

A TENTATIVE KEY TO IDENTIFY THE SPECIES OF *PHALLUS*

by

F. D. CALONGE

Real Jardín Botánico, CSIC, Plaza de Murillo 2. E-28014 Madrid, Spain.
e-mail: calonge@ma-rjb.csic.es

Summary. CALONGE, F. D. (2005). A tentative key to identify the species of *Phallus*. *Bol. Soc. Micol. Madrid* 29: 9-18.

A tentative key looking forward to get a tool to identify the different species of the genus *Phallus*, described in the world, is presented in this article. As a consequence of this study 25 species are accepted, including keys in English and Spanish. Several illustrations of some representative taxa are added.

Key words: *Basidiomycotina*, *Gasteromycetes*, *Phallus*, key, taxonomy.

Resumen. CALONGE, F. D. (2005). Clave provisional para identificar las especies de *Phallus*. *Bol. Soc. Micol. Madrid* 29: 9-18.

Se presenta una clave provisional, en inglés y español, dirigida a la identificación de las especies del género *Phallus* descritas en el mundo. Las especies incluidas, que suman 25, son las aceptadas en este artículo. Se añaden algunas ilustraciones de los táxones más representativos.

Palabras clave: *Basidiomycotina*, *Gasteromycetes*, *Phallus*, clave, taxonomía.

INTRODUCTION

Due to the great variability in size, shape and colour shown by the *Phallales*, the literature on the genus *Phallus* presents many imaginary taxa, which have been compiled in long synonymy lists (CUNNINGHAM, 1944; BOTTOMLEY, 1948; LIU, 1984). However, the main basic works, looking forward to the confection of a rational and practical key, are those by MÖLLER (1895), LLOYD (1909), LIU (1984) and KREISEL (1996).

The genera *Dictyophora* Desv., *Hymenophallus* Nees, *Ithyphallus* (Fr.) E. Fisch., *Aporophallus* A. Möller, *Itajahya* A. Möller, *Alboffiella* Speg., *Clautriavia* (Pat.) Lloyd and *Endophallus* M. Zang & R.H. Petersen have been assimilated for the confection of this key. The terminology used here is that published by CALONGE (1998).

