod district due to its agro-climatic conditions favourable for mushroom cultivation in winter season and whole year under protected or specific environment.

Pleurotus djamor, commonly known as pink oyster mushroom, is indigenous to tropical and subtropical regions of Asia and has high potential for cultivation under varied agro-climatic conditions (Rai & Arumugan, 1988) [17]. The mushroom is characterized by its colour from pink to white, which depending on the specific environmental and growing conditions (Jafarpour *et al.*, 2010) [9].

The pink oyster mushroom *P. djamor* have better shelf life, less crop cycle time and higher yield compared to other oyster mushroom varieties (Manjunath & Pareek, 1981) [14] and (Sarita *et al.*, 2023) [19]. However, studies on the growth and yield performance of *P. djamor* under different environmental conditions are limited. The Balod district of Chhattisgarh state has suitable agro-climatic conditions for mushroom cultivation with availability of basic raw materials like rice and wheat straw (Annual Report, Department of Agriculture, Government of Chhattisgarh, 2015) [1].

Material and Method
All laboratory experiments were conducted at the Mushroom Research Laboratory, Department of Plant Pathology, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.). Different media i.e. Potato Dextrose Agar (PDA), Potato Dextrose Yeast Agar (PDYA), Czapek's, Richards, Asthana Hawkers, and Mushroom Complete Medium sterilized at 15 lbs psi for 15 minutes,

temperature (20°C to 35°C), pH (3 to 9), relative humidity (40% to 100%), light wavelength [Red (620-750 nm), Green (495-570 nm), Blue (450-495 nm), Yellow (570-590 nm) & Transparent (400-700 nm)], sources of carbon (Maltose, Fructose, Mannitol, Lactose, Sucrose, Glucose and Sorbitol) and Nitrogen sources (Potassium Nitrate, Urea, Peptone, Magnesium Nitrate, Ammonium sulfate, Glycine, L-Arginine, Barium nitrate) were studied to see their effects and biomass on growth. fresh and dry mycelial weights). Each treatment had multiple replications and observations were made once growth was complete in any treatment.

Result

Different Media: Among different media PDA showed significantly higher mycelial growth (89.31 mm) and biomass (6.01 g FMW and 0.36 g DMW) was recorded in potato dextrose agar medium while it was significantly lower noticed in Richards mediu, mycelial growth (52.84 mm) and biomass (3.68 g FMW and 0.16 g DMW) and Asthana Hawker medium, mycelial growth (54.50 mm) and biomass (3.93 g FMW and 0.16 g DMW) both were statistically at par with each other. In other medium growth and biomass significantly lower with PDA but superior from Richards and Asthana Hawkers medium. The present results are confirmation with the findings of earlier workers i.e. Bhandana (2014) who suggest PDA as best medium for growth of *P. florida, P. flabellatus, P. eryngii and P. djamor. Potato dextrose agar medium for growth of P. citrinopileatus* (Krishna *et al.)* Pant *et al.* (2020a) [15] reported maximum growth of *P. ostreatus* in PDA medium.

Different Temperature (˚C)

Different temperature showed significant difference in mycelial growth and biomass of *P. djamor*, temperature 26˚C gave significantly higher (89.73 mm) mycelial growth of *P. djamor* and next was 23˚C (84.56 mm), whereas it was significantly lower (36.48 mm) found at 35˚C. At the other temperature growth was varied from 70.74 to 78.63 mm but growth was significantly differ at 29 ˚C (78.63 mm) and 32 ˚C (70.74 mm) while it was not differ at 20 ˚C (74.69 mm) and 32 ˚C (70.74 mm).

The biomass (fresh weight and dry weight) was in accordance with that of mycelial growth of *P. djamor* and it was significantly more obtained at 26 ˚C (5.89 g FMW & 0.35 g DMW) while least (2.71 g FMW and 0.09 g DMW) was obtained at at 35 ˚C. At 23 ˚C growth, biomass (FMW 5.28 g and 0.32 g DMW) was closely with 26 ˚C

The results obtained in the present study is in accordance with the results of Kalaw *et al.* (2022a) [10] and Pereira (2024) [16].

Different pH

Different levels of pH showed significant difference in mycelial growth and biomass of *P. djamor*. Among the significantly higher (89.81 mm) mycelial growth of *P. djamor* was recorded at 7 pH. Which was at par with the 6 pH (88.23 mm), whereas it was significantly lower mycelial growth (0.00 mm) at 3 pH and 4 pH. Mycelial growth was recorded in 8 pH (75.45 mm) followed by 5 pH (71.23 mm) and 9 pH (59.29 mm) their was no significantly difference found between.

Different levels of pH showed significant difference in mycelial growth and biomass of *P. djamor*. Among the significantly higher (5.91 g) fresh weight (g) of *P. djamor* was recorded at 7 pH. Which was at par with the 6 pH (5.68 g), whereas it was significantly lower fresh weight (g) (0.00 g) at 3 pH and 4 pH. Fresh weight (g) was recorded in 8 pH (4.23 g) followed by 5 pH (4.14 g) and 9 pH (3.16 g) their was no significantly difference found between.

Different levels of pH showed significant difference in mycelial growth and biomass of *P. djamor*. Among the significantly higher (0.36 g) dry weight (g) of *P. djamor* was recorded at 7 pH. Which was at par with the 6 pH (0.34 g), whereas it was significantly lower dry weight (g) (0.00 g) at 3 pH and 4 pH. Dry weight (g) was recorded in 8 pH (0.22 g) followed by 5 pH (0.21 g) and 9 pH (0.17 g) their was no significantly difference found between.

