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Systematic Studies On Wild Edible Mushroom *Ramaria botrytis* (Fr.) Ricken, Collected From Shimla Hills Situated In Himachal Pradesh, India

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ABSTRACT: *Ramaria botrytis*, commonly known as the clustered coral, or the cauliflower coral, is an edible species of coral fungus in the family Gomphaceae. The fungus is ectomycorrhizal with broadleaf trees and conifers. It grows alone, scattered, or in groups under hardwoods or conifers. As an ectomycorrhizal species, *Ramaria botrytis* forms mutualistic associations with broadleaf trees and conifers. The specific epithet *botrytis* is derived from the Greek word 'botrus' meaning "bunch of grapes." The branching pattern is irregular, with the primary branches few and thick—typically 2–3 cm (0.8–1.2 in) and the final branches slender (2–3 mm), and usually terminated with five to seven branchlets, branchlet tips are pink to purplish-red. The flesh is solid and white. Spores are produced by basidia on the outer surface of the branches. The spores of *Ramaria botrytis* are yellow-brown to rusty-brown in mass deposit and range from smooth to warty to echinulate or striate; Microscopically, they have fine longitudinal or oblique striations that often fuse together in a vein-like network. In the present study, *Ramaria botrytis* is being described from Shimla hills of Himachal Pradesh. Its habit, habitat, taxonomic features, edibility and ethnomycological details have been incorporated in this communication.

KEYWORDS: clustered coral, ectomycorrhizal, ethnomycological, Hymenium, clamp connections, Melzer's reagent, Lactophenol, camera lucida, *Ramaria botrytis*.

I. INTRODUCTION

The edible mushrooms belong both to Ascomycotina and Basidiomycotina. The Ascomycetous members are contained in Discomycetes and these are non-lamellate, whereas the Basidiomycetous members are usually contained in the order Agaricales and are lamellate or gill bearing.

Around 2000 species of fungi are reported to be edible throughout the world and nearly 300 of these are said to be available in India (Purkayastha and Chandra, 1985). Out of these, only a few e.g. *Pleurotus* spp., *Agaricus bisporus*, *A. campestris*, *Volvariella dysplasia*, *V. volvacea*, *V. esculenta*, and *Coprinus comatus* are being cultivated on commercial or experimental scale in many parts of India, including Himachal Pradesh. These species, however, represent just a fraction of the available mushroom resource of the country and Himachal Pradesh in particular. In Himachal Pradesh, there are about 138 species of wild mushrooms which are edible. Out of these, presently being consumed in different parts of Himachal Pradesh, regularly during their growing seasons, by the local inhabitants, without causality or fatality are the species of *Morchella*, *Helvella*, *Sparassis*, *Hydnum*, *Clavaria*, *Clavulina*, *Trappiendia* new genus (Octaviania) and *Albatrelus* among non-gilled members and species of *Lactarius*, *Russula*, *Cantharellus*, *Armillariella*, *Pleurotus*, *Coprinus*, *Lepiota*, and *Lentinus* among the gilled fungi. These are not only consumed fresh but collected and dried for use during winter or snow months (Lakhanpal, 1991).

In recent years, the rate of consumption of mushrooms in many countries has increased considerably and hence, it has become imperative to explore new sources of edible mushrooms. In the present day scenario, a quick and reliable method for fungal identification is particularly appealing. However, since the fruiting body of mushroom is easily affected by environmental conditions such as light, moisture, temperature and nutrient sources, the identification based on morphological characters have been problematic. The mushrooms are highly polymorphic in appearance,

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Vol. 5, Issue 3, March 2016

exhibiting many shapes, sizes and colour variants. This polymorphic nature has led to taxonomic uncertainties. Morphological markers to study polymorphism in the mushrooms are limited. The present study, therefore, have been carried out on *Ramaria botrytis*, to work out its systematic study. The systematic study was conducted by:

- i) Making frequent trips during rainy/winter seasons to collect mushroom specimens;
- ii) Noting important macroscopic characters such as colour, size shape and texture of cap and stalk in the field in fresh specimens;
- iii) Working out microscopic details of specimens in the laboratory and identify them on the basis of macroscopic and microscopic characteristics;
- iv) Interviewing the local inhabitants and record data on collection, drying, consumption (recipes) and myths attached, if any, with appearance of the species; and
- v) Recording data regarding habit, habitat, forest type and associated tree, if any, with these mushroom species.

