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STUDIES ON GENUS *GANODERMA* KARST. WITH RESPECT TO MACROSCOPIC AND MICROSCOPIC CHARACTERS FROM KOYNA REGION OF SATARA DISTRICT, MAHARASHTRA, INDIA.

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ABSTRACT

The present paper deals with the collection and study of two major species of Genus Ganoderma – like G. lucidum and G. applanatum from Koyna region of Satara District of Maharashtra, India. During the present investigation, a rich and beautiful mycoflora of this region was studied. Dense vegetation, humidity and heavy rainfall favour the growth of Aphyllophorales in this area. The study of Fungi belonging to genus Ganoderma was carried out in various places of Koyna region of Satara District viz. –Humbarli, Koynanagar and Helwak. The collection sites, their latitude and longitude, host names, macroscopic characters and microscopic characters are briefly described in this paper.

KEYWORDS :*fungi, Aphyllphorales, Ganoderma.*

INTRODUCTION

Carl Linnaeus firstly proposed 10 genera of Fungi with almost 86 species in 1753. Robert Whittaker (1969) in his Five Kingdom system of classification proposed- fungi as separate Kingdom. Fungi are the heterotrophic, eukaryotic and non-photosynthetic organisms. Their cell wall is made up of chitin. The body fungi is made up of thin fibre-like structures called as hyphae, which further form a network called mycelium. They are either parasitic or saprophytic in nature. They reproduce sexually as well as asexually. They are very important for nutrient cycling, transport, decomposition and are indispensable for achieving sustainable development. (Palm and Chapela 1998).

Aphyllophorales is a major order of class Basidiomycetes of fungi. This order was first introduced by Carletor Rea (1922). The members of aphyllophorales are commonly known as wood rotting fungi. Donk (1964) has recognized 22 families of Order Aphyllophorales which are followed for the present work. Hawksworth et.al.,(1983) in the "Dictionary of Fungi" accepted the order Aphyllophorales with 21 families as compared with Donk (1964) to which some families were added by Reid (1965), and Corner (1970). Aphyllophorales are the important pathogens of Angiospermic plants, in natural as well as plantation forests. They decay the plant structure and

slowly result in their downfall and death.

Satara district is located in the western part of Maharashtra in Sahyadri ranges. It occupies an area of 10,484 Km^2. It is situated at 17.5^0 to 18.11^0 North Latitude and 73.33^0 to 74.54^0 East Longitude. The average rainfall here is 2643 mm. Koyna is a small town in Patan taluka of Satara district. It is also called Koynanagar. It is on Chiplun-Sangli state highway on the banks of Koyna River. It is situated at 17.3919° N, 73.7404°E. This region is famous for Koyna Dam and Koyna Hydroelectric Project. It is well nestled in the Western Ghats about 2,448 above sea level. The forest type here is of Southern tropical evergreen forests and mixed deciduous forests. The flora is dominated by Anjan, Jambhul, Awala, Hirda, Amba, Umber, Bibba, Palas, Mango, Babhul,*Cassia* etc.

Fig.1.Map of Maharashtra

Fig.2. Satellite view of Koynanagar

Ganoderma is a genus belonging to order Polyporales and family Ganodermataceae. They grow on wood and are commonly known as the bracket fungi. They are characterized by large, perennial basidiocarps called as conk. They are typically leathery with or without stalk. The pilear surface is dark to reddish brown. They show typical trimictic hyphal system. The basidiospores are double walled. They are saprophytic on dead wood as well as parasitic on the live wood of trees causing white rot. G. lucidum is medicinally important and is used in treatment of cancer and other diseases. It was observed that Koyna region show presence of plenty of fungal species from genus *Ganoderma.* Two such frequently occuring species of *Ganoderma* viz. *G. lucidum* and *G. applanatum* were studied in detail for their morphological and microscopic characters and presented in this paper.

MATERIALS AND METHODS:

Area of Study:

An extensive field survey of Koyna region (17.3919° N, 73.7404°E.) of Satara district of Maharashtra state was undertaken. Specimens belonging to the genera *Ganoderma* were collected by the authors. Visits were made to three different localities of Koyna region of Satara district, which included- Humbarli, Koynanagar and Helwak. An extensive collection of fungal specimens was done from this Taluka and studied for their macroscopic and microscopic characters.

Collection and Preservation of samples:

The Aphyllophorales belonging to genus Ganoderma were collected in the form of the The basidiocarps of the genus *Ganoderma* were collected along with their supporting wood. They were collected from the live standing trees, fallen tree logs, and deforested tree trunks. They were collected in brown paper bags. The information regarding the locality, shape, colour and dimensions of the basidiocarps were noted. The name of the host was identified and noted in the field book. Photographs of the specimens were taken in different angles. The specimens were later brought to the research laboratory. They were either sun dried for two days or they were dried in autoclave at 70^0C. This prevents the decomposition of the basidiocarps by borers. Some parts of the fungal specimens were also preserved in 10% Formalin solution.

Preparation of Slides (Stain and Mounting): The fungal preparations were stained by Cotton Blue in Lactophenol. The Lactophenol cotton blue is an acidic dye which stains the chitinious cell wall of fungi. 5 % Potassium Hydroxide was used as a pre-treatment to soften the fungal components. The slides were mounted in Lactophenol. Slides were prepared for studying the microscopic characters of the fungal specimens. Free hand sections of the basidiocarps were taken. The basidiocarps were cross sectioned along the lower surface to find out the pore shape. Sections of the context of pileal cover and hymenium were also taken. The context was removed and teased on the slide to separate the contents. It was then observed for various microscopic details. The slides were stained with Lactophenol Cotton Blue. Slides of basidiospores, hyphae, pores etc. were prepared in the laboratory and examined under research microscope and photographed. For temporary sealing of the prepared slides, nail paint was used.

CLASSIFICATION AND IDENTIFICATION:

The fungal specimens were described in detail with respect to type of rot, host, structure of basidiocarp, shape and mode of attachment with the host. The microscopic characters were also recorded. These characters were used to identify the fungal specimens. The specimens were identified upto species level on the basis of macro and micro characters with the help of standard literature and keys prepared by Ainsworth (1973), Ryvarden (1976), Sharma (1995), Roy and De (1996).

OBSERVATIONS:

Koyna region of Satara is a hilly part included under tropical evergreen deciduous forests. Different types of Aphyllophorales members are found in this region growing as wood rotters on the tree trunks in this area.

The genus *Ganoderma* Karst.:

Ganoderma is the largest genus in Aphyllophorales. It causes root rot as well as heartwood rot of trees. Karsten (1881) described the genus *Ganoderma*. The basidiocarps are annual or perennial having stipe or sessile. The pileus surface is thick, shiny and laccate. The context is cream coloured to dark purple, soft and spongy. The pore surface is cream coloured to white, pores are regular, 4-6 per mm. The hyphal system is trimictic showing binding, generative and skeletal hyphae. The basidiospores are broadly ellipsoid with a truncate apex and apical germ pore. The wall of basidiospores is two layered. At present 80 species of *Ganoderma* are identified from tropical forests. Two dominantly occurring species o*f Ganoderma- G.lucidum* and *G. applanatum* were collected from different hosts and localities and recorded in tabular form.

Table 1: *Ganoderma* species along with their hosts, location and date of collection.

No	Name of the Fungi	Name of the host	Loaction	Date
1.	***Ganoderma lucidum*** (Karst.)	*Millingtonia hortensis* deforested tree trunk	Koynanagar	22/7/2015
		Mangifera indica– base of tree trunk	Humbarli	23/7/2015
		Millingtonia fallen wood logs	Koynanagar	27/8/2015
2.	***Ganoderma applanatum*** (Pers.)	*Pongamia pinnata* dead wood logs and living tree base.	Humbarli	23/7/2015
		Acacia nilotica fallen tree roots	Helwak	27/7/2015

DESCRIPTION OF *Ganoderma* SPECIES:

1. *Ganoderma lucidum* (Karst.) (PLATE 1)

DISTRIBUTION: It occurs throughout the forest regions on dead fallen branches as well as standing and living trees. It is most common on deciduous hardwood forests. It causes White root rot on hardwoods.

MATERIALS EXAMINED: It was found on the deforested stem stump of *Millingtonia hortensis* tree. It was also present on base of *Mangifera indica* plant.

MORPHOLOGICAL CHARACTERS: The basidiocarps are annual, sessile or centrally stipitate. They are firstly irregular in shape but at maturity, they become more or less fan-shaped. They are applanate, 15-20 cm broad. The upper surface is shiny with thin varnished crust. At maturity it turns dark reddish brown. They are concentrically sulcate.The margins are acute and the pore surface is creamy white. The pores are circular to angular, 4-5 per mm. The context is firstly creamy white and later becomes dark brown.

ANATOMICAL / MICROSCOPIC CHARACTERS: The hyphal system is trimictic. In some specimens it was dimictic. It shows presence of generative, skeletal and binding hyphae. The skeletal hyphae is hyaline to pale brown, thick walled, aseptate with branching. The generative hyphae are thin walled 2-3 micrometer in diameter with clamps. The binding hyphae are hyaline to pale yellow nearly 5 micrometer in diameter. Cystidia and setae are absent. The basidiospores are ellipsoid, truncate at apex and pale brown in colour. It has double wall covering with inter wall pillars between two layers.

2. *Ganoderma applanatum* (Pers.) Pat. (PLATE 2)

DISTRIBUTION: It is the common Aphyllophorales found in deciduous forests. It occurs throughout the forests causing White mottled root rot.

MATERIALS EXAMINED: It was found on dead wood logs and living tree bases of *Pongamia pinnata*. It was also present on fallen tree roots of Acacia plant.

MORPHOLOGICAL CHARACTERS: The basidiocarps are perennial, broadly sessile, woody hard and applanate. The pileus surface is smooth, crustose, zonate grey to black in colour. The margins are thin, white and the context is brown and corky. The pore surface is white and it gets discoloured when touched. The pores are circular 4-6 per mm.

ANATOMICAL / MICROSCOPIC CHARACTERS: The hyphal system is trimictic.It shows presence of

generative, skeletal and binding hyphae.The generative hyphae are inconspicuous, unbranched, and thin walled with clamps,they are 2-5 micrometer in diameter. The binding hyphae are very few; the skeletal hyphae are thick walled, brown, aseptate, 3-5 micrometer in diameter. The cystidia are absent. The basidiospores are pale brown, ovoid, truncate at distal end. They are covered by two walls connected by inter-wall pillars.

PLATE - 1

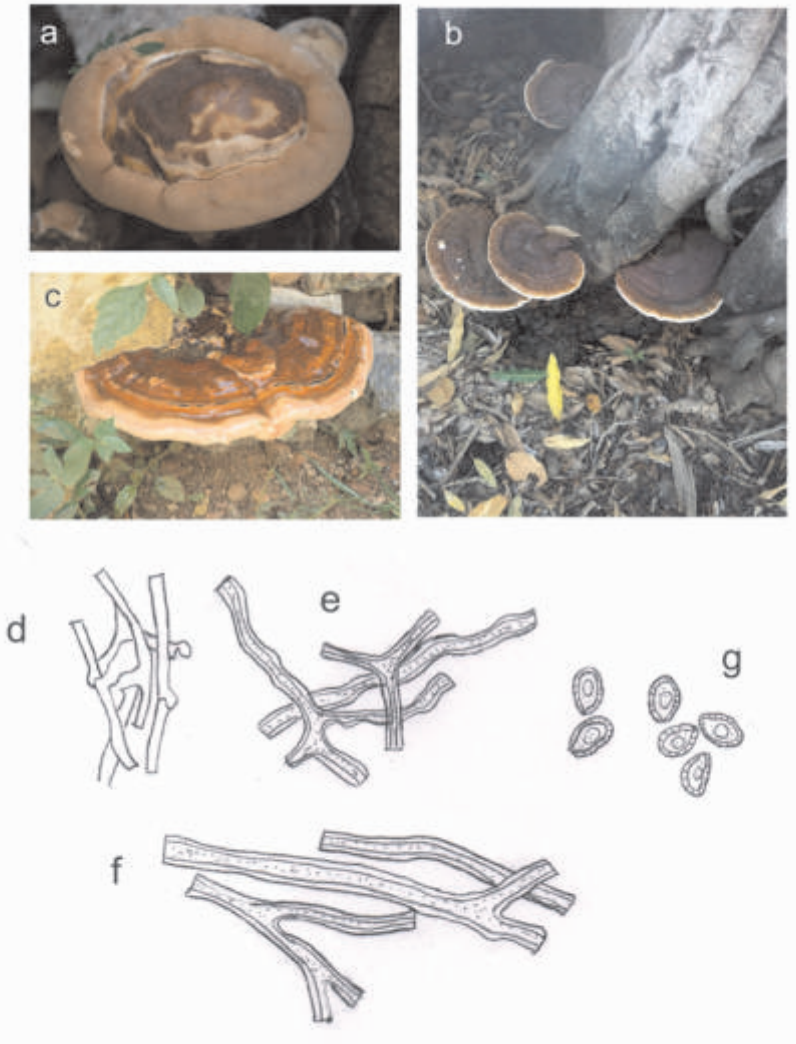

PLATE 1 : ***Ganoderma lucidum***

a : Immature Basidiocarp, b : Mature Basidiocarp on Living Tree,
c : Mature Basidiocarp on Dead Wood, d : Generative hyphae, e : Skeletal hyphae
f : Binding hyphae, g : Basidiospores

PLATE - 2

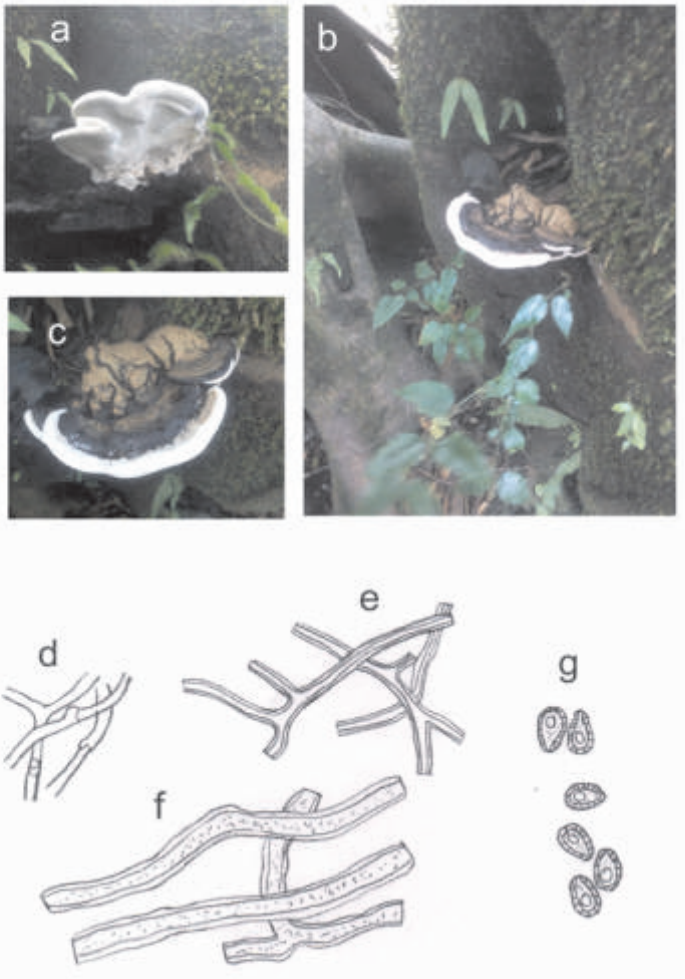

PLATE 2 : *Ganoderma applanatum*

a : Immature Basidiocarp, b : Mature Basidiocarp on Living Tree,
c : Mature Basidiocarp on Wood, d : Generative hyphae, e : Skeletal hyphae
f : Binding hyphae, g : Basidiospores

RESULTS AND DISCUSSION:

In the present study on *Ganoderma*, it was observed that *G. lucidum* and *G. applanatum* were occuring in dominance in forests of Koyna region. They were found on different Angiospermic hosts. Their maturity levels were different on each host species. They were observed causing heavy root rot and heart wood rot on living trees. They mainly infect the stem and roots. It was observed that some of the collected specimens of *G.lucidum* showed trimictic hyphal system while some showed dimictic hyphal system. The spore of both species showed typical double wall structure with pillars in between the two walls. However the pileal surface shows difference in colour and appearance. The pileal surface of *G.lucidum* was shiny, varnished and reddish brown in colour, while that of G. applanatum was glossy and greyish balck in colour. *G. applanatum* was commonly found on root as well as stem while G. lucidum was most common on stems.

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