The significant variation in mycelial growth and biomass of *P. djamor* across different pH levels highlights the crucial role of pH in fungal growth. The optimal growth at pH 7 indicates that neutral conditions favor enzymatic activity and nutrient uptake, leading to maximum biomass production. The similar performance at pH 6 suggests slight acidity is also conducive to growth. However, the absence of growth at pH 3 and 4 reflects the inhibitory effects of highly acidic environments, likely due to disrupted cellular processes. These findings emphasize the importance of maintaining a neutral to slightly acidic pH for optimal mushroom cultivation. The finding of present study is in accordance with those of Chowdhury *et al.* (2024a) [3] and Kalaw *et al.* (2022b) [10].

Different RH (%)

Different relative humidity showed significant difference in mycelial growth and biomass of *P. djamor*. Among the significantly higher (89.32 mm) mycelial growth of *P. djamor* was recorded at 100% relative humidity. Which was followed by with the 80% relative humidity (83.33 mm), whereas it was significantly lower mycelial growth (49.64 mm) at 60% relative humidity, which was followed by 60% relative humidity at (76.52 mm) and there is no significant difference between them.

Different relative humidity showed significant difference in mycelial growth and biomass of *P. djamor*. Among the significantly higher (5.98 g) fresh weight (g) of *P. djamor* was recorded at 100% relative humidity. Which was followed by with the 80% relative humidity (5.71 g), whereas it was significantly lower fresh weight (g) (3.03 g) at 60% relative humidity, which was followed by 60% relative humidity at (5.25 g) and there is no significant difference between them.

Different relative humidity showed significant difference in mycelial growth and biomass of *P. djamor*. Among the significantly higher (0.35 g) dry weight (g) of *P. djamor* was recorded at 100% relative humidity. Which was followed by with the 80% relative humidity (0.32 g), whereas it was significantly lower dry weight (g) (0.13 g) at 60% relative humidity, which was followed by 60% relative humidity at (0.29 g) and there is no significant difference between them.

The significant differences in mycelial growth and biomass of *P. djamor* across varying relative humidity levels underscore the importance of moisture in fungal development. The highest growth and biomass at 100% relative humidity indicate that maximum moisture availability enhances nutrient absorption and mycelial expansion. The lower growth at 60% relative humidity suggests that insufficient moisture restricts metabolic

processes and cell enlargement, leading to reduced biomass. These results highlight the necessity of maintaining high relative humidity for optimal mushroom growth, with 100% RH providing the most favorable conditions. These outcomes are consistent with findings of Shukla, (2003) [22] and Kim *et al.* (2013) [11].

Different light wavelength

Different light wavelength showed significant difference in mycelial growth and biomass of *P. djamor*. Among the significantly higher (89.34 mm) mycelial growth of *P. djamor* was recorded at Red (620-750 nm). Which was at par with the Blue (450-495 nm) (88.23 mm), whereas it was significantly lower mycelial growth (74.86 mm) at Yellow (570-590 nm), which was followed by Green (495-570 nm) at (72.34 mm) and Transparent (400-700 nm) (77.61 mm) and there is no significant difference between them.

Different light wavelength showed significant difference in mycelial growth and biomass of *P. djamor*. Among the significantly higher (5.92 g) fresh weight (g) of *P. djamor* was recorded at Red (620-750 nm). Which was at par with the Blue (450-495 nm) (5.67 g), whereas it was significantly lower fresh weight (g) (4.05 g) at Green (495-570 nm), which was followed by Yellow (570-590 nm) (4.98 g) and Transparent (400-700 nm) (5.04 g) and there is no significant difference between them.

Different light wavelength showed significant difference in mycelial growth and biomass of *P. djamor*. Among the significantly higher (0.36 g) dry weight (g) of *P. djamor* was recorded at Red (620-750 nm). Which was at par with the Blue (450-495 nm) (0.35 g), whereas it was significantly lower dry weight (g) (0.21 g) at Green (495-570 nm), which was followed by at Yellow (570-590 nm) (0.25 g) and Transparent (400-700 nm) (0.26 g) and there is no significant difference between yellow and transparent light wavelength.

The study investigated the influence of various light wavelengths on the mycelial growth and biomass characteristics of the edible mushroom *P. djamor*. Red and blue light promoted significantly greater mycelial growth, fresh weight, dry weight, and average weight per mushroom as compared to the other wavelengths tested. Red light performed the best for all growth and yield parameters measured, followed by blue light, indicating their positive effect on vegetative growth and development of *P. djamor* mycelium. In contrast, green and yellow light resulted in lower values for these parameters, with green light inhibiting accrual of dry weight the most. Thus, red and blue wavelengths appear most suitable for cultivation of *P. djamor*, as they maximize mycelial proliferation and mushroom biomass accumulation. The finding of present study is in accordance with those of Chauhan and Gupta (2017) [4] and De Bonis *et al.* (2024) [5].

Different carbon sources

Different carbon sources showed significant difference in mycelial growth and biomass of *P. djamor*. Among the significantly higher (88.95 mm) mycelial growth of *P. djamor* was recorded at Sorbitol. Which was at par with the Mannitol (86.34 mm) and Sucrose (85.32 mm), whereas it was significantly lower mycelial growth (31.16 mm) at Lactose, which was followed by Fructose at (72.21 mm) and Maltose (78.14 mm) there is no significant difference between them. Mycelial growth was recorded in potato dextrose agar (Control) (83.34 mm) followed by Glucose (81.23 mm) and there was no significantly difference between them.

Different carbon sources showed significant difference in mycelial growth and biomass of *P. djamor*. Among the significantly higher (6.12 g) fresh weight (g) of *P. djamor* was recorded at Mannitol. Which was at par with the Sorbitol (6.09 g) and Sucrose (6.02 g), whereas it was significantly lower fresh weight (g) (2.05 g) at Lactose, which was followed by Fructose at (4.11 g) and Maltose (4.93 g) there is no significant difference between them. Fresh weight (g) was recorded in potato dextrose agar (Control) (5.63 g) followed by Glucose (5.48 g) and there was no significantly difference between them.