II. MATERIALS AND METHODS

Collection of material

The specimens of *Ramaria botrytis* were collected from nature during 2011-2012. Collections were made from different parts of Distt. Shimla (H. P.)¹. Distant sites were visited during mushroom growing season by temporarily camping at different places and making mushroom forays to different localities in the vicinity. The collections were usually made till mid day and rest of the time was utilized in recording field characteristics.

The fruiting bodies were removed carefully from substrate with the help of a sharp knife. The specimens were put in bags especially procured for the purpose and were carefully brought to the base camp. In base camp collections were systematically placed on papers, spreading on the tables or floor and each sample was allotted a collection number.

Villagers were enquired to gather data on methods of collection, drying and consumption of these wild edible mushrooms.

Preservation / drying of material

The specimens were preserved dry. The collections were dried in folding portable wooden driers, specifically designed for the purpose. The dried collections were wrapped in polythene bags and properly sealed. These bags were kept systematically in card board boxes which were stored in damp proof conditions. 1:4 P-Dichlorobenzene and Naphthalene balls were used as insect repellants.

Specimens to be used for raising culture and systematic studies were usually sun dried or dried gradually at 25-30°C in the drier.

Examination methods

Macroscopic observations

Various perishable macroscopic characters which help in the identification of mushrooms were recorded on the date of collection. These characteristics were carefully recorded in the field keys specifically designed for the purpose. The following macroscopic features were noted.

- a) **Pilues:** Shape, size, colour, consistency, dry/wet/ sticky/smooth/warty/ scaly/powdery, marginal characters, veil present or absent, if present colour and consistency.
- b) **Stipe:** Shape, size, colour, consistency, presence/ absence of annulus or volva, smooth/scaly/striate/fibrillose/dry/viscid, solid or hollow.

¹ Jakhoo, , Sharog, Glen, Navbahar, (Shimla).

International Journal of Innovative Research in Science, Engineering and Technology

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Vol. 5, Issue 3, March 2016

- c) **Lamellae:** Distinctly formed or not, attachment, crowded or distant, consistency, thickness, width, shape, colour, number, colour changes if any, edge.
- d) **Context:** Colour, consistency, thickness, colour change on cutting and bruising, presence/absence of latex.
- e) **Smell and taste**
- f) **Spore print:** Spore prints were taken from the fresh collections on clean glass slides by placing the smaller pileus/pieces on the slides and covering them with petriplates. Spores were deposited on the slides after 3-4 hours. Colour of the spores in mass was noted and slides were kept carefully after placing a glass cover slip (60 x 22 mm) and wrapping in paper envelopes which carried the collection number.

Microscopic observations

Microscopic details of the specimens were worked out in the laboratory with the help of a research microscope. The magnification of the system with various combinations of eye piece and objective lenses was as: X 2350 at 10 x 100, X 1040 at 10 x 45 and X 235 at 10 x 10. Measurements of spores, basidia, cystidia and other parts have been represented by the scale. All microscopic structures were drawn with the help of a camera lucida and field photography was done using digital camera (Sony DSC-HX9V).

Following microscopic features were studied in detail.

Spores: Basidiospores were studied from spore deposits. Spores were mounted in water, 3% KOH as well as in Melzer's reagent (Melzer, 1934) and examined under oil immersion for their size, shape, ornamentation and colour.

Hymenium: Hymenium was studied by cutting free hand sections of dry material after soaking it into water until it softened. The sections were mounted in KOH with aqueous phloxine and also in 1% cotton blue lactophenol² size and shape of basidia, cystidia and number of sterigmata, subhymenium and hymenophoral trama were studied.

Habitat ecology

During collections, data regarding habit, habitat, predominant vegetation of the area explored, altitude and trees associated with the mushroom species were recorded in the field. Mycorrhizal associations were recorded by carefully digging the fruit bodies in the field and tracing mycelial connections between fruiting bodies and associated trees (Young, 1936, 1940; Zak, 1971, 1973; Sharma and Lakhanpal, 1981).

Identification

All the collections of wild edible mushroom *Ramaria botrytis* have been identified by integrating their macroscopic and microscopic characterization by following Singer (1987) and Lincoff (1981). The examined specimens have been deposited in the herbarium of Department, of Biosciences, Himachal Pradesh with accession numbers.

III. RESULTS

Ramaria botrytis (Fr.) Ricken, Fig.1 (A-D).

