Effect of pH on the Growth of Fungi associated with Lac

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Lac is a natural resinous substance of profound economic importance in India. It is one of the most valuable gifts of nature to man. It is the only resin of animal origin, being actually the secretion of a tiny scale insect, *Kerria lacca* (Kerr) (Homoptera : Tachardiidae). It basically yields three useful materials: resin, dye and wax. It makes a small but significant contribution to the foreign exchange earnings of the country, but the most important role that the lac plays in the economy of the country is that roughly 3-4 million tribal people, who constitute the socio-economically weakest link of Indian population, earn a subsidiary income from its cultivation.

India is the major producer of lac, accounting for more than 50% of the total world production. It virtually held a monopoly in the lac trade during the period of the world war-I, producing nearly 90% of the world's total output. Now a day's lac cultivation has become very popular all over the country due to its uses, a source of high income, suitable for tribal people of Jharkhand etc. Scientific methods of lac cultivation provide high income and reduce risk. At present total annual average production of stick lac in India is approxmately 20-22 thousand tons, which forms the raw material for lac industries. Chhattisgarh ranks Ist among the States followed by Jharkhand, Madhya Pradesh, Maharashtra and West Bengal. These five states contribute around 95% of the national lac production.

It has been shown that pH is an important criterion for understanding the ecology of spoilage fungi, especially mycotoxigenic species (Ahmed & Naresh, 2009). Reports have shown that growth of fungi could be affected by 'Hydrogen ion concentration' (pH) in a medium in which it grows, either directly by its action on the cell surface or indirectly by its effect on the availability of nutrients. Fungi differ considerably in their tolerance to different pH values. The growth of fungi may be completely inhibited in media, which are either too acidic or too alkaline. Most of the fungi, however, tend to grow better on the acidic side. Therefore, present study was carried out to determine the effect of pH on the growth of fungi associated with lac.

Material & Methods

Isolation and Identification of Fungi associated with lac : Fungal species were isolated from soil samples by using Potato Dextrose Agar (PDA) medium. Samples were inoculated over plates by multiple tube dilution technique (MTDT) and the plates were incubated at 26°C for 6 days. Fungi were identified with the help of compound microscope.

Effect of lac on growth of fungi : Petri plates containing PDA, medium with different concentration of lac was used as agar medium (1.0g 2.0g, 3.0g,4.0g and 5.0g). The plates were inoculated with 5 mm diameter disc from ten day old cultures of different fungi. The inoculated plates were kept at 30°C. Three replications were maintained for each media. Colony diameter was measured ten days after inoculation. Three replications were maintained for each medium.

Table 1: Isolation of Fungi from Lac collected from different host plants.

	Name of Fungi	Fungi isolated from Lac of different host plants			
		Umber	Palas	Raintree	Ber
1	*Aspergillus niger*	+	+	+	+
2	*A. flavus*	+	+	+	-
3	*A. fumigatus*	-	+	-	+
4	*Fusarium moniliforme*	+	+	+	+
5	*Penicillium citrinum*	+	+	-	-
6	*Rhizoctonia solani*	-	+	-	+
7	*Curvularia lunata*	-	+	+	-
8	*Cladosporium* sp.	+	-	+	+

Table 2. Effect of pH on growth of Lac fungi.

	Name of Fungi	Days	Colony diameter at pH (mm) pH		
			3.5	6.5	8.5
1	*Aspergillus niger*	2	38	62	06
		4	46	74	10
		6	58	88	12
2	*Fusarium moniliforme*	2	15	14	05
		4	20	25	05
		6	25	30	05
3	*Penicillium citrinum*	2	08	60	06
		4	12	70	08
		6	15	84	09
4	*Rhizoctonia solani*	2	14	35	05
		4	16	45	05
		6	18	56	05
5	*A. flavus*	2	15	60	05
		4	18	70	05
		6	23	80	05
6	*A. fumigatus*	2	14	55	06
		4	17	66	08
		6	20	72	10
7	*Curvularia lunata*	2	12	56	05
		4	14	73	05
		6	16	68	05
8	*Cladosporium* sp.	2	11	35	05
		4	13	42	05
		6	15	52	05

Effect of Hydrogen Ion Concentration (pH): The effect of pH on the growth of the fungi was studied following the method described by Kiryu (1939) using PDA medium. Three replications were maintained for each treatment.