Different carbon sources showed significant difference in mycelial growth and biomass of *P. djamor*. Among the significantly higher (0.38 g) dry weight (g) of *P. djamor* was recorded at Mannitol. Which was at par with the Sorbitol (0.37 g) and Sucrose (0.37 g), whereas it was significantly lower dry weight (g) (0.10 g) at Lactose, which was followed by Fructose at (0.20 g) and Maltose (0.23 g) there is no significant difference between them. Dry weight (g) was recorded in potato dextrose agar (Control) (0.34 g) followed by Glucose (0.32 g) and there was no significantly difference between them.

The study evaluated the influence of various carbon sources on the mycelial growth and biomass production by *P. djamor*. Sorbitol, mannitol and sucrose significantly enhanced mycelial growth, fresh weight, dry weight and average fruit body weight compared to other test carbon sources. Among these, mannitol performed the best in promoting overall growth and yield parameters, demonstrating its high suitability. In contrast, lactose strongly inhibited mushroom development, restricting all measurements the most. Potato dextrose agar and glucose supported growth adequately but were inferior to sorbitol, mannitol and sucrose. Hence, of all the carbon sources screened, mannitol, sorbitol and sucrose can be considered highly preferable for cultivation of *P. djamor* due to their mushroom proliferating abilities. These outcomes are consistent with findings of Kumar *et al.* (2018) [13] and Chowdhury *et al.* (2024) [3].

Different nitrogen sources

Different nitrogen sources showed significant difference in mycelial growth and biomass of *P. djamor*. Among the significantly higher (88.95 mm) mycelial growth of *P. djamor* was recorded at potato dextrose agar (Control). Which was at par with the Ammonium sulfate (88.41 mm) and L - Arginine (87.34 mm), whereas it was significantly lower mycelial growth (49.67 mm) at Barium nitrate, which was followed by Glycine at (52.50 mm) and Magnesium nitrate (65.63 mm) there is no significant difference between them. Mycelial growth was recorded in Urea (83.52 mm) followed by Potassium nitrate (79.21 mm) and Peptone (77.42 mm), there was no significantly difference between them.

Different nitrogen sources showed significant difference in mycelial growth and biomass of *P. djamor*. Among the significantly higher (5.87 g) fresh weight (g) of *P. djamor* was recorded at Ammonium sulfate. Which was at par with the potato dextrose agar (Control) (5.80 g), whereas it was significantly lower fresh weight (g) (3.11 g) at Barium nitrate, which was followed by Glycine at (3.62 g) and

Magnesium nitrate (4.20 g) there is no significant difference between them. Fresh weight (g) was recorded in Urea (5.25 g) followed by L - Arginine (5.02 g), Potassium nitrate (4.88 g) and Peptone (4.38 g), there was no significantly difference between them.

Different nitrogen sources showed significant difference in mycelial growth and biomass of *P. djamor*. Among the significantly higher (0.37 g) dry weight (g) of *P. djamor* was recorded at Ammonium sulfate. Which was at par with the potato dextrose agar (Control) (0.36 g), whereas it was significantly lower dry weight (g) (0.14 g) at Barium nitrate, which was followed by Glycine at (0.16 g) and Magnesium nitrate (0.21 g) there is no significant difference between them. Dry weight (g) was recorded in Urea (0.30 g) followed by Potassium nitrate (0.26 g), L - Arginine (0.24) and Peptone (0.22 g), there was no significantly difference between them.

The study investigated the influence of various nitrogen sources on the growth and yield of *P. djamor*. Ammonium sulfate and potato dextrose agar performed similarly as control and promoted the highest mycelial growth, fresh weight, dry weight and average fruit body weight compared to other nitrogen treatments. However, barium nitrate severely restricted mushroom development, proving least suitable for cultivation. Urea, potassium nitrate and peptone supported moderate growth. Overall, ammonium sulfate emerged as the best nitrogen source for maximizing the mycelial proliferation and biomass production of *P. djamor*, followed by potato dextrose agar as control. Whereas, barium nitrate strongly inhibited mushroom growth demonstrating its inhibitory effects. The results obtained in the present study is in accordance with the results of Hoa and Wang, (2015) [8] and Thi *et al.* (2020) [24].

Table 1: Effect of different media on growth and biomass of *P. djamor*

Tr. No.	Media	Mycelial growth * (mm)	Fresh weight* (g)	Dry weight* (g)	Average (g)
T_1	PDA	89.31	6.01	0.36	3.19
T_2	PDYA	83.20	5.48	0.32	2.90
T_3	Czapek's	79.49	4.32	0.21	2.27
T_4	Richards	52.84	3.68	0.16	1.92
T_5	Asthana Hawkers	54.50	3.93	0.16	2.05
T_6	MCM	81.62	5.96	0.31	3.14
	Sem (±)	1.2	0.10	0.01	-
	CD (1%)	4.95	0.39	0.03	-
	CV (%)	3.31	3.89	6.53	-

*Average of 4 replications

Table 2: Effect of different temperature on growth and biomass of *P. djamor*

Tr. No.	Temperature (˚C)	Mycelial growth * (mm)	Fresh weight* (g)	Dry weight* (g)	Average (g)
T_1	20	74.69	4.48	0.25	2.37
T_2	23	84.56	5.28	0.32	2.80
T_3	26	89.73	5.89	0.35	3.12
T_4	29	78.63	4.81	0.22	2.52
T_5	32	70.74	4.13	0.19	2.16
T_6	35	36.48	2.71	0.09	1.40
	Sem (±)	1.20	0.10	0.01	-
	CD (1%)	4.88	0.41	0.02	-
	CV (%)	3.31	4.44	4.45	-

*Average of 4 replications

Table 3: Effect of different pH on growth and biomass of *P. djamor*

Tr. No.	pH	Mycelial growth * (mm)	Fresh weight* (g)	Dry weight* (g)	Average (g)
T_1	3	0.00	0.00	0.00	0.00
T_2	4	0.00	0.00	0.00	0.00
T_3	5	71.23	4.14	0.21	2.18
T_4	6	88.23	5.68	0.34	3.01
T_5	7	89.81	5.91	0.36	3.14
T_6	8	75.45	4.23	0.22	2.23
T_7	9	59.29	3.16	0.17	1.67
	Sem (±)	1.04	0.04	0.00	-
	CD (1%)	4.15	0.17	0.02	-
	CV (%)	3.78	2.58	4.70	-

*Average of 4 replications

Table 4: Effect of different RH (%) on growth and biomass of *P. djamor*

Tr. No.	RH (%)	Mycelial growth * (mm)	Fresh weight* (g)	Dry weight* (g)	Average (g)
T_1	60	49.64	3.03	0.13	1.58
T_2	60	76.52	5.25	0.29	2.79
T_3	80	83.33	5.71	0.32	3.01
T_4	100	89.32	5.98	0.35	3.16
	Sem (±)	0.76	0.06	0.00	-
	CD (1%)	-	-	-	-
	CD (5%)	2.28	0.18	0.01	-
	CV (%)	2.26	2.61	3.93	-

*Average of 5 replications

Table 5: Effect of different light wavelength on growth and biomass of *P. djamor*

Tr. No.	Treatments	Mycelial growth * (mm)	Fresh weight* (g)	Dry weight* (g)	Average (g)
T_1	Red (620-750 nm)	89.34	5.92	0.36	3.14
T_2	Green (495-570 nm)	72.34	4.05	0.21	2.13
T_3	Blue (450-495 nm)	88.23	5.67	0.35	3.01
T_4	Yellow (570-590 nm)	74.86	4.98	0.25	2.62
T_5	Transparent (400-700 nm)	77.61	5.04	0.26	2.65
	Sem (±)	1.12	0.08	0.01	-
	CD (1%)	4.67	0.34	0.02	-
	CV (%)	2.78	3.19	3.83	-

*Average of 4 replications

Table 6: Effect of different carbon sources on growth and biomass of *P. djamor*

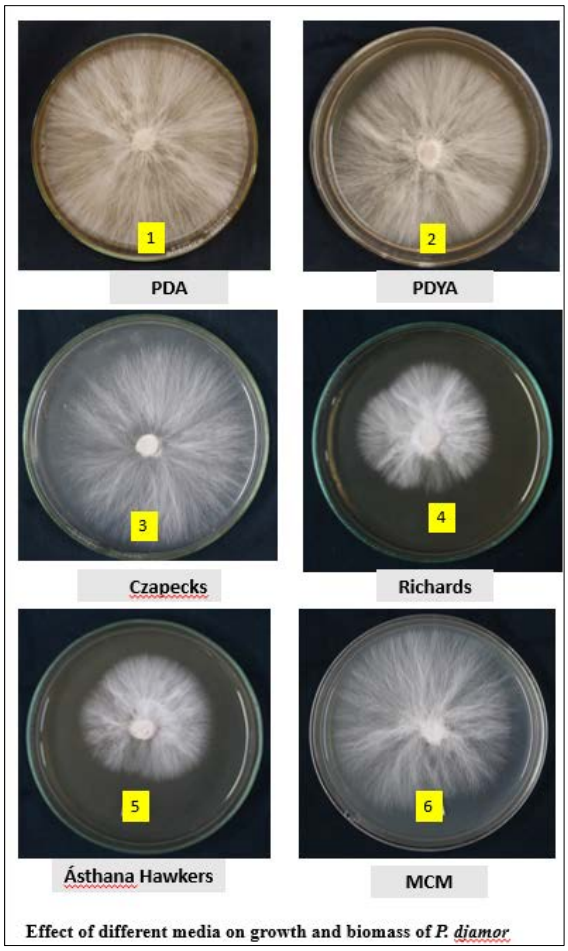
Tr. No.	Carbon sources	Mycelial growth * (mm)	Fresh weight* (g)	Dry weight* (g)	Average (g)
T_1	Maltose	78.14	4.93	0.23	2.58
T_2	Fructose	72.21	4.11	0.20	2.16
T_3	Mannitol	86.34	6.12	0.38	3.25
T_4	Lactose	31.16	2.05	0.10	1.07
T_5	Sucrose	85.32	6.02	0.37	3.20
T_6	Glucose	81.23	5.48	0.32	2.90
T_7	Sorbitol	88.95	6.09	0.37	3.23
T_8	PDA (Control)	83.34	5.63	0.34	2.99
	Sem (±)	1.00	0.08	0.01	
	CD (1%)	3.95	0.32	0.02	
	CV (%)	2.63	3.16	4.36	

*Average of 4 replications

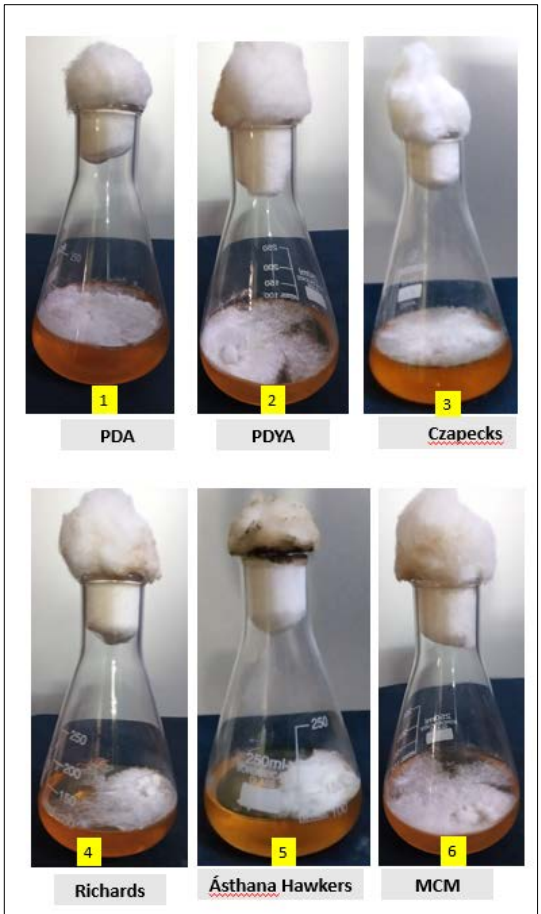
Table 7: Effect of different Nitrogen sources on growth and biomass of *P. djamor*

