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Anatomy of the peridium in the genus *Nidula* (Nidulariales, Basidiomycetes)

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The anatomic structure of the peridia of the basidiocarps in species of *Nidula* is described and illustrated. Fruit bodies were collected in the NW Patagonian region of Argentina. In addition, the type specimens of *Nidula candida* (Peck) White and *Nidula emodensis* (Berk.) Lloyd and other collections from a herbarium were also examined. Different kinds of peridia were found, ranging from one-layered peridia to five-layered peridia. This suggests that the anatomic structure of the peridium in *Nidula* cannot be used as a generic taxonomic character as is the case with the other Gasteromycetes.

Keywords: Basidiomycetes, taxonomy, morphology.

The basidiocarps of Gasteromycetes are characterised by peridia of various degrees of complexity, from one-layered peridia to five-layered peridia. Because of its consistency, each type of peridium is related to a specific genus (Domínguez de Toledo, 1993).

There is evidence, however, of slight variations in the anatomy of the peridium in a few genera. In *Arachnion* Schwein., for instance, species may possess either a one-layered or a two-layered peridium (Dominguez de Toledo, 1993). The genus *Pyrenogaster* Malençon & Riousset generally has a two layered peridium, although, sometimes there can be a third layer. In the genus *Radiigera* Zeller, the peridium is typically three-layered but may occasionally show a poorly developed fourth layer (Domínguez de Toledo & Castellano, 1996).

The family Nidulariaceae consists of five genera with varied peridial construction. *Nidularia* Fries has a thick one-layered peridium formed of rigid, spinose and branched coloured hyphae. In the genus *Mycocalia* J. T. Palmer the peridium is thin, formed of branched, septate, hyaline hyphae bearing clamp connections. *Crucibulum* Tulasne species have a thick, one-layered peridia whereas *Cyathus* Haller is characterized by a three-layered peridium (Brodie, 1975).

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The peridium of *Nidula* White was initially described as a single and homogeneous but layered membrane. Further studies have shown that the peridium in this genus is homogeneous in only one species, *N. macrocarpa* Lloyd. The anatomic structure of the peridium in the other three species, viz. *N. niveotomentosa* (Henn.) Lloyd, *N. candida* (Peck) White, and *N. emodensis* (Berk.) Lloyd is formed at least by two and possibly three layers (Brodie, 1975).

This paper presents detailed analyses of the anatomy of the peridium of the type species and different collections in the genus *Nidula*.

Materials and methods

The anatomy of the peridium of fruit bodies in a total of 41 collections belonging to the genus *Nidula* was studied. The material from Nahuel Huapi National Park, located in the west of the provinces of Neuquén and Río Negro (Argentina), is labelled BCRU and samples are deposited at the herbarium of the Centro Regional Universitario Bariloche, Universidad Nacional del Comahue. In addition, material from the herbaria LPS, BPI, NYS and K was examined, to investigate representatives of the four species included in the genus *Nidula*.

Medial parts of the peridium of young and mature specimens, previously soaked in water, were transversally cut by hand and using a Reichert's freezing microtome. Semipermanent preparations of the sections were included in Amann lactophenol and cotton blue (Hawksworth & al., 1995).

The structure of the peridium was illustrated by drawings obtained with a camera lucida mounted on a Leitz Laborlux 11 microscope, and with photographs. To describe the anatomy of the peridium, the nomenclature introduced by Stärback (1895) for different types of hyphal tissues (texturae) when dealing with discomycetes has been used.

Results

Five types of peridial texture were observed in the 41 collections of *Nidula* (Fig. 1). Each of the five types are described below.