Fruiting body: large erect 7.0-13.0× 6.0-17.0 cm wide, white at first becoming ochraceous with pink or red tips. Cauliflower like, robust with thick numerous branches arising from a large, fleshy base. **Hymenium:** white, moderately brittle. Taste and smell pleasant. **Stipe:** stout, short, thick, fleshy with numerous elongate branches,

² Cotton blue	Lactic acid	25.0 ml
Lactophenol	Phenol	25.0 gm
	Glycerin	25.0 ml
	Distilled water	25.0 ml

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branching usually crowded, cauliflower like, surface rugose, wrinkled. **Basidia:** 35.0-50.0 μm \times 6.5-9.0 μm , closely packed, clavate, 2-4 spored, guttulate, sterigmata straight or slightly curved. **Basidiospores** 12.0-15.0 \times 4.5-5.5 μm , ochraceous, oblong to elliptical, smooth, with fine, longitudinal striations, light orange, brown spore print, **Hyphae** monomitic, hyaline, branched, septate, thin walled with clamp connections.

Collections examined: H.P., Shimla, Navbahar Aug. 20, 2011, HPUB 5030; H.P.; Shimla, Glen Sept, 04, 2011, HPUB 5031; H.P., Shimla, Jakhoo, Aug. 16, 2012, HPUB 5032.

Edibility: Corner (1950), Atkinson (1961), Krieger (1967). It is an excellent edible species. It can be preserved by canning for future use.

Habit and Habitat Ecology

The creamish branched tips and massive cauliflower appearance are characteristic of this species. Sometimes only dense head may appear above the duff with rest of the fruiting body partially buried. It grows scattered on soil in mixed coniferous forests of *Pinus wallichiana* (A.B.Jackson) *Picea smithithiana* (Wallich.), *Cedrus deodara* (Roxb.), *Quercus incana* (Roxb.) *Q. semicarpifolia* (Smith), *Quercus dilata* (Lindl.) and *Abies pindrow* (Spach.) *Rhododendron arboreum* (Smith) at an elevation ranging 1800 to 2800m.

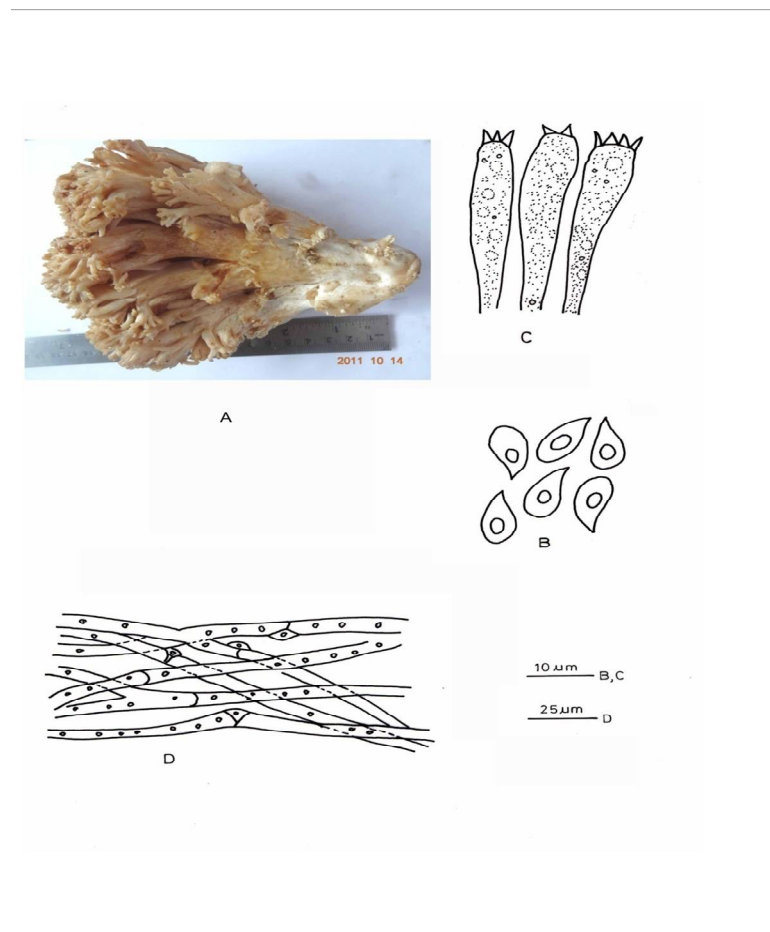


Fig: 1 (A-D)
***Ramaria botrytis* (Fr.)**
Ricken

- A. Basidiocarp
- B. Basidiospores
- C. Basidia
- D. Pileus surface

International Journal of Innovative Research in Science, Engineering and Technology

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Vol. 5, Issue 3, March 2016

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