Provisional key to the species of PHALLUS

- 1 Basidioma with a well-developed indusium.....2

- 1* Basidioma without indusium or with a rudimentary one (see *P. duplicatus*, *P. impudicus*, *P. nanchangensis*).....10
- 2 With echinate volva...*P. echinovolvatus* (M. Zang, D.R. Zheng & Z.X. Hu) Kreisel
- 2* With not echinate volva3
- 3 Indusium white and volva white or black.....4
- 3* Indusium or volva of different colours.....7
- 4 Receptacle (pileus) granulose, rugose or merulioid (pleated).....5
- 4* Receptacle reticulate.....6
- 5 With white volva...*P. merulinus* (Berk.) Lloyd
- 5* With black volva
.....*P. atrovolvatus* Kreisel & Calonge
- 6 Indusium 8-15 cm long.....
.....*P. indusiatus* Vent.: Pers.
- 6* Indusium 2-6 cm long.....7
- 7 Indusium white; volva deep red....*P. rubrovolvatus* (M. Zang, Ji & B. Liu) Kreisel
- 7* Indusium and volva orange yellowish or pale pinkish.....8
- 8 Indusium orange yellowish; volva dirty white to pale pinkish.....
.....*P. multicolor* (Berk. & Br.) Lloyd
- 8* Indusium and volva with reddish to brownish colours.....9
- 9 Indusium pinkish, 2-4 cm long; volva flesh coloured..... *P. duplicatus* Bosc
- 9* Indusium cinnabar-red, 5-8 cm long; volva grayish to dingy brown coloured.....
.....*P. cinnabarinus* (W.S. Lee) Kreisel
- 10 Receptacle with smooth or reticulate surface.....11
- 10* Receptacle with granulose, rugulose or merulioid surface.....19
- 11 Growing on dead wood.....12
- 11* Growing on soil.....14
- 12 With reticulate pseudostipe, up to 10 mm high, and smooth receptacle
.....*P. pygmaeus* Baseia
- 12* With not reticulate pseudostipe, more than 10 mm high, and reticulate receptacle.....13
- 13 With white pseudostipe, 25-33 mm high.....
.....*P. minusculus* Kreisel & Calonge
- 13* With yellow pseudostipe, 70-100 mm high.....*P. tenuis* (E. Fisch.) O. Kuntze
- 14 Without volva, but with a discoid base; pseudostipe 30-75 mm high.....*P. yunnanensis* (M. Zang & R.H. Petersen) Kreisel
- 14* With volva, but without a discoid base; pseudostipe 100-180 mm high.....15
- 15 Receptacle, pseudostipe and volva white.....*P. impudicus* L.: Pers.
There are varieties and forms with a rudimentary indusium: *P. impudicus* var. *obliteratus* (Malençon) Kreisel, *P. impudicus* var. *pseudoduplicatus* O. Andersson, *P. impudicus* f. *subindusiatus* Pilát, *P. impudicus* f. *velatus* Ulbr.
- 15* Receptacle, pseudostipe or volva not white.....16
- 16 Receptacle yellow and pseudostipe white.....*P. flavocostatus* Kreisel
- 16* Receptacle white and pseudostipe pinkish or whitish.....17
- 17 Pseudostipe and volva pale reddish.....*P. formosanus* Kobayasi
- 17* Pseudostipe white and volva with reddish tints.....18
- 18 With spores of 7-7.6 x 4- 4.7 µm; volva pale red.....*P. macrosporus* B. Liu, B. Li & Du
- 18* With spores of 3-5 x 1-2 µm; volva purple.....*P. hadriani* Vent.: Pers.
- 19 Receptacle surface merulioid.....
.....*P. caliendricus* Dring & R.W. Rayner
- 19* Receptacle surface not merulioid20
- 20 Receptacle surface wig-like..... 21
- 20* Receptacle surface granulose to rugulose.....22
- 21 Pseudostipe white.....
.....*P. galericulatus* (A. Möller) Kreisel
- 21* Pseudostipe pink.....*P. roseus* Delile
- 22 Receptacle conical, red; pseudostipe reddish orange.....*P. rubicundus* (Bosc)
Fr.= *P. rugulosus* (E. Fisch.) O. Kuntze
- 22* Receptacle globose or campanulate; pseudostipe white.....23
- 23 Receptacle globose.....
.....*P. glutinolens* (A. Möller) O. Kuntze
- 23* Receptacle campanulate.....24
- 24 Receptacle and pseudostipe white.....
.....*P. ravenelii* Berk. & M.A. Curtis
- 24* Receptacle and pseudostipe reddish.....25
- 25 Pseudostipe 3.5-4 cm high; orange red; with a

short indusium, double, up to 2 cm long, growing under trees in forest.....
*P. nanchangensis* Z.Z. He
 25* Pseudostipe 1-1.5 cm high; deep red; partially covered by a cylindrical sheath, under bamboo. *P. taibeiensis* B. Liu & Y.S. Bau (= *P. formosanus* Lee non Kobayasi)

Clave provisional para identificar las especies del género PHALLUS en el mundo
 (La terminología usada está basada en el trabajo de CALONGE, 1998)