One-layered peridium: (Figs. 1A, 2, 9A) This kind of peridium is composed by a homogeneous, 140–250 µm thick, hyphal layer (b) of "intricata" texture, chestnut-brown in color, somewhat denser in the central part. Towards the exterior, hairs (c) are formed from chestnut-brown hyphae. These hyphae are thick-walled, with short lateral projections. The peridium has an internal tissue composed of disin-

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tegrated, gelatinous hyphae (a), 5–10 µm thick, that gives a smooth appearance to the interior part of the fruit body. This kind of internal tissue is found in all types of peridia.

Material examined. – BCRU 759; LPS 26179; BPI 703898; BPI 728200.

Two-layered peridium: (Figs. 1B, 3, 9D) Two hyphal layers of "intricata" texture are present: a very dense chestnut-brown, 80–140 µm thick, inner layer (d), and an outer, 115–370 µm thick, lax layer (e), with hyaline hyphae of a chestnut tinge. Thick hairs (f) of aggregated hyphae are formed.

This two-layered structure is repeated in the majority of the remaining types of peridium (from three to five layers), adding an extra layer each time.

Material examined. – BCRU 1727; BCRU 1741; BCRU 1744; BPI 728165.

Three-layered peridium: Two different forms have been observed in the material examined.

Form 1 (Figs. 1C-1, 4, 9B). – In this form, a third hyphal layer is added to the structure of the already described two-layered peridium. The third layer is a loose "intricata" texture (g) composed of hyaline, 100–330 µm thick hyphae. From this third layer, hyphal tufts arise (h).

In some collections the three layers are hyaline.

Material examined. – BCRU 525; BCRU 1038; BCRU 1113; BCRU 1728; BCRU 1730; BCRU 1733; BCRU 1736; BCRU 1743; BCRU 1745; BCRU 1839; BCRU 1841; BCRU 1840; BCRU 1843; LPS 37551; NYS 1966a (type of *Nidula candida*).

Form 2 (Figs. 1C-2, 5, 9C). – This type of peridium differs from the form 1 in that the third 380–460 µm thick layer (i) is formed of thick hairs joined among themselves in the upper part by horizontally disposed hyphae. Among the hairs it is possible to observe hyphae, clearly separate from each other, growing on the second layer.

This is a rare structure that was found in only one collection.

Material examined. – BCRU 1732.

Four-layered peridium: (Figs. 1D, 6, 9F) The peridium has three internal layers comparable to those of the three-layered form 1, with the addition of a fourth hyaline, 380–390 µm thick layer (j), composed of hyphae in densely grouped vertical "columns", joined among themselves in the upper part by a group of horizontally dis-

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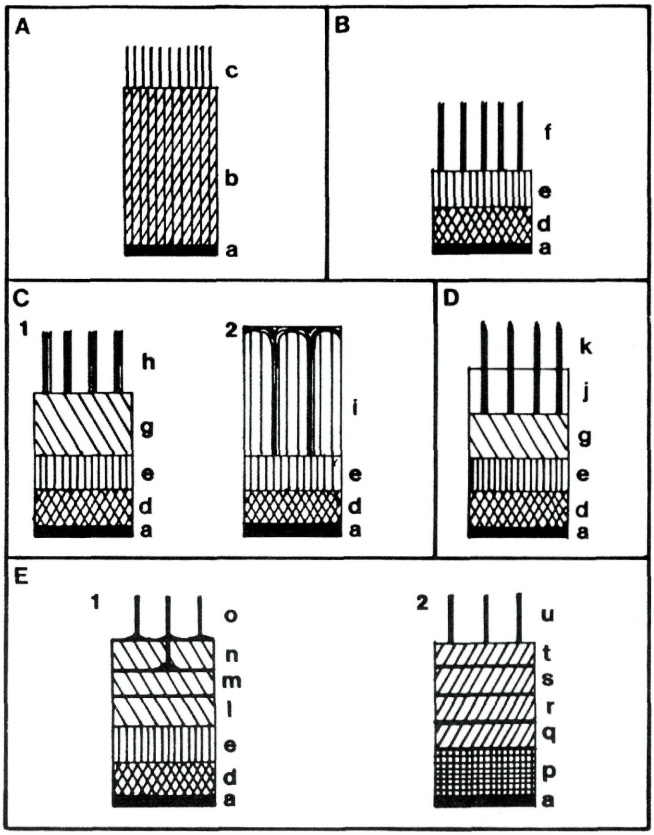

