



## Three new records of Poroid Aphylophorales to Indian fungal flora from Pune district

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### Abstract

Pune is an important district of Maharashtra. Western Ghats of Pune districts is very much rich in the fungal flora of fleshy as well as wood rotting fungi. Three records namely *Phellinus arctostaphyli* (Long) Niemelä., *Phellinus sanfordii* (C.G. Lloyd) Ryvar den & *Podoscypha petaloides* (Berk.) Boidin are the valuable additions to the total count of Aphylophoraceous fungal diversity from India for the first time.

**Key words** – Basidiomycetes – fungi – semi-evergreen forest – Western Ghats

### Introduction

The major importance of the species of Aphylophorales as a whole is their saprobic activities as decomposers, particularly in the degradation of cellulose and lignin. Many Aphylophorales species decay wood of trees that are already dead, but some particular species in the families Polyporaceae, Hymenochaetaceae, Stereaceae and Hericiaceae, are known to enter the wounds in living trees and to make their way to the heartwood. These species make the way by a series of physical and chemical changes that overcome the natural defenses of the tree. (Alexopoulos et al.2002). A total of more than 190 genera of 52 families and total 1175 species of from poroid and non-poroid Aphylophorales fungi were reported from Indian literature till date. (Ranadive 2013) Three records namely *Phellinus arctostaphyli* (Long) Niemelä, *Phellinus sanfordii* (C.G. Lloyd) Ryvar den & *Podoscypha petaloides* (Berk.) Boidin (Table 2) are the valuable additions to the total count of Aphylophoraceous fungal diversity from India for the first time. (Ranadive 2012)

### Pune District

Pune, an important district of Maharashtra is located between 17°52' to 19°23'North and 73°20' to 75°10' East and extends over an area of 15, 640 sq. kms. It has a near triangular shape with its base coinciding with the continental divide, which marks the boundary between the plateau on the East and the Konkan to the West. (Fig. 2) It extends South-South-Eastwards over a distance of approximately 212 kms. Along the Sahyadri ranges, it has a North South width of about 150 kms. Pune District is in the Western region in Maharashtra in India. It is bounded by Thane District to the North-West, Raigad District to the West, Satara District to the South, Solapur District to the South-East, and Ahmednagar District to the North and North-East. Pune district lies in the Western Ghats or Sahyadri mountain range and it extends on to the Deccan Plateau on the East. Pune stands on the

leeward side of the Western Ghats. Pune is at an altitude of 567.842 m. (Anonymus 1976). The whole of the forest area in the Pune district falls under “reserved” forests category. Some of the localities show mixed type of forests in which we could get the different patches of different types of vegetation. (Table 1, Fig. 1) As the forest type changes, the Aphyllophorales fungal flora also shows the variation in the forms. The investigation area shows following types of forests in all 15 major localities from the Western Ghats of Pune district namely Tropical stunted semi-evergreen forest, Tropical stunted semi-evergreen forests and scrubby woodlands, Tropical moist deciduous forests, Tropical moist deciduous forests and scrubby woodlands and Tropical dry deciduous forests. (Anonymous 1954, Anonymous 1976)

### **Materials and Methods**

Collection and preservation of samples – During the collection tours the fungal material, mostly dead twigs and wood with basidiocarps were examined using a 3 fold pocket lens (15X) and kept in the zip lock polythene bags as well as some times paper bags. This method though it appears simple, needed extensive screening of maximum fallen twigs, bark and wood, dead wood, dead roots of trees as well as the infected trees and shrubs. This was done during all seasons but the collections were abundant after rainy season. The specimens were brought to the laboratory and examined under a Milhard-SBM 02 stereo-binocular to observe position of the basidiocarps, their gross morphology, shape, size colour of the basidiocarp, presence or absence of the appendages etc. All the specimens described are labeled and deposited in the Department of Botany, University of Pune, Pune-411007. The collected materials were kept in brown paper folders of size 20 x 15 cms prepared from paper of 29 × 33 cms size with label (Size 16.5 × 7.5 cms). The specimens were photographed with the help of Panasonic FZ-50 (Pro-SLR) camera to get the best result showing all Macro-morphological details of the specimen. Selection of the quality photographs was done by checking its zooming quality.

Microscopic examinations – Free hand sections of the basidiocarp were taken carefully and primary observations were made using lacto-glycerin mounts to see the colour of basidiospores, setae and other elements of the section. Sections were also stained in cotton blue and mounted in lacto-glycerin. For microscopic examinations of the basidiocarps, the specimens are sectioned along the tubes with razor blades for noting down the shape, size and dimensions of the hyphae, spores, basidia, and various setal elements. In poroid samples, the pore mouths are mostly sterile and a fertile hymenium is found a certain distance beyond the pore mouths where spores and possibly cystidia may be observed. A small context of pileal cover maybe mounted in the same preparation. The sections mounted in 5 % KOH, can easily be squashed with a gentle tap on the coverslip and it facilitates the recording of hyphal morphology and dimensions. The spore measurements were taken from thin sections or hymenial squashes and should mostly based on the observations on spores not yet detached from their basidia. Basidiocarps and hyphae were also stained with Melzer’s reagent (IKI). If they are yellow to nearly colourless they are said to be inamyloid or IKI –ve. The reaction is said to be amyloid if they turn grey or blue and dextrinoid if becomes reddish brown. Microscopic details of various representative areas of the basidiocarp, hyphal system and spores were studied as suggested by Teixeira (1962 b). Camera lucida sketches were also made for all materials with prism type camera lucida. Measurements of the basidia, cystidia, setae, spores were made by ocular of ERMA INC , made in Japan and objective micrometer of ERMA TOKYO company and eyepiece micrometer under 10X, 45X, and 100X objectives. For fructification, measurements were taken 5–10 times and average values were recorded. Identification was done by using standard literature.

### **Observations & Results**

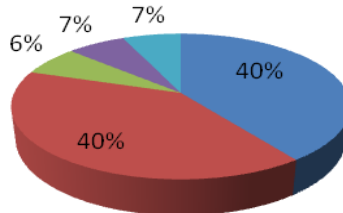
During field and literature surveys, a rich mycobiota was observed in the vegetation of India. The heavy rainfall and high humidity favours the growth of Aphyllophoraceous fungi. The present work materially adds to our knowledge of Poroid and Non-Poroid Aphyllophorales from all over India. A total of more than 190 genera of 52 families and total 1175 species of from poroid and non- poroid Aphyllophorales fungi were reported from Indian literature till 2012.(Ranadive 2013) In the present study a total of 20 species of Aphyllophorales (8 families and 14 genera) from the 10 respective hosts were identified out of 126 collected