Tr. No.	Nitrogen sources	Mycelial growth * (mm)	Fresh weight* (g)	Dry weight* (g)	Average (g)
T_1	Potassium nitrate	79.21	4.88	0.26	2.57
T_2	Urea	83.52	5.25	0.30	2.78
T_3	Peptone	77.42	4.38	0.22	2.30
T_4	Magnesium nitrate	65.63	4.20	0.21	2.21
T_5	Ammonium sulfate	88.41	5.87	0.37	3.12
T_6	Glycine	52.50	3.62	0.16	1.89
T_7	L - Arginine	87.34	5.02	0.24	2.63
T_8	Barium nitrate	49.67	3.11	0.14	1.63
T_9	PDA (Control)	89.91	5.80	0.36	3.08
	Sem (±)	1.02	0.07	0.01	-
	CD (1%)	4.01	0.27	0.02	-
	CV (%)	2.73	2.89	3.91	-

*Average of 4 replications



Effect of different media on growth and biomass of *P. diamor*



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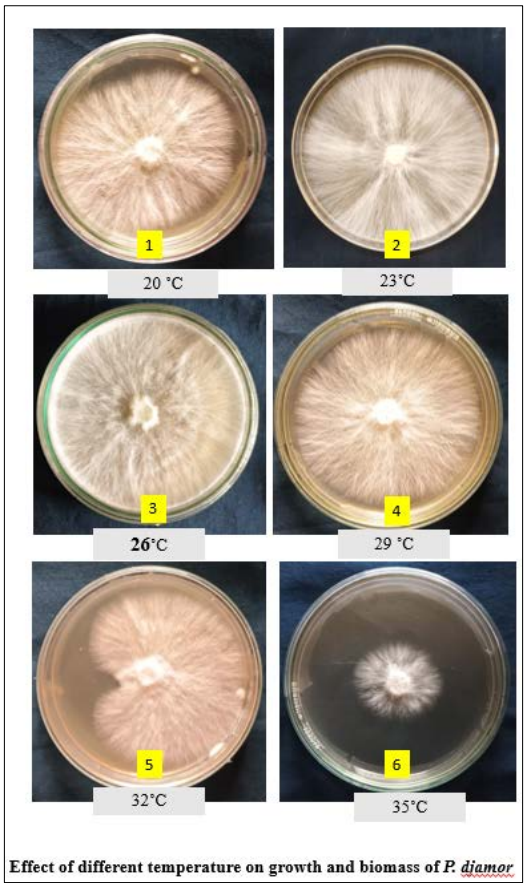

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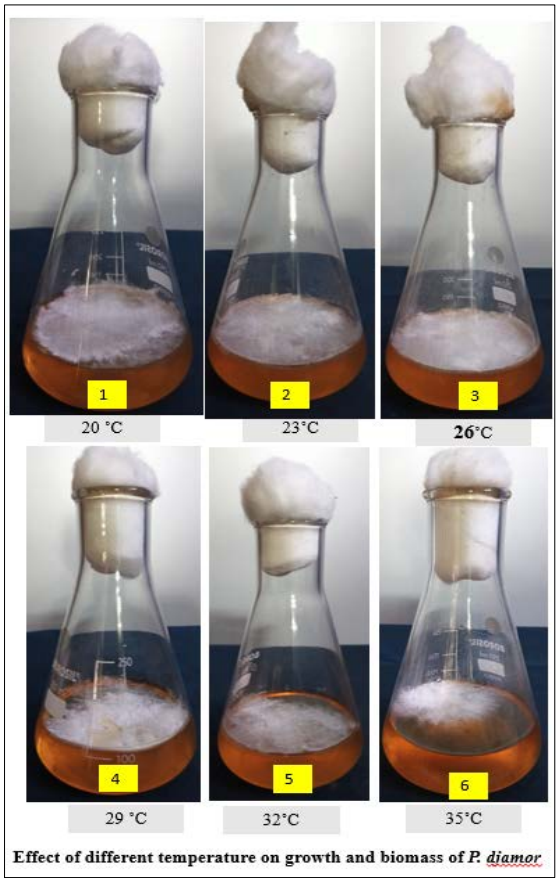