Fig 1. – Schematic representation of the types of peridium in the genus *Nidula* White. – A: one-layered. – B: two-layered. – C: three-layered; 1: three-layered form 1; 2: three-layered form 2. – D: four-layered. – E: five-layered; 1: five-layered form 1; 2: five-layered form 2.

posed hyphae from which arise approximately 370 µm long hairs (k), made up of aggregated hyphae.

Material examined. – BCRU 1729; BCRU 1734; BCRU 1735; BCRU 1737; BCRU 1738; BCRU 1742; BCRU 1740; BCRU 1838; LPS 39669.

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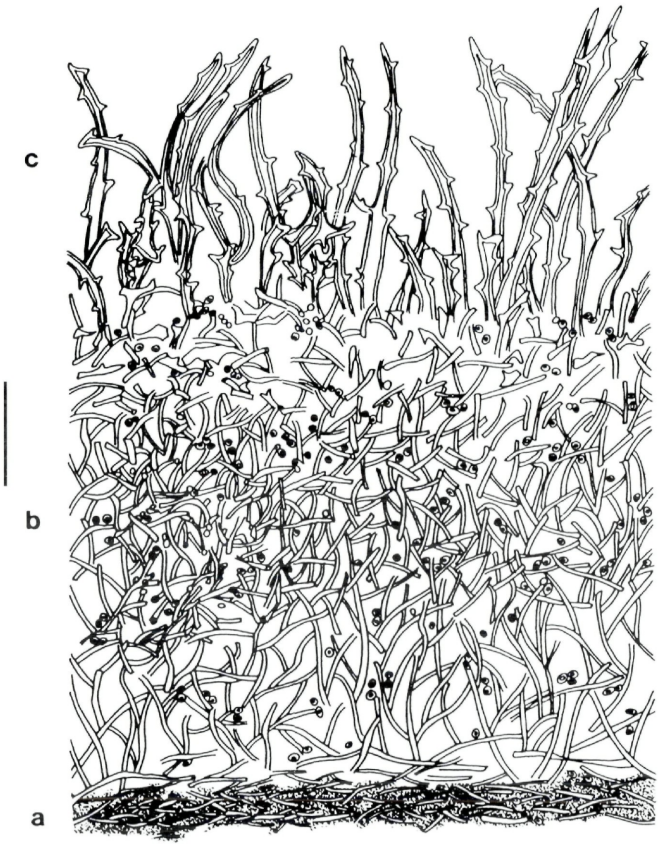

Fig 2. – Section through a one-layered peridium. – a: internal edge of disintegrated hyphae. – b: homogeneous hyphal layer. – c: external hairs. – Bar: 50 µm.