**Table 1** Forest Types in Western Ghats of Pune District. (Anonymous 1954, Anonymous 1976)

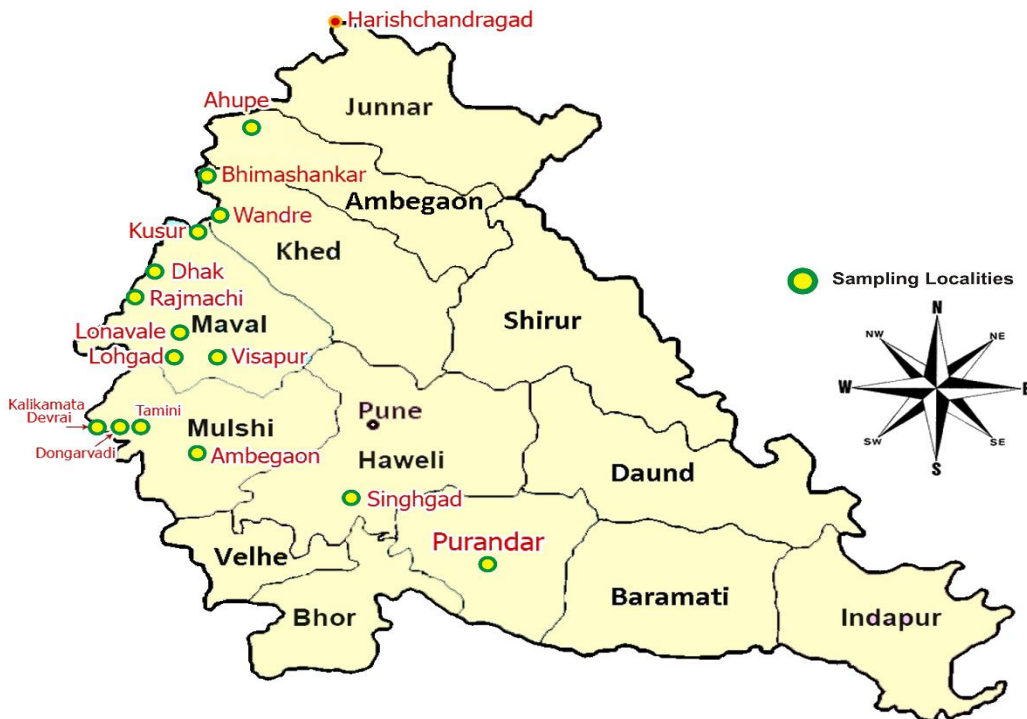
Type of Forest	Percentage
Tropical stunted semi-evergreen forest	40%
Tropical stunted semi-evergreen forests and scrubby woodlands	40%
Tropical moist deciduous forests	6.66%
Tropical moist deciduous forests and scrubby woodlands	6.66%
Tropical dry deciduous forests	6.66%

### Forest Types in Western Ghats of Pune District

- 1 Tropical stunted semi-evergreen forest
- 2 Tropical stunted semi-evergreen forests & scrubby woodlands
- 3 Tropical moist deciduous forests
- 4 Tropical moist deciduous forests & scrubby woodlands
- 5 Tropical dry deciduous forests



**Fig. 1** – Forest types in Western Ghats of Pune District (Anonymous 1954, Anonymous 1976)



**Fig. 2** – Localities of Western Ghats of Pune District

specimens from 15 different localities throughout the Western Ghats of Pune districts, Maharashtra State. (Ranadive 2012) Western Ghats of Pune district shows three new locality records of the species for India for the first time namely *Phellinus arctostaphyli* (Long) Niemelä, *Phellinus sanfordii* (C.G. Lloyd) Ryvarden & *Podoscypha petaloides* (Berk.) Boidin.

*Phellinus* Quel. Elench. Fung. p. 172, 1886.

The genus is wide spread in distribution with 427 known species from world and 96 from India. Basidiocarp pileate to resupinate, perennial, rarely annual, pileus dark brown to black in species with a crust, more rarely pale ochraceous, hirsute to glabrous, often sulcate now and then radially cracked in older basidiocarps, pores variable, but mostly small, tubes usually stratified, context thin and dense.

### Key to *Phellinus* species

1 Pileus 8 to 10 cm long and wide and 3.5 to 4 cm thick at the base, woody hard; pileus tomentose, rusty brown in narrow sulcate zones, in older specimens becomes glabrous grey to black, spores  $2.5-4 \times 2-3 \mu\text{m}$  long, pore surface rusty to snuff brown, pores round, small, 6-8 per mm ..... *Phellinus sanfordii*

2 Pileus 1-9 cm wide and 1-3.5 cm thick; upper surface quickly becoming glabrous and crustose, grayish, sulcate, becoming blackened and rimose with age, basidiospores ovoid, flattened on one side, hyaline, smooth, with slightly thickened walls, cyanophilous,  $4-5 \times 2-3.5 \mu\text{m}$ . pores circular, 4-6 per mm ..... *Phellinus arctostaphyli*

*Phellinus arctostaphyli* (Long) Niemelä. Ann. Bot. Fenn. 12:120. 1975. Figs 3-A & 4-1