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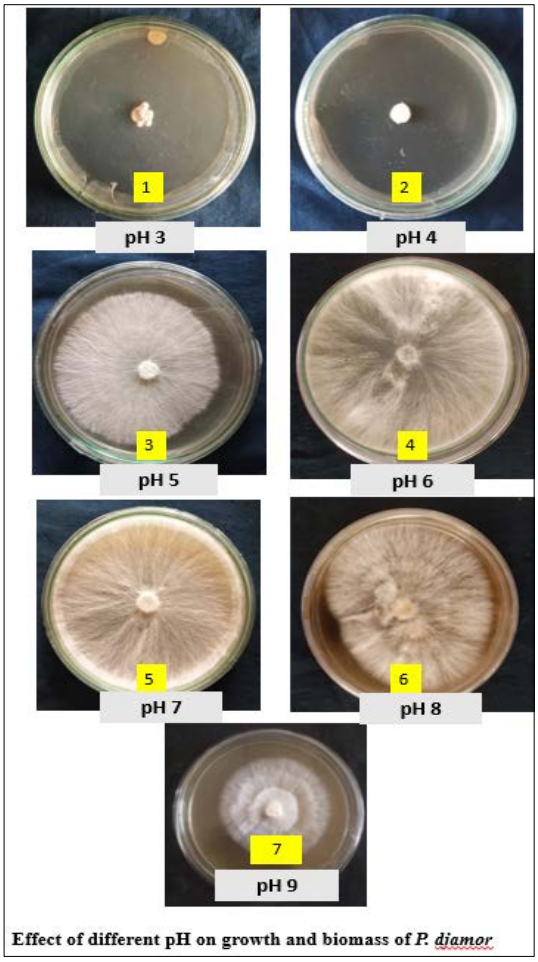
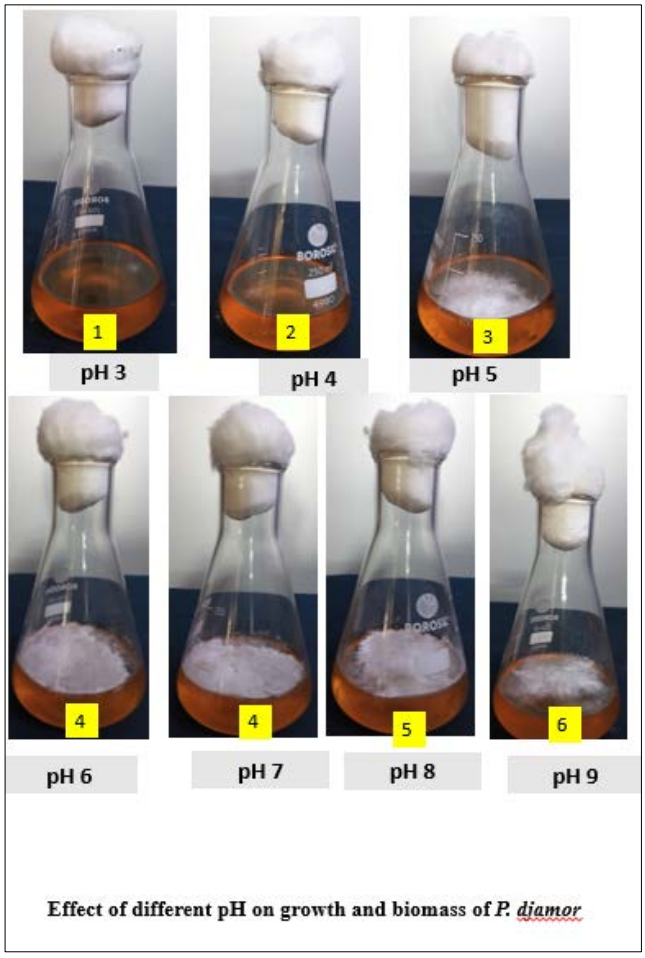
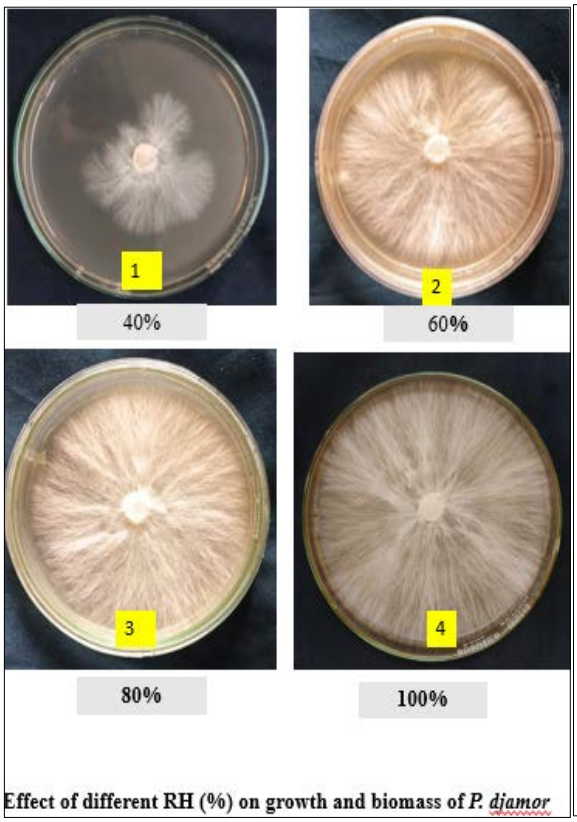


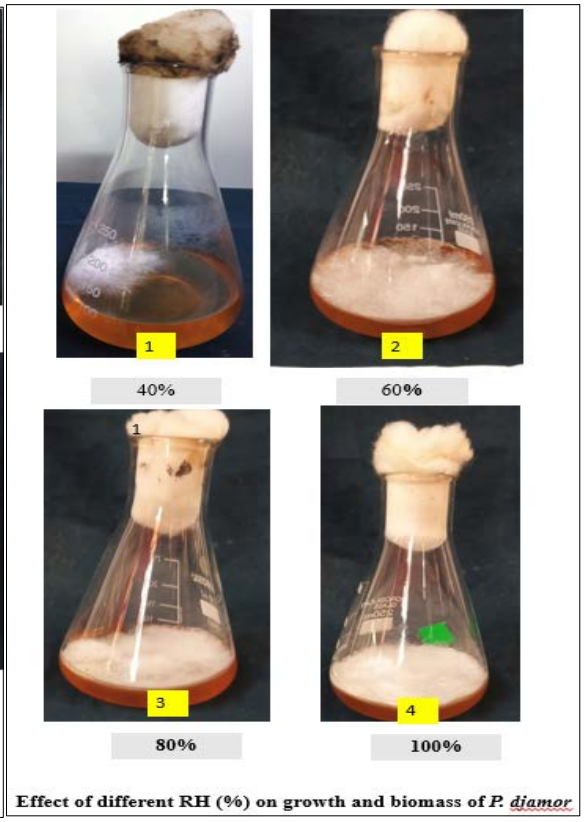
Effect of different pH on growth and biomass of *P. djamor*