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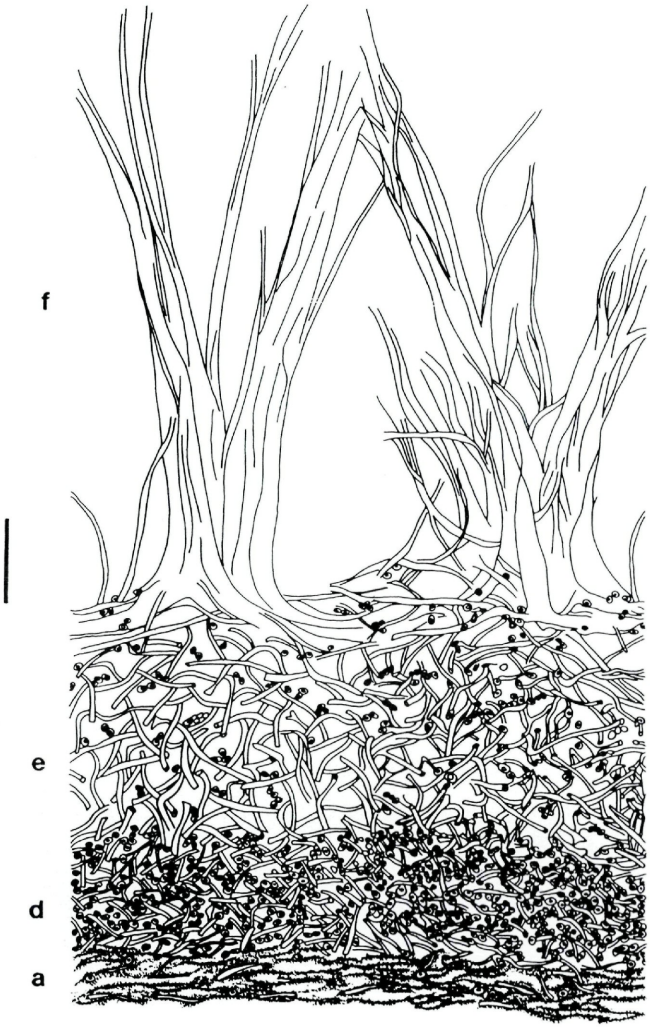

Fig 3. – Section through a two-layered peridium. – a: internal tissue of disintegrated hyphae. – d: inner hyphal layer. – e: outer hyphal layer. – f: hairs. – Bar: 50 µm.

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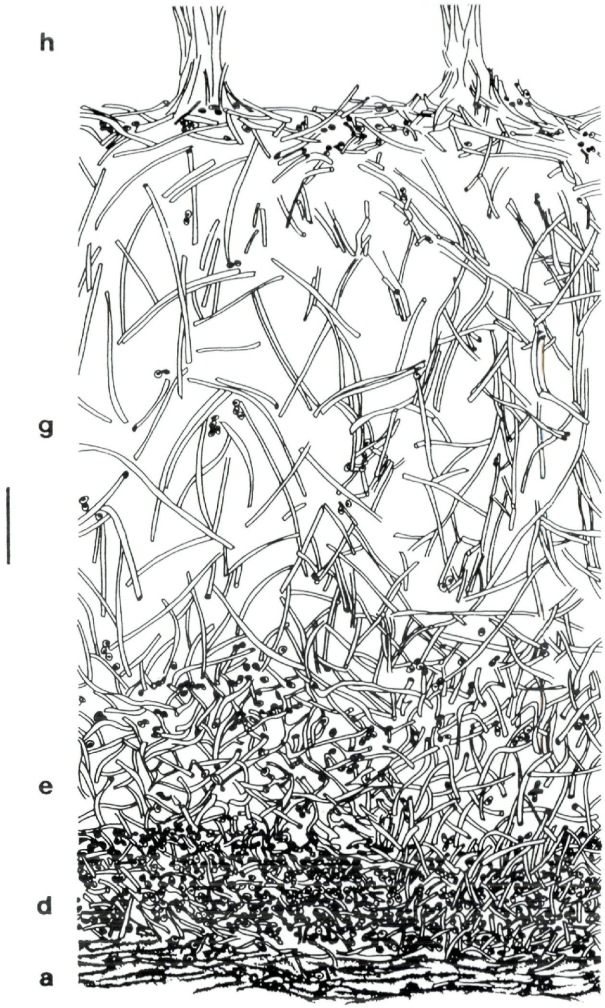

Fig 4. – Section through a three-layered form 1 peridium. – a: internal edge of disintegrated hyphae. – d: first hyphal layer. – e: second hyphal layer. – g: third hyphal layer. – h: hairs. – Bar: 50 µm.

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Fig 5. – Section through a three-layered form 2 peridium. – a: internal edge of disintegrated hyphae. – