THREE *HERICIUM* PERS. FROM RATANMAHAL WILD-LIFE SANCTUARY (RWS) OF GUJARAT, INDIA

Abstract

A study was conducted during 2010-2011 to find out the various white rot causing fungi in Ratanmahal wildlife sanctuary of Gujarat. Based on macroscopic and microscopic characters; fungal samples was identified as *Hericium abietis* (Weir ex Hubert) K. Harrison, *H. cirrhatum* (Pers.) Nikol. *H. erinaceus* (Bull. ex Fr.) Pers. From the study area, two *Hericium* sp. was reported for the first time. For the first time *H. abietis* was reporting from India. All the three *Hericium* was used as food by tribal of Gujarat, so the conservation was done.

Keywords: Conservation, Gujarat, *Hericium*, India, Medicinal, Mushrooms,

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I. INTRODUCTION

The edible mushroom *Hericium* was described as genus for first by Persoon (1794). It is a part of the *Hydnum* genus due to the spiny nature of hymenophore (Fries 1822, Miller 1933). It belong to Hericiales order and Hericiaceae family (Donk 1964), but according to Index Fungorum the Hericiales was merged in the Russulales order (Kirk et al. 2001). In Index Fungorum, 34 species 66 taxon of *Hericium* was listed (Index Fungorum 2021), 71 species names was listed in Mycobank (2022) and from notes of genera in Basidiomycota, 23 species was records (He et al. 2019). The mega-diverse country of the world is India, being underexplored for *Hericium* macro-fungi, except some sporadic noteworthy mycologists' contributions (Berkeley 1851; Bagchee et al. 1954, Thind and Khara 1975, Das and Sharma 2010, Das et al. 2011, 2013, Zutshi and Gupta 2013, Semwal et al. 2014, Karun and Sridhar 2016). The genus *Hericium* shows a peculiar morphology in fruit body like woolly surface. So they are called as bears head mushroom i.e. *H. americanum*, monkeys head mushroom i.e. *H. cirrhatum* and lions mane i.e, *H. erinaceus* and based on the nature of spines they are also called coral-spine mushroom i.e. *H. coralloides*, tiered-tooth mushroom i.e. *H. cirrhatum* (Karun & Sridhar 2016). Basidiomata was resembles to iced thorns hang from branch and also tough un-branched tissue cushion it is white, fleshy, growing on dead trees or woods, (Kuo 2014). In the present paper the distribution, identification and conservation of *Hericium* from RWS of Gujarat, India was reported.

II. MATERIALS AND METHODS

1. **Study Area:** The dry deciduous forest area of RWS is 55.65 Sq. Km, present in between the river panama and orsang in Panchmahals, Limkheda. It is 45 km away from baria with 74º37' to 70º11' east longitude and 22º32' to 22º35' north latitude. The forest have 543 plants, out of which trees was 119, shrubs was 40, herbs was 238, grasses was 48, climbers was 87, partial parasites was 2 and orchids was 9. Among trees, the maximum density was teak plants and with 19.6 % of the total trees. The second highest density was the badaro plants with 15.7 %. In monsoon season the subtropical arid climates changes to humid from July to October. It becomes dry and cold from November to February and a long hot summer in May and June. Mean annual temperature is 25.3 ºC. Rain fall is about 980 mm in June and September

2. **Collection and Identification:** The basidiocarp was collected from Eco-regions of Gujarat, from July to September in the year 2015 to 2019. The habit, host, name of the locality and. for identification of fungal samples, macroscopic and Microscopic characters was recorded by preparing crushed and sections of samples in water, 5% KOH, and staining was done with cotton blue (1%, in lactophenol), Congo red (1%, in distilled water), phloxine (1%, in distilled water), and Melzer's reagent (Arya et al., 2008, Nagadesi and Arya,2012, 2016, Nagadesi 2019, Nagadesi et al 2014).

III. RESULTS AND DISCUSSION

1. ***Hericium Abietis* (Weir ex Hubert) K. Harrison. Canad. Jour. Bot. 42: 1208. 1964. Plate 1 Figure C,D:** Sporophore up to 5 x 2.5 cm, solid tubercle; white to yellowish, buff when young, yellowish when bruised. sessile large, solid, massive, tubercle attached

laterally to the wood by rooting strands, context firm, pallid; spines up to 1.2 cm long, very short and stout when young, pointed on ends in tufts. The basal mycelium is interwoven with rhizomorphic strands; hyphae on surface of basal tubercle non-amyloid, clamped, 2.65-3.75 µm wide, cells long, walls thin; no KOH reaction when dried; Melzer's reagent gave amyloid reaction to tramal context, branches, and spines. Hymenium and sub-hymenium non-amyloid, dull yellow in Melzer's; sub-hymenium compact, 20.85 - 30.65µm thick, consisting of a layer of thin-walled generative hypha 3.65-4.75 µm in diameter. Hyphae in basidiocarp is amyloid, flexuous, often bifurcating broadly, interwoven, variable in width, clamped at the septa, thick-walled, with wider lumen. Spores 4.65-5.56 x 4.25 - 4.75µm, sub-globose, white, smooth, amyloid with thick-walls, dextrinoid; Basidia 5-7 x 25-30 µm, with walls irregular wavy; cystidia flexuous, clavate. Gloeocystidia 8-12 µm; oleiferous hyphae 200 µm, thick-walled, exposed in hymenium, moniliform, usually burst in Melzer's reagent and exuding oily contents. Odor and taste was mild.

Specimen Examination: India, Gujarat, RSW, on dead bamboo causing a white rot, 15th August 2010, collected by N. Praveen Kumar, (Acc no: MSUB Bot 120),

This fungus causing a white pocket rot in *Abies grandis*, *A. lasiocarpa* *A. procera*, *Picea engelmannii*, *Tsuga heterophylla*, *Pseudotsuga menziesii* in the Pacific Northwest. In Alaska, it is causing a rot in western hemlock, and *Picea sitchensis*. (Englerth 1947). In Canada of British Columbia it causes a trunk rots in western hemlock and true fir (Bier 1949). it causing a rot in western hemlock (Foster and Foster 1951). In the present paper it causes white rot on dead Bamboo.

2. ***Hericium Cirrhatum* (Pers.) Nikol. Acta Inst. Bot. Acad. Sci. USSR Plant Crypt., Fasc. II 6, 343 (1950) Plate 1 Figure E:** Sporophore: white in colour, bracket shaped caps, hairy upper surface and fertile flattened tiered teeth underneath, solitary, annual, woody, rare, and measures 2.2 – 10.9 × 0.5 – 3.3 cm in size (Plate I Fig. E). Basidiomata initially small, pinkish-white eruption with fine hairs in young, at maturity becomes bracket-shaped, hairy and irregularly semicircular to lobed with wavy margin (Plate I Fig. E). Upper surface is sterile, light-brown in colour, hairy bristels and on ageing short-spined to warty (Plate I Fig. E). The lower is white, deadaleoid to lamellate, incised, flattened teeth 5 - 18 mm tall, surface finely sulcate, tiered, crowded, spread over (Plate I Fig. E) and sometimes decurrent, sessile, laterally attached to substrate. Context is whitish and soft. Basidia elongated, club-shaped and 2- 4 spored. Spores was whitish, smooth, oval, 9.8 – 11.2 × 7.2–8.2 µm in size (Plate I Figure E). Odor was almond; taste is not distinctive and edible.

   Specimen Examination: India, Gujarat, RSW, on dead and living tree of *Madhuca indica* causes a white rot, 15th August 2010, collected by N. Praveen Kumar, (Acc no: MSUB Bot 125),

3. ***Hericium Erinaceus* (Bull. ex Fr.) Pers. Mycol. Europ. 2: 153. 1825. Plate 1 Figure A, B,:** Basidiocarp an ovoid, solid, up to 5 cm wide, attached laterally; upper surface a tangle of coarse agglutinated strands of mycelium; white becoming yellowish and finally

brownish. Margin of pileus indefinite, but marked by the bases of long pendent spines. Context fleshy, tough, watery, concolorous; Spines 1.5-4.2 cm long, pendent, beard-like, covering the sides. These are formed in a line as though the rows of spines originated in sequence during the enlargement of the tubercle. Stipe represented by a tough rooting attachment arising within the woody substrate. When KOH was applied to dried material there was no reaction; with Melzer's reagent, context surface and spores were amyloid, context usually amyloid but may not show any darkening in some sections. Spores 5.5-6.8 x 4.5-5.6 µm, subglobose, finely roughened to smooth; basidia 25-40 x 5.25-7.65 µm, 4-spored; Gloeocystidia arising in subhymenium, 7.75 µm, with dense contents exuding as oily droplets in KOH. Hyphae in trama is 3.65 – 20.75 µm, inflated, thick-walled, closed lumen, interwoven, gloeocystidia forms in the spines. Inter-weaving hyphae is 3.65-10 µm, clamps, branched and thick-walled. odor and taste was mild.

Specimen Examination: India, Gujarat, Rajpipla forest, on dead wood causing a white rot, 15th September 2011, coll. N. Praveen Kumar, (Acc no: MSUB Bot 128),

H. erinaceus is rare, native to North America, and also found in East Asia and India (Das et al. 2011), very rarely found in Europe. It is causing heart rot of oaks, frondose species, and found growing in knotholes of living trees. It is also found on Fagus in a number of states, on Acer spp. (Washington), Eucalyptus (California) and Platanus (Virginia). In 2003, it was recorded in red-listed by 13 of the 23 European countries because its natural habitats are disappearing (Thongbai et al. 2015). In the present study it is causing white rot in dead wood of Rajpipla forest area.

- **Distribution:** 8 *Hericium* sp. are found in the India on wood from the Himalayan region (Thind and Khara 1975, Das and Sharma 2009, Das et al. 2011, 2013, Zutshi and Gupta 2013, Semwal et al. 2014, Das et al. 2013) (Table 2). *H. erinaceus* is reported from reserve forest of Western Ghats in July 2012 (Karun and Sridhar 2016). In the present study it is reported from reserved forest of Rajpipla area of Gujarat. *H. cirrhatum, H. coralloides* and *H. erinaceus* were reported from Asia, North America and Europe (Boddy et al. 2011). In the present paper it was recorded from the India country of Asian continent

- **Medicinal Uses:** Mostly the young *Hericium* sp. was edible, have therapeutic potential as stimulant or nerve growth factor (NGF) synthesis and dementia treatment :(Kawagishi and Zhuang 2008, Ma et al. 2010, Friedman 2015, Thongbai et al. 2015). *H. erinaceus* have polysaccharide like beta-glucan groups used in antitumor activities (Seok et al. 2009).

Plate I

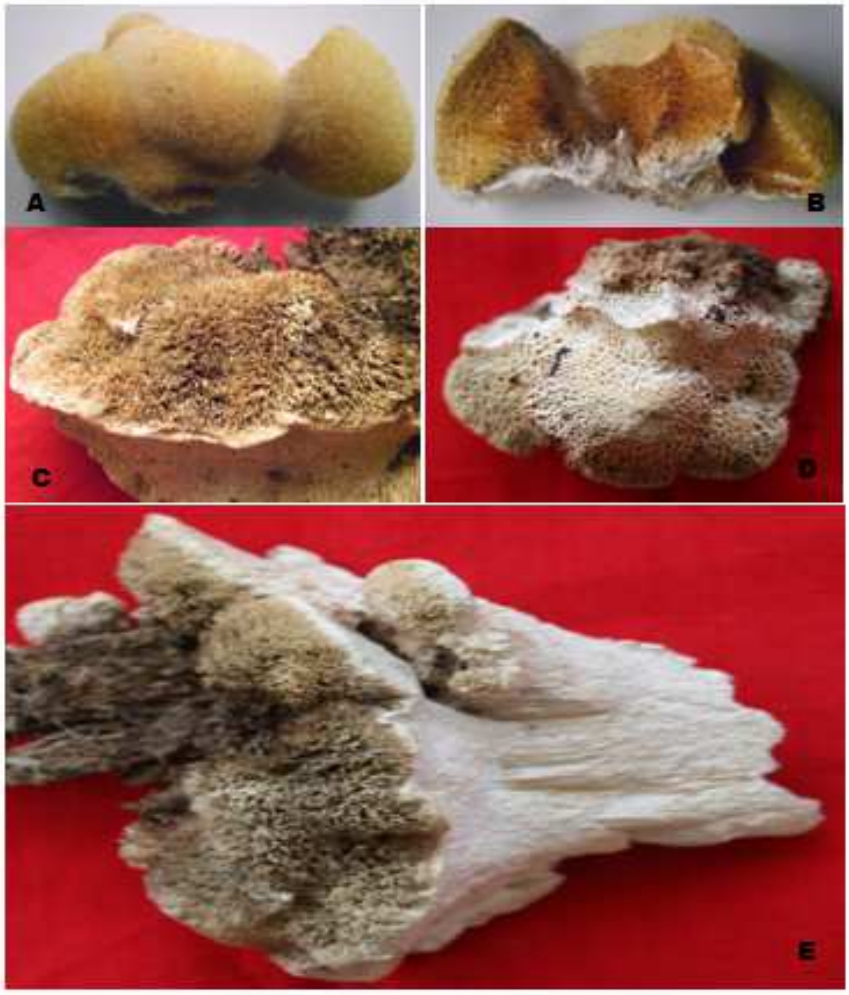

Plate I Figure A: the sharp spinate surface of *Hericium erinaceus*; Figure B: the context and sporocarp of *H. erinaceus* attached to substrate by broad base; Figure C very sharp spinate surface of *Hericium abietis*; Figure D: the hymenium surface with pores in *H. abietis* Figure F. The spinate upper surface and porate to lamellate lower surface in *Hericium cirrhatum.*

Table 2: India *Hericium* Mushroom Distribution and Substrate Preferred for Living on it

S. No	Species	Location	Habitat	Reference
1	*Hericium abietis*	Gujarat, Rathanmahal,	Bamboo	Present study
2	*H. bharengense*	Sikkim, Upper Bhareng,	*Tsuga dumosa* Logs	Das et al. (2011)
3	*H. cirrhatum.*	Sikkim, Yuksom,	*Alnus nepalensis* Wood; *Quercus* sp Trunk	Das and Sharma (2010)
		Karnataka, Makutta of Western Ghats	*Euodia lunuankenda* endemic tree	Karun and Sridhar (2016)

		Gujarat, Rthanmahal,	*Madhuca indica* Living tree	Present work
4	*H. clathroides*	Himachal Pradesh, Chamba,	*Quercus incane* Dead tree	Thind and Khara (1975)
5	*H. coralloides*	West Bengal, Darjeeling;	unknown	Berkeley (1851)
		Uttarakhand, Mussoorie Hills,	unknown	Bagchee et al. (1954)
		Jammu-Kashmir, Pahalgam,	conifers Log	Thind and Khara (1975)
		Jammu-Kashmir, Doda,	*Quercus leucotrichophora* Dead wood	Zutshi and Gupta (2013)
6	*H. erinaceus*	Sikkim	Unknown	Berkeley (1851)
		Uttarakhand, Mussoorie Hills,	Unknown	Bagchee et al. (1954)
		Simla, Narkanda,	coniferous tree Log	Thind and Khara (1975)
		Uttarakhand, Nainital,	*Quercus incane*	Thind and Khara (1975)
		Uttarakhand, Pauri,	Cracks of live but decaying wood	Semwal et al. (2014)
		Himachal Pradesh, Shimla,	*Quercus leucotrichophora* wood	Semwal et al. (2014)
		Karnataka, Western Ghats	Unknown tree	Karun and Sridhar (2016)
		Gujarat, Rajpipla,	Imported wood log	Present study
7	*H. rajendrae*	Jammu-Kashmir, Himalayan,	Unknown wood	Upendra Singh and Kanad Das in 2019
8	*H. yumthangense*	Sikkim, Yumthang,	Abies densa Wood	Das et al. (2013)

- **Conservation:** *H. coralloides* and *H. erinaceus* are vulnerable category in Red list from Europe (Boddy et al. 2011). The *Hericium* sp. was edible, medicinally versatile, and conservation was needed for mass collection from wild; so several strategies and priorities of conservation of *Hericium* sp. was studied by Boddy et al. (2011). In the present study also the *Hericium* sp was used by tribal of Gujarat as food so it is edible. In the western ghats, *H. cirrhatum* was reported on dead wood and endemic, living trees of *Euodia lunuankenda*. Besides, *H. cirrhatum* was recorded on unknown tree in July 2012 (Karun and Sridhar 2016). Western ghats have some more *Hericium* sp.

which needs further exploration studies (Karun and Sridhar 2016). In the present work the *H. cirrhatum* was dead and living tree of *Madhuca indica* and this plant is used for making tribal drink alcohol in Gujarat.

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