Basidiocarps perennial, sessile, applanate to unguulate, dimidiate, 1-9 cm wide and 1-3.5 cm thick; upper surface quickly becoming glabrous and crustose, grayish, sulcate, becoming blackened and rimose with age; margin concolorous to light brown, rounded; pore surface pale grayish brown to dark rusty brown, smooth, the pores circular, 4-6 per mm, dissepiments thick, tomentose, entire; context reddish brown, azonate, fissile, firm, woody, up to 2 cm thick, tube layers indistinctly stratified, up to 1 cm thick. Contextual setae absent. Hymenial setae present  $26.25 \times 10 \mu\text{m}$ , pointed with broad base, dark brown. Hyphae of fibrous context parallel, skeletal hyphae thick-walled, aseptate, with rare branching,  $2.5-3.75 \mu\text{m}$  in diam; Hyphae of trama parallel, skeletal hyphae thick-walled, dark brown in KOH, aseptate, with rare branching  $2.5-5 \mu\text{m}$  diam; generative hyphae hyaline to pale yellow, thin-walled, with simple septa and occasional branching,  $1.5-2.5 \mu\text{m}$  diam. Setal hyphae infrequent, thick-walled,  $3.75 \mu\text{m}$ . Basidiospores ovoid, flattened on one side, hyaline, smooth, with slightly thickened walls, cyanophilous,  $2.5-4 \times 2-3.5 \mu\text{m}$ .

Materials examined – On fallen stumps and dead branches, Ahupe (29/10/09) VKPO-265, 272, 271, On *Lagerstromia* sp., Unknown angiosperm, On fallen stumps, On dead standing tree, Dongarwadi (4/11/07, 7/5/07, 26/10/08) VKPO-102, 104, 105, 116, On dead angiospermic branches, Vinjai Devrai (12/11/08) VKPO-103, On fallen branches and stumps, Lohagad (18/10/08, 6/11/07) VKPO-106, 107, 111, On fallen stumps and parasitic on unknown angiosperm Lonawala (23/12/08) VKPO-109, 110, On fallen trunk of angiosperm Harishchandragad (23/3/08) VKPO-112, On unknown angiosperm as a parasite on bark, Kalkaimata Devrai (12/11/08) VKPO-114, On *Terminalia* sp., Lonawala-Kusoor (6/12/08) VKPO-115.

Remark – Typical white rot.

Distribution – Arizona, India.

*Phellinus sanfordii* (C.G. Lloyd) Ryvarden 1972 Norw. J. Bot. 19 (1972) 235; Ryvarden and Johansen (1980) 212. Figs 3-B & 4-2

Basidiocarps perennial, pileate, single to imbricate, semicircular, applanate to convex, 8 to 10 cm long and wide and 3.5 to 4 cm thick at the base, woody hard; pileus tomentose, rusty brown in narrow sulcate zones, in older specimens becomes glabrous grey to black, in zones from the base,

**Table 2** List of new Aphyllophorales records from India.

Family	Name of the fungus	Host	Type of basidiocarp	Locality
Hyemnochaetaceae	<i>Phellinus arctostaphyli</i> (Long) Niemelä.	On wooden stumps of <i>Lagerstromia</i> and <i>Terminalia</i> sp.	Applanate to Ungulate	Ahupe, Dongarwadi-Vinjai Devrai Lohagad, Lonawala, Harishchandragad, Kalkaimata Devrai Lonawala-Kusoor
	<i>Phellinus sanfordii</i> (C.G. Lloyd) Ryvardeen	On dead angiospermic wood	Pileate Single to imbricate	Lonawala
Meruliaceae	<i>Podoscypha petaloides</i> (Berk.) Boidin	On Fallen sticks of <i>Ficus</i> sp.,	Spathulate	Lonawala-Dhak Bhairi, Dhak Lohagad and Ahupe

margin fairly acute; pore surface rusty to snuff brown, pores round, small, 6–8 per mm, tubes indistinctly stratified, dark cinnamon to pale rusty brown, up to 1 cm long in each layer; context dark cinnamon, hard, up to 5 mm thick, separated from the tomentum by a black line. Hyphal system dimitic; generative hyphae simple-septate, hyaline, thin-walled, 1.5–2.5  $\mu\text{m}$ ; skeletal hyphae dominating, yellow to pale rusty brown, 3.75–6.25  $\mu\text{m}$ , rarely branched. Hymenial setae abundant, mostly ventricose but a few also acuminate, dark brown, straight or slightly allantoid thick walled, 12.50–26.25  $\times$  6–10  $\mu\text{m}$ . Basidia not seen. Basidiospores broadly ellipsoid, pale yellow, 2.5–5  $\times$  2.5–3  $\mu\text{m}$ .

