

Systematic Studies on Wild Edible Mushroom *Clavulina rugosa* (Coker, 1923) Comer, Collected From Shimla Hills Situated In Himachal Pradesh, India

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ABSTRACT: *Clavulina rugosa*, commonly known as the wrinkled coral fungus belonging to the family Clavulinaceae. It is edible. Fruit body is, white or cream, solitary, gregarious, simple or with a few antler-like side branches. The surface is often wrinkled and uneven. Spores are white, broadly ovoid-ellipsoid to subglobose, 9–14×8–12 μ . Habitat terrestrial, in woods. Season late summer to late autumn. *Clavulina rugosa* is fairly easily identified by its unbranched or sparingly branched structure, its white color, its rugged surface, and its blunt branch tips. In the present study, *Clavulina rugosa* is being described from Shimla hills of Himachal Pradesh. Its habit, habitat, taxonomic features, edibility and ethnomycological details have been incorporated in this paper.

KEYWORDS: coral, ethnomycological, Hymenium, Melzer's reagent, Lactophenol., camera lucida., *Clavulina rugosa*

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 bisporous*, *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, 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 *Clavulina rugosa*, to work out its systematic study. The systematic study was conducted by:

- i) Making frequent trips during rainy/winter seasons to collect mushroom specimens;

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- 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 *Clavulina rugosa* 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.
- 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**

¹ Chhota Shimla, Glen, Gavahi, Navbahar, (Shimla).

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- 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 this wild edible mushroom 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

Clavulina rugosa (Coker, 1923) Comer, Fig.1 (A-D).

Fruiting body: 4-12cm high to 1.5cm wide divided several times (often appearing antler like). **Branches:** rugged creamish, sometimes developing yellowish tint with age, yellow when dried, tips coloured like the sides, blunt or occasionally Cristae with several sharp points. **Base** not clearly separated from the upper portion of the fruiting body. **Flesh :** whitest fairly tough and taste not distinctive. **Basidia:** clavate, 40-85×6.0-9.5 µm, 2-strigmate with 6-9 µm long sterigmata, incurved sterigmata, clamp connections present. **Basidiospores:** 9-14 × 8-12.0 µm, subglobose or broadly elliptical, smooth with an apiculus. Odor and Taste: Not distinctive. Spore Print: White. Chemical Reactions: Irons salts negative on branches.

Collections examined: H.P., Shimla, Navbahar, July. 13, 2011, HPUB 5011; H.P., Shimla, Chhota Shimla, Aug. 03, 2011, HPUB 5012; H.P., Shimla, Glen Sept. 15, 2011, HPUB 5013; H.P., Shimla, Gavahi, Aug. 13, 2013, HPUB 5014.

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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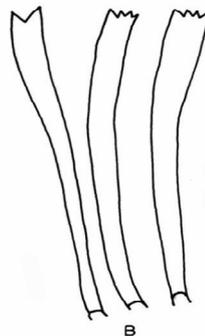
Edibility: Phillips (1981), Weber and Smith (1985).Excellent edible species.

Habit and Habitat Ecology

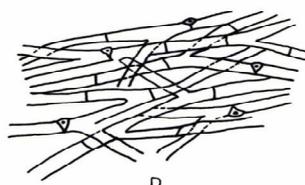
Presumably mycorrhizal; found under conifers and hardwoods; growing alone, gregariously, or in clusters; summer and fall (over winter in warm climates)..It grows in mixed forests of *Pinus wallichiana* (A.B.Jackson) *Picea smithithiana* (Wallich.), *Cedrus deodara* (Roxb.), *Quercus incana* (Roxb.) *Q. semicarpifolia* (Smith), *Quercus dilata* (Lindl.) and *Abies pindrow* (Spach.) *Rhododendron arboreum* (Smith) at an elevation ranging 1800 to 2800m



A



B



D



C

10 μm B,C

25 μm D

Fig: 1 (A-D)

***Clavulina rugosa* (Coker,1923)
Comer**

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

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