- | | |
|---|---|
| 1 Basidioma con indusio bien desarrollado.....2 | 10* Receptáculo con la superficie granulosa, rugulosa o plisada..... 19 |
| 1* Basidioma sin indusio, o con indusio rudimentario (ver <i>P. duplicatus</i> , <i>P. impudicus</i> , <i>P. nanchangensis</i>).....10 | 11 Vive sobre madera muerta.....12 |
| 2 Con volva espinosa.... <i>P. echinvolvatus</i> (M. Zang, D.R. Zheng & Z.X. Hu) Kreisel | 11* Vive en tierra..... 14 |
| 2* Con volva lisa o rugosa.....3 | 12 Con pseudoestípite reticulado de hasta 10 mm de altura y receptáculo liso..... |
| 3 Con indusio blanco y volva blanca o negra....4 | <i>P. pygmaeus</i> Baseia |
| 3* Con indusio o volva de colores diferentes....7 | 12* Con pseudoestípite no reticulado de más de 10 mm de altura y receptáculo reticulado..... 13 |
| 4 Receptáculo (sombrero) con superficie granulosa, rugosa o plisada.....5 | 13 Con pseudoestípite blanco de 25-33 mm de altura. <i>P. minusculus</i> Kreisel & Calonge |
| 4* Receptáculo reticulado.....6 | 13* Con pseudoestípite amarillo de 70-100 mm de altura. <i>P. tenuis</i> (E. Fisch.) O. Kuntze |
| 5 Con volva blanca... <i>P. merulinus</i> (Berk.) Lloyd | 14 Sin volva, pero con una base discoidal; pseudoestípite de 30-75 mm de altura..... |
| 5* Con volva negra..... | <i>P. yunnanensis</i> (M. Zang & R.H. Petersen) Kreisel |
| <i>P. atrovolvatus</i> Kreisel & Calonge | 14* Con volva, pero sin base discoidal; pseudoestípite de 100-180 mm de altura..... 15 |
| 6 Indusio de 8-15 cm de longitud..... | 15 Receptáculo, pseudoestípite y volva blancos..... |
| <i>P. indusiatus</i> Vent.: Pers. | <i>P. impudicus</i> L.: Pers. Existen variedades y formas con indusio rudimentario; <i>P. impudicus</i> var. <i>obliteratus</i> (Malençon) Kreisel; <i>P. impudicus</i> var. <i>pseudoduplicatus</i> O. Andersson; <i>P. impudicus</i> f. <i>subindusiatus</i> Pilát, <i>P. impudicus</i> f. <i>velatus</i> Ulbr. |
| 6* Indusio de 2-6 cm de longitud.....7 | 15* Receptáculo, pseudoestípite o volva no blancos..... 16 |
| 7 Indusio blanco; volva de color rojo intenso. <i>P. rubrovolvatus</i> (M. Zang, Ji & B. Liu) Kreisel | 16 Receptáculo amarillo y pseudoestípite blanco..... <i>P. flavocostatus</i> Kreisel |
| 7* Indusio y volva de tono amarillo anaranjado o salmón pálido.....8 | 16* Receptáculo blanco, pseudoestípite de color salmón o blanquecino..... 17 |
| 8 Indusio amarillo anaranjado; volva de tono blanco sucio a salmón pálido..... | 17. Pseudoestípite y volva de color rojo pálido..... <i>P. formosanus</i> Kobayasi |
| <i>P. multicolor</i> (Berk. & Br.) Lloyd | 17* Pseudoestípite blanco, volva de tono rosado..... 18 |
| 8* Indusio y volva con tonos rojizos o parduzcos.....9 | 18 Con esporas de 7-7,6 x 4-4,7 µm, volva de tonos rosados. <i>P. macrosporus</i> B. Liu, B. Li & Du |
| 9 Indusio de tono rosado salmón, de 2-4 cm de longitud; volva de tono rosado carne..... | 18* Con esporas de 3-5 x 1-2 µm, volva de tonos púrpura..... |
| <i>P. duplicatus</i> Bosc | <i>P. hadriani</i> Vent.: Pers. |
| 9* Indusio de tono rojo cinabrio, de 5-8 cm de longitud; volva de tono gris parduzco..... | 19 Con la superficie del receptáculo plisada |
| <i>P. cinnabarinus</i> (W.S. Lee) Kreisel | <i>P. caliendricus</i> Dring & R.W. Rayner |
| 10 Receptáculo con la superficie lisa o reticulada..... 11 | 19* Con la superficie del receptáculo no plisada.....20 |

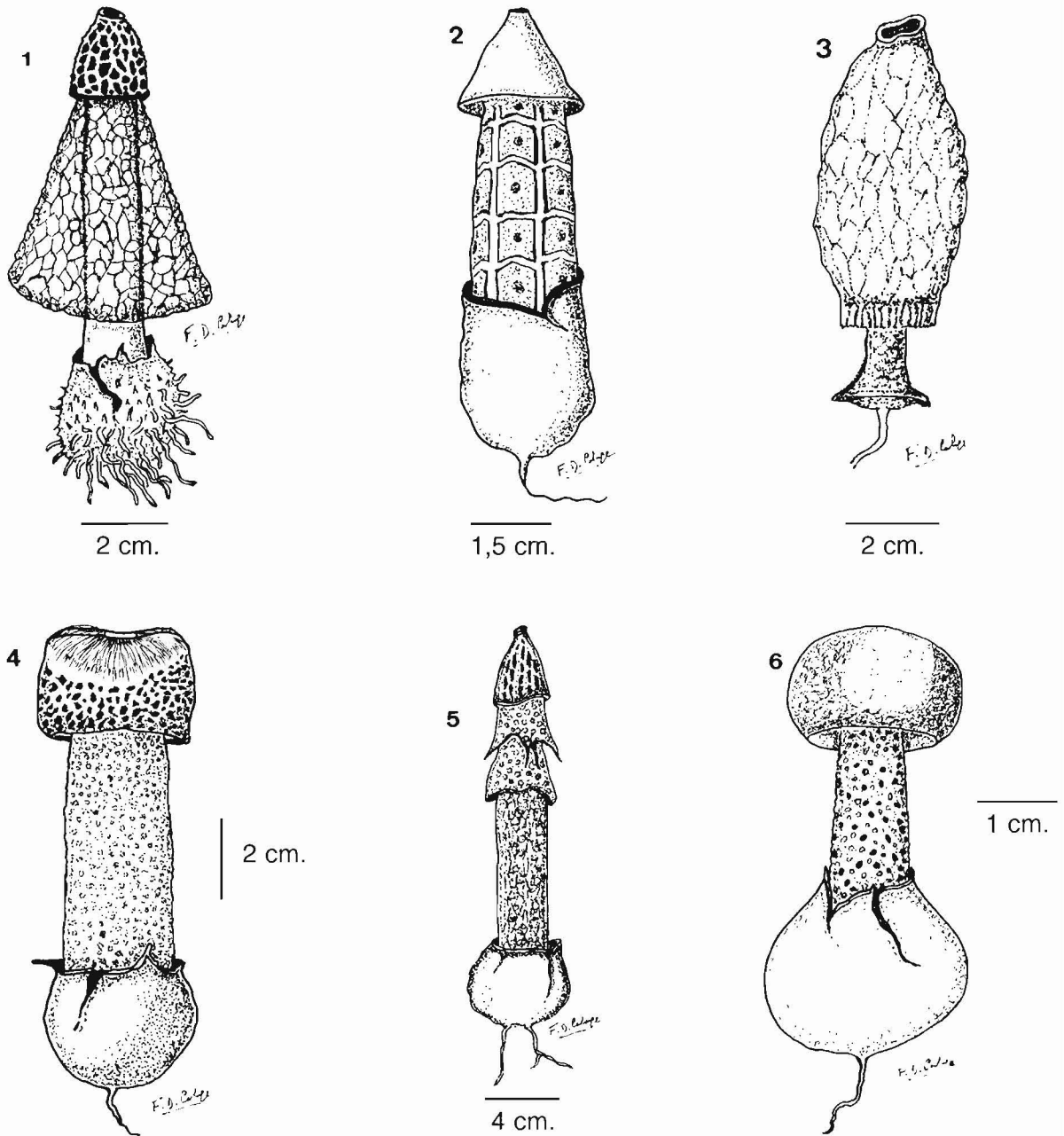


Fig. 1.- *Phallus echinovolvatus*. Diagrammatic representation of a mature basidioma showing reticulate receptacle, well-developed indusium and echinate volva. (Based on ZANG & *al.*, 1988). Fig. 2.- *Phallus pygmaeus*. Diagrammatic representation of a mature basidioma showing a typical reticulate pseudostipe. (Based on BASEIA & *al.*, 2003). Fig. 3.- *Phallus yunnanensis*. Diagrammatic representation of a mature basidioma showing a discoid base instead of a volva. The receptacle appears covered by a sheath attached to the receptacle surface. (Based on ZANG & PETERSEN, 1989). Fig. 4.- *Phallus galericulatus*. Diagrammatic representation of a basidioma showing a wig-like surface receptacle. (Based on MÖLLER, 1895). Fig. 5.- *Phallus nanchangensis*. Diagrammatic representation of a basidioma with a reticulate receptacle and double indusium. (Based on HE, 1989; LIU & *al.*, 2003). Fig. 6.- *Phallus glutinolens*. Diagrammatic representation of a mature basidioma showing a depressed-globose receptacle with granulose surface. (Based on MÖLLER, 1895).

- 20 Con la superficie del receptáculo en forma de peluca.....21
 20* Con la superficie del receptáculo granulosa o rugulosa.....22
 21 Con pseudoestípite blanco.....
*P. galericulatus* (A. Möller) Kreisel
 21* Con pseudoestípite de color salmón.....
*P. roseus* Delile.
 22 Receptáculo cónico, rojo; pseudoestípite rojo anaranjado.*P. rubicundus* (Bosc) Fr. =*P. rugulosus* (E. Fisch.) O. Kuntze
 22* Receptáculo globoso o campanulado, blanco, pseudoestípite blanco.....23
 23 Receptáculo globoso.....
*P. glutinolens* (A. Möller) O. Kuntze
 23* Receptáculo campanulado.....24
 24 Receptáculo y pseudoestípite blancos.....
*P. ravenelii* Berk. & M.A. Curtis
 24* Receptáculo y pseudoestípite de tonos rojizos..... 25
 25 Pseudoestípite de 3,5-4 cm de altura, rojo anaranjado, con indusio corto, doble, de hasta 2 cm de altura, vive debajo de árboles, *P. nanchangensis* Z.Z. He