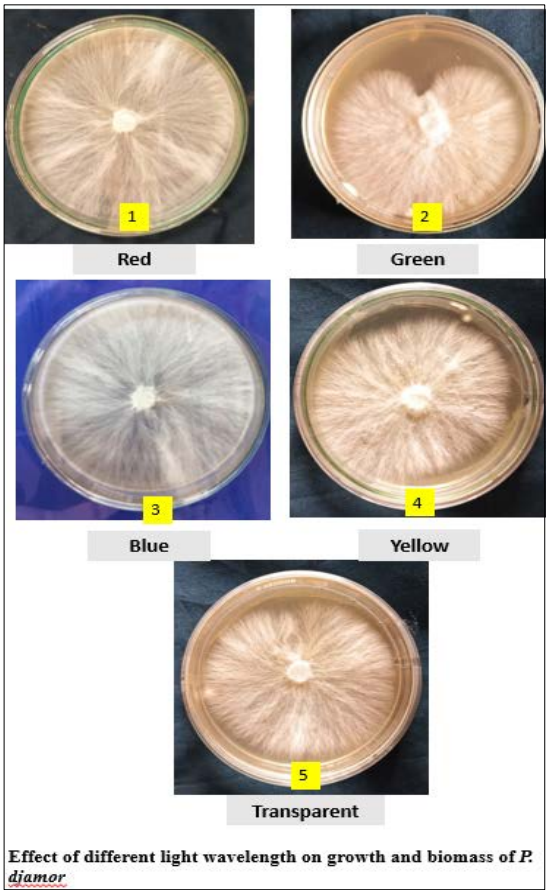
Effect of different pH on growth and biomass of *P. djamor*



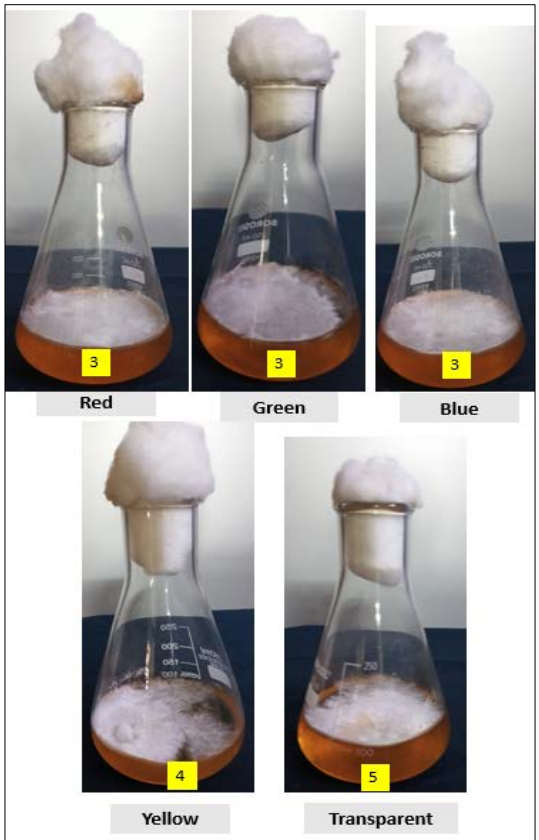
Effect of different RH (%) on growth and biomass of *P. djamor*



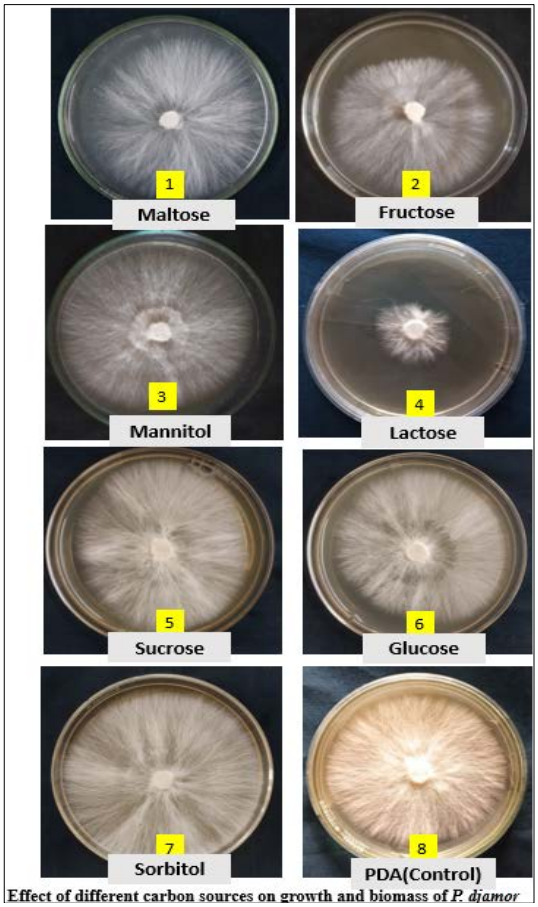
Effect of different RH (%) on growth and biomass of *P. djamor*