Results and Discussion

Results presented in tables 1 and 2 show that total 8 fungal species were isolated from lac. Maximum fungi were recovered from lac on *Butea monosperma* (Palas), followed by *Ficus racemosa* (Umber). *Aspergillus niger* and *Fusarium moniliforme* were dominant fungi as compared to other fungi. *Rhizoctonia solani* was isolated from Palas and Ber. However, acid/alkaline requirement for growth of fungi is quite broad, ranging from pH 3.0 to more than pH 8.0, with optimum around pH 5.0 if nutrient requirements are satisfied (Pardo et al., 2006). Studies on pH reveal that fungi grow at pH 3.0 - 8.0, with maximum production of dry mycelial weight and sporulation at pH 5.5 and pH 6.5 respectively, in liquid media (Saha et al., 2008; Deshmukh et al., 2012)). In general, a neutral to weak acidic environment was suitable for mycelial growth, with optimum pH 5.0-7.0 and pH 5.0-8.0 for conidial production (Zhao et al., 2010). For this reason, *in-vitro* studies of Fungi generally utilize substrates in the form of solution only if the reaction of solution conducive to fungal growth and metabolism (Kiryu, 1939). This brings importance of hydrogen ion concentration for better fungal growth. Of all the eleven pH levels, pH 6.5 was found to be ideal and produced the maximum mean mycelial growth of 87.50 mm, followed by pH 3.5 (84.60 mm) . The mean mycelial growth was lowest at pH 8.5 which recorded 28.00 mm. The pH below six and above seven was noticed to be inhibitory to the growth. The results of experiment indicated that *A. alternata* prefers pH 6.5. The inhibitory action of pH above 6.5 and below 6 was attributed to the unconducive reaction of the media. Filamentous fungi are generally known to be tolerant to acidic pH and most of them have an optimum pH between 5.0 and 6.0 for cellular growth and several metabolic activities (Rosfarizan et al., 2000). However, the range of pH for growth in *A. parasiticus* with regards to dry myce-

lial weight and sporulation seem to be wide; spanning from pH 4.0 to pH 9.0 and pH 4.0 to pH 8.0 respectively. Cochrane (1958) states that many fungi, with few exceptions, grow best on media with an initial pH of 5.0 to 6.5.

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Three Indian Beaches among Asia's Top 10

Goa and Andamans have these

India has three of the top 10 beaches in Asia favoured by travellers, a survey by travel website 'Trip Advisor' said. The beaches are Agonda, Palolem (both in Goa) and Radhanagar on the Havelock Island in the Andamans, according to Trip Advisor's top 10 Asia's Travellers' choice Award-winning Beaches.

"India, with its extensive shoreline, is dotted with beautiful stretches of sand and it's great to see these gems gaining recognition globally," Trip Advisor India's Country Manager Nikhil Ganju said.

Traveller's Choice Award winning beaches were determined on the quantity and quality of traveller reviews and ratings on the Trip Advisor website gathered over a 12-month period.

This year's award honour 343 beaches, including the top 10 in the world and lists for Asia, Africa, Australia, the Caribbean, Central America, Europe, South America, the South Pacific, the UK and the US.

Three of India beaches have featured in the list of the top 10 beaches in Asia.

Agonda beach (Goa) has been ranked at number four position in the Asia's top 10 list, mostly for being wide, quiet, picturesque and a great spot for sunbathing and relaxing with relatively few tourists around, the survey said.

Goa's Palolem beach has been ranked 8th in the list for its beach hut accomodations. Stretching between two magnificent head lands, Palolem beach is lined with towering coconut palms and is largely unspoiled. It is inhabited by local fishermen and foreign tourists alike.

Radhanagar Beach on the Havelock Island in the Andamans has been placed at number 10 in the list for its stretch of white sand with picture perfect waters lined with palm trees, it said.

Ngapali beach in Myanmar has topped the list, followed by Nacpan beach in Philippines and Kata Noi beach in Thailand, it said.

Yapak beach in Philippines stood at number five, followed by Nai Harn beach in Thailand at number six and Sunrise beach in Thailand at seventh spot, while Otres beach in Cambodia was ranked at number nine, it said.

However, none of the beaches from India features in the category of the world's best beaches.

Grace Bay beach in the Caribbean has topped as the world's number one Traveller's Choice beach, followed by Baia do Sancho beach in Brazil and Playa Paraiso beach in Cuba, the survey said.