 25* Pseudoestípite de 1-1,5 cm de altura, rojo carmín, cubierto parcialmente por una vaina cilíndrica, vive debajo de bambú.....
*P. taibeiensis* B. Liu & Y.S. Bau
 (= *P. formosanus* Lee non Kobayasi)

Doubtful species

- P. amurensis* (Jacz.) Pilát
P. callichrous (A. Möller) Lloyd
P. canariensis Mont.
P. costatus (Penz.) Lloyd
P. favosus (Penz.) E. Fisch.
P. fragrans M. Zang
P. lauterbachii (Henn.) Kreisel
P. moelleri Lloyd
P. novae-hollandiae Corda
P. subtilis (A. Möller) Lloyd

DISCUSSION

There are some species with a well taxonomic delimitation, like *P. echinovolvatus*, which shows white pseudostipe and indusium, reticulate receptacle and volva with mycelioid, echinulate projections, reminding the cactus ornamentation (Fig. 1) as described by ZANG & al. (1988). Other species with echinulate volva is *P. lauterbachii* only known in immature state unfortunately (LLOYD, 1909), which lacks of any indusium and shows meruloid receptacle surface. We consider this taxon, together with *P. favosus*, as doubtful since the holotypes of both are missing actually; thus, it is impossible their confirmation.

A unique species is *P. pygmaeus* (BASEIA & al. 2003) which besides its tiny size, up to 10 mm high, shows a reticulate pseudostipe (Fig. 2), while *P. minusculus* (Fig. 8), a similar little species, lacks of any reticulation on the pseudostipe (CALONGE & KREISEL, 2002).

In a parallel way of rarity, *P. yunnanensis* (ZANG & PETERSEN, 1989) lacks of any volva, but instead it shows a distinct discoid base (Fig. 3). On the other hand, *P. galericulatus* (MÖLLER, 1895) is another typical species, easy to identify by its wig-like receptacle surface (Fig. 4).

Phallus merulinus (LLOYD, 1909) and *P. atrovolvatus* (CALONGE & al., 2005) are close species, but the volva of the first is white and grows on the ground while *P. atrovolvatus* shows a blackish volva (Fig. 7) and grows on wood waste.

Regarding the receptacle shape, it may appear globose (Fig. 6) like in *P. glutinolens* (MÖLLER, 1895); campanulate like in *P. impudicus*, *P. indusiatus* (Figs.9-10); conical like in *P. rubicundus* (Figs. 11a, 11b), etc. The indusium may be rudimentary, like in *P. impudicus* var. *pseudoduplicatus* (Fig. 13); midway long like in *P. atrovolvatus* (Fig. 7), *P. duplicatus* (Fig. 14), *P. merulinus*, etc.; full-developed, like in *P. echinovolvatus*, *P. indusiatus* (Figs. 1, 10); or double, like in *P. nanchangensis* (Fig. 5), according to HE (1989). Sometimes the pseudostipe appears partially covered by a sheath, like in *P. impudicus* f. *velatus* and *P. taibeiensis* (Figs. 12, 15).

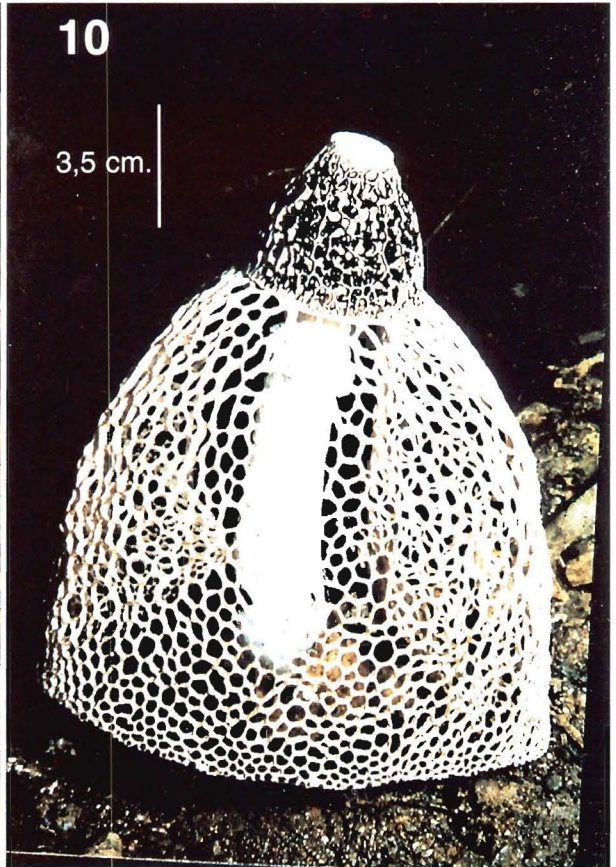
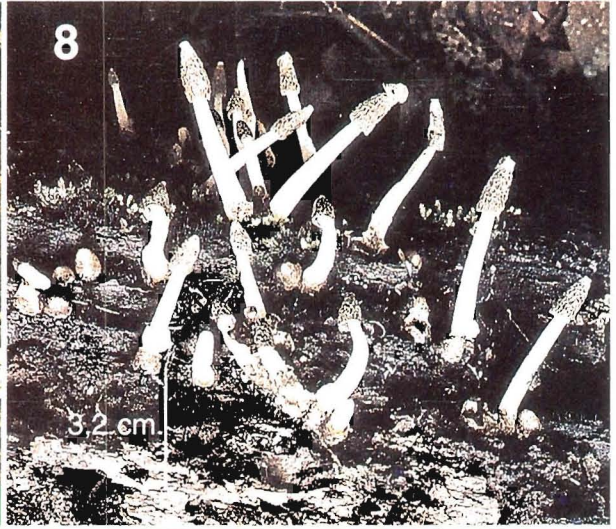


Fig. 7.- *Phallus atrovolvatus*. A colony of basidiomata in different degrees of development. The mature ones show merulioid surface receptacle and midway-developed indusium, but all them, mature and immature, present black volva. Fig. 8.- *Phallus minusculus*. A colony of mature basidiomata growing on dead wood with reticulate receptacle and white pseudostipe and volva. Fig. 9.- *Phallus impudicus*. Two basidiomata, immature and mature, with white reticulate receptacle, pseudostipe and volva. Fig. 10.- *Phallus indusiatus*. A mature basidioma showing a complete indusium

Finally, there are two species alike at a first look, which show a purple-reddish volva, *P. hadriani* (Fig. 16) and *P. macrosporus*, but easy to separate by the spore size: 3-5 x 1-2 μm in the first and 7-7.6 x 4-4.7 μm in the second (LIU & *al.*, 1980).

A big problem is the synonymy, with many names for few species. Thus, *P. inclusatus*, has been given under numerous names, which are synonyms; e. g. *P. callichrous*, *P. moelleri*, *P. tunicatus* Schlecht., *P. brasiliensis* Schlecht., etc. So as *P. rugulosus*, *P. novae-hollandiae*, *P.*

canariensis, *P. discolor* (Kalehbr.) Lloyd, *P. sanguineus* P. Henn., etc., as synonyms of *P. rubicundus* (CUNNINGHAM, 1944; LIU, 1984).

On the other hand, *P. fragrans* is alike to *P. nanchangensis*, with the only difference of the smell; very pleasant in the first and foetid in the second (FAN & *al.*, 1994). *Phallus favosus* is intermediate between *P. impudicus* and *P. tenuis*, with a thin receptacle and a pale yellowish pseudostipe. Difficult to separate each other



Figs. 11a, 11b.- *Phallus rubicundus* Basidiomata with conical, granulose receptacle, showing a reddish colour. (Photos: C. Gelpi). Fig. 12.- *Phallus impudicus* f. *retatus*. A basidioma showing a sheath on the upper part of the pseudostipe. (Photo: C. Gelpi). Fig. 13.- *Phallus impudicus* var. *pseudoduplicatus*. Several basidiomata showing reticulate receptacle and a rudimentary indusium (Photo: L. Romero de la Osa). Fig. 14.- *Phallus duplicatus*. Mature basidioma with reticulate receptacle, a short indusium and volva, showing a pale pinkish tone.

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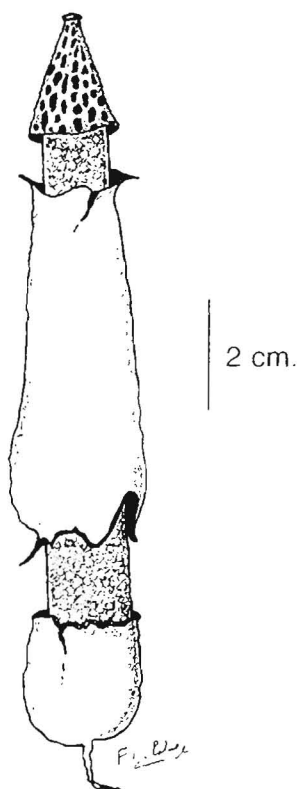


Fig. 15.- *Phallus taibeiensis*. Diagrammatic representation of a mature basidioma presenting a sheath covering most of the pseudostipe surface, becoming free at the ends. (Based on LIU, 1957). Fig. 16.- *Phallus hadriani*. Mature basidioma with a purple-reddish volva.

Phallus subtilis has only been found in Brazil and schematically described by MÖLLER (1895). According to LLOYD (1909), this species does not show any marked difference from any other small *Phallus*.

Phallus moelleri could be considered like a form of *P. indusiatus*, showing a narrow pileus and a rigid, spreading veil, as illustrated by MÖLLER (1895). The Brazilian material is so close to the type, *P. indusiatus*, that it is not possible to keep it distinct (LLOYD, 1909). On the other hand, it has been demonstrated that *P. taibeiensis* and *P. formosanus* Lee are synonyms, while *P. formosanus* Kobayasi is an independent species (KOBAYASI, 1938; LEE, 1957; LIU & BAU, 1982).

Finally, *P. amurensis* is another doubtful species, growing on *Abies* and *Picea* rotten wood in

the former URSS, which is very similar to *P. tenuis* (PILÁT, 1958).

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