Materials examined – On dead angiospermic wood, Lonawala (23/12/8) VKPO- 85, 83, 81.

Distribution – Sri Lanka, Pakistan India, and Japan.

Remark – The species is closely related to *P. extensus* and chiefly separated by its larger setae which are less ventricose than those of *P. extensus*.

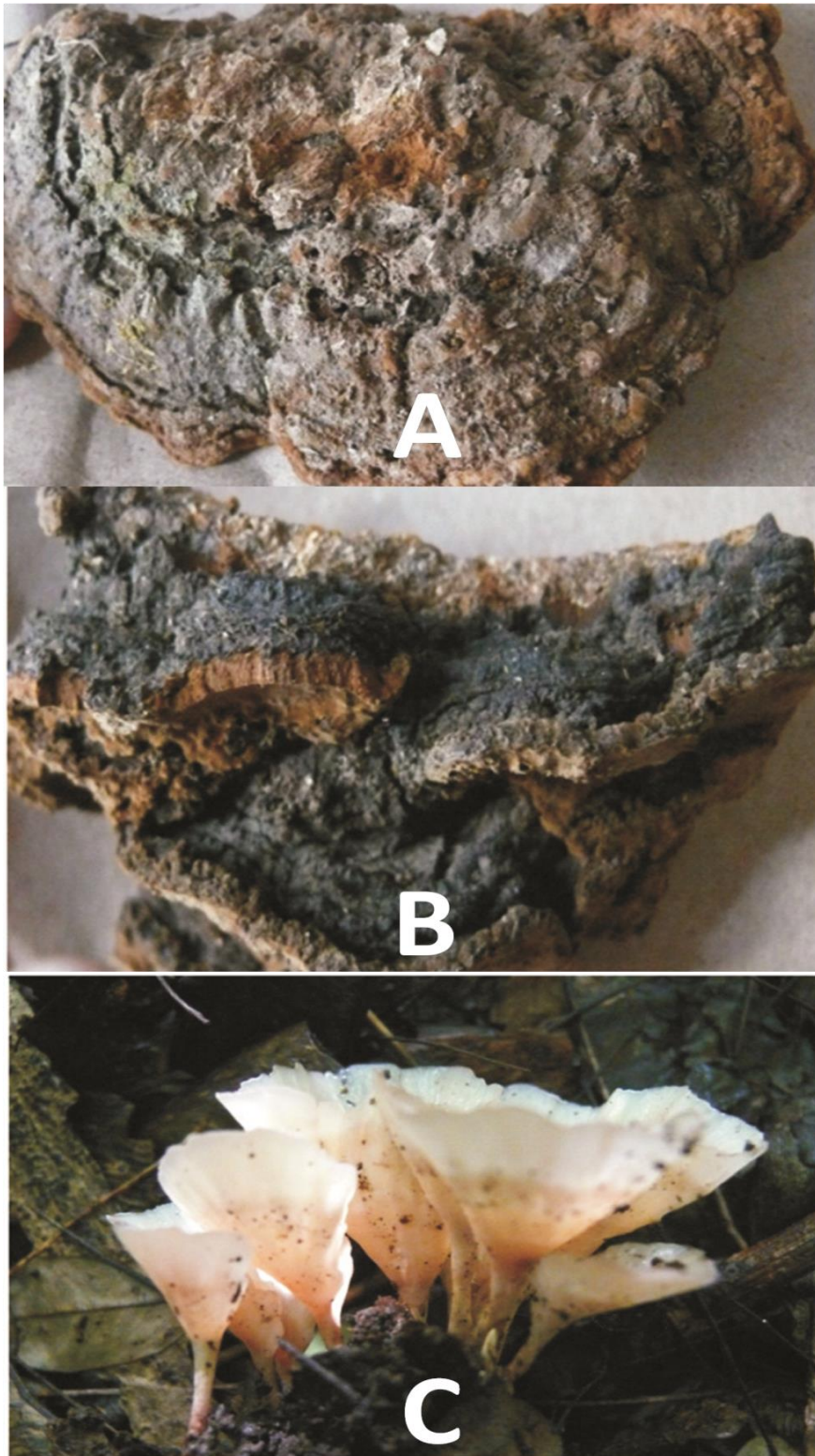
***Podoscypha*** Pat., Essai Tax. Hyménomyc. (Lons-le-Saunier): 70, 1900.

The genus is wide spread in distribution with 84 known species from world but no any report till date from India. *Podoscypha* is mainly characterized by the stipitate and flabellate basidiome, the dimitic hyphal system and the presence of gloeocystidia.

***Podoscypha petaloides*** (Berk.) Boidin 1959

Figs 3–C & 4–3

Basidiocarp 2–6 cm high and 1–2 cm wide. The basidiocarps are spatulate, although the edges of the pilei frequently curl inward and fuse to form pseudoinfunduliform fructifications. The basidiocarps are usually gregarious but discrete. Pileus when fresh varying from light brown to pinkish-brown after drying becomes chestnut-brown and ornamented with darker concentric zones. Hymenial surface of dried specimens either ochraceous- or greyish buff or concolourous with the pileus. Stipe short and rudimentary. Hyphal structure dimitic, consisting of generative and skeletal hyphae. The freely branched generative hyphae, 2–5  $\mu\text{m}$  in diam., are thin-walled, hyaline and bear clamp-connexions at the septa. The skeletal hyphae, 2.5 to 4.5  $\mu\text{m}$  in diam. are thick-walled and unbranched. However, there are subcylindric pilocystidia 12.50  $\mu\text{m}$ , on the surface of the cap which have a rather superficial origin. Hymenial cystidia are absent. Gloeocystidia abundant as elongated, thin-walled organs with highly refractive contents 40  $\times$  8  $\mu\text{m}$ . These bodies are basically subcylindric, swollen base and narrow gradually toward the obtuse apex. They have the potential of unlimited growth and many traverse the entire width of the thickened hymenium; some cease to grow and become buried but their place is taken by others which arise at almost any level. Basidia 4-spored, and clavate, 18  $\times$  9  $\mu\text{m}$ . Spores 2.75–3.75  $\times$  1.5–2.5  $\mu\text{m}$ , thin-walled, hyaline, mono-guttulate, varying in shape from ovate to elliptical.

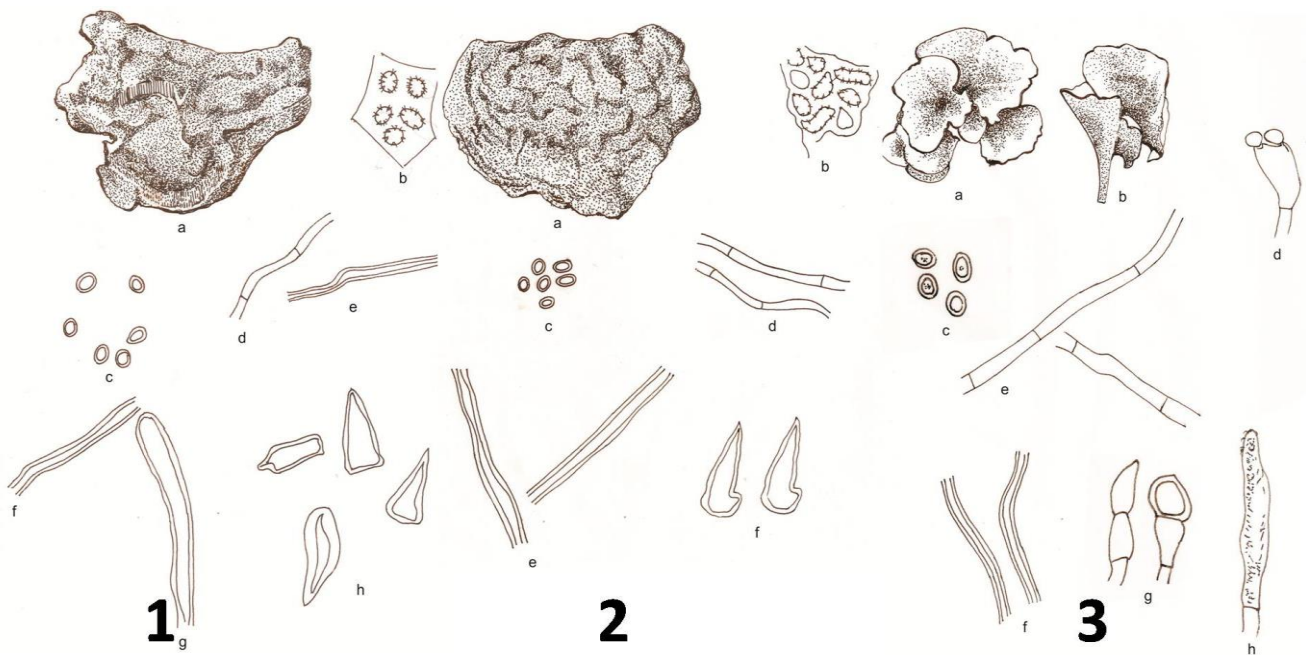


**Figs 3** – **A.** *Phellinus arctostaphyli* (Long) Niemelä., **B.** *Phellinus sanfordii* (C.G. Lloyd) Ryvardeen. **C.** *Podoscypha petaloides* (Berk.) Boidin.

Material examined – On dead wood of *Ficus* sp., Lonawala-Dhak Bhairi Dhak (2/11/08) VKPO-239, On dead stumps Lohagad (6/11/07) VKPO-264, On fallen branches of angiosperms, Ahupe (29/10/09) VKPO-289.

Distribution – America, Pacific Islands.

Remarks – The basidiocarp is very thin than that of *Microporus* and it is fleshy when fresh.



**Figs 4 – 1.** *Phellinus arctostaphyli* (Long) Niemelä. a. Habit, b. Pore shape, c. Basidiospores ( $2.5\text{--}4 \times 2\text{--}3.5 \mu\text{m}$ ), d. Generative hyphae ( $1.5\text{--}2.5 \mu\text{m}$ ), e. Skeletal hyphae ( $2.5\text{--}5 \mu\text{m}$ ), f. Hymenial setae ( $26.25 \times 10 \mu\text{m}$ )., 2. *Phellinus sanfordii* (C.G. Lloyd) Ryvarden a. Habit, b. Pore shape, c. Basidiospores ( $2.5\text{--}5 \times 2.5\text{--}3 \mu\text{m}$ ), d. Generative hypha ( $1.5\text{--}2.5 \mu\text{m}$ ), e., f. and g. Skeletal hyphae ( $3.75\text{--}6.25 \mu\text{m}$ ), f. Setae ( $12.50\text{--}26.25 \times 6\text{--}10 \mu\text{m}$ ). & 3. *Podoscypha petaloides* (Berk.) Boidin a. and b. Habit, c. Basidiospores ( $2.75\text{--}3.75 \times 1.5\text{--}2.5 \mu\text{m}$ ), d. Basidium ( $18 \times 9 \mu\text{m}$ ), e. Generative hyphae ( $2\text{--}5 \mu\text{m}$ ), f. Skeletal hyphae ( $2.5$  to  $4.5\mu\text{m}$ ) g. Pilocystidia ( $12.50 \mu\text{m}$ ), h. Gloeocystidium ( $40 \times 8 \mu\text{m}$ ).

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