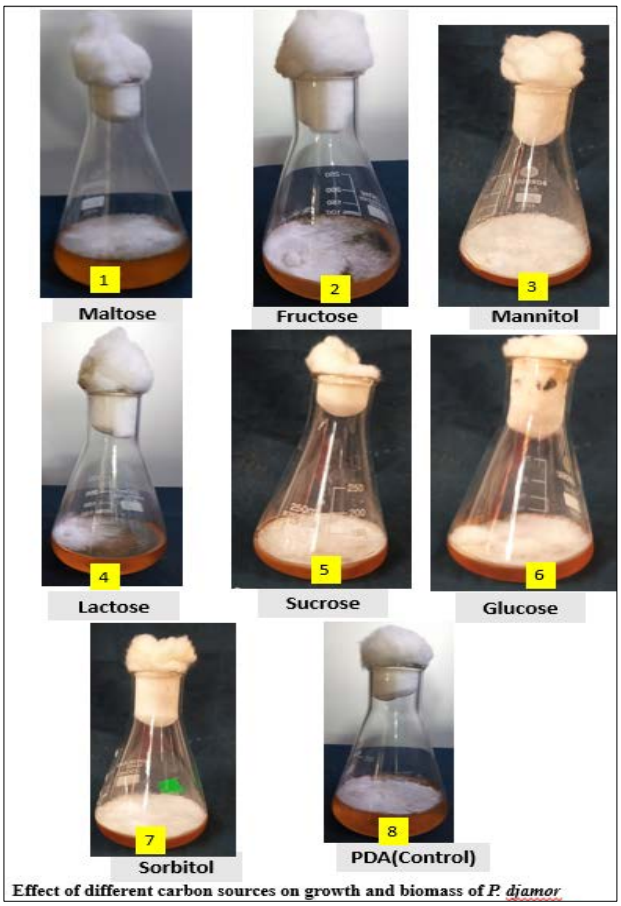
Effect of different light wavelength on growth and biomass of *P. djamor*



Effect of different light wavelength on growth and biomass of *P. djamor*



Effect of different carbon sources on growth and biomass of *P. djamor*



Effect of different carbon sources on growth and biomass of *P. djamor*

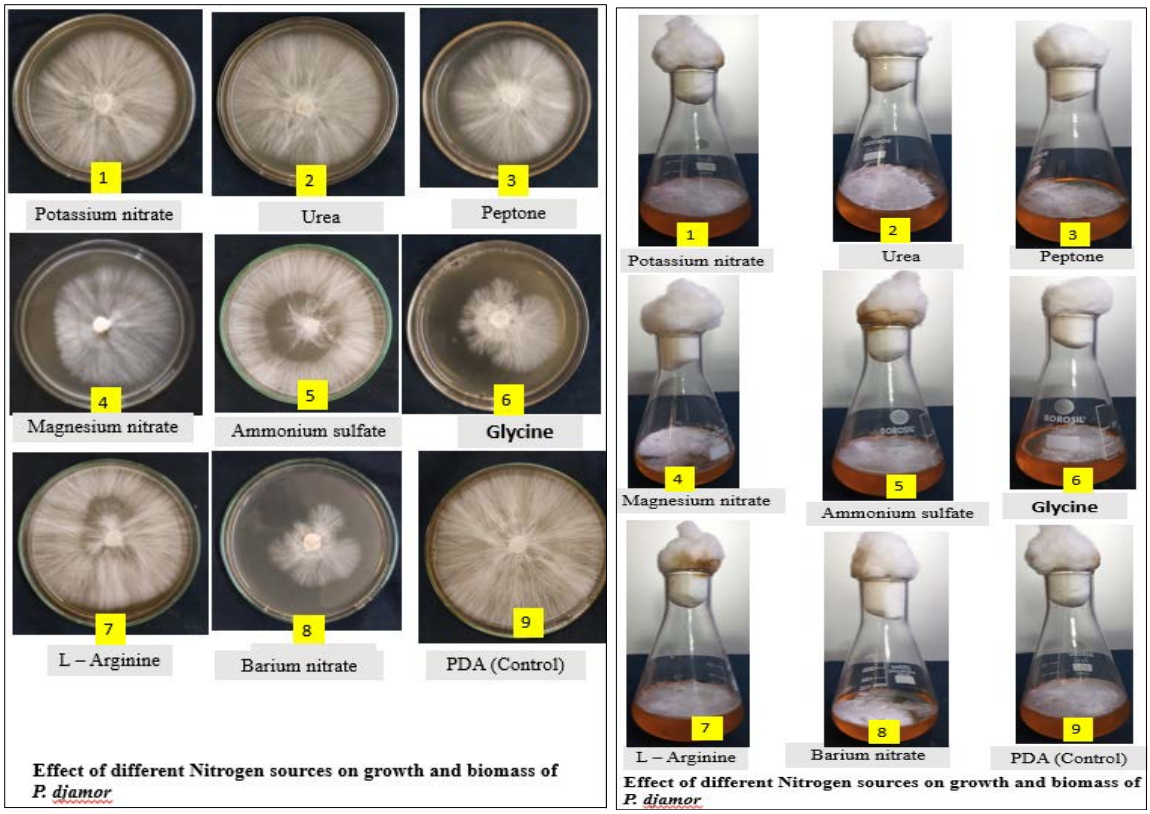


Fig 1: Effect of different sources on physiological and nutritional requirements for growth and biomass of *P. djamor*.

Conclusion

The study found that the optimal growth conditions for *Pleurotus djamor* were: potato dextrose agar (PDA) medium, 26°C temperature, pH 7, 100% relative humidity, red light wavelength, Sorbitol carbon source and Nitrogen sources control (Potato Dextrose Agar Medium) which resulted in significantly higher mycelial growth, fresh and dry mycelial weights, and average weight compared to other tested conditions. These insights can help guide the optimization of *Pleurotus djamor* cultivation and production practices.

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Future Suggestions

Optimization of Growth Conditions: Further studies can focus on fine-tuning environmental parameters like light, humidity, and temperature to maximize the yield and quality of *Pleurotus djamor* biomass.

Nutritional Substrate Analysis: Investigating alternative agricultural and industrial by-products as substrates could help reduce production costs and promote sustainable practices.

Biochemical Profiling: Comprehensive studies on the biochemical composition of *P. djamor* can provide insights into its nutritional and medicinal value, paving the way for functional food development.

Genetic Improvement: Exploring genetic variations or implementing molecular techniques can enhance desirable traits such as growth rate, yield, and resistance to diseases.

Commercial Viability Assessment: Pilot-scale and commercial-scale studies should evaluate the economic feasibility, market demand, and consumer acceptance of *P. djamor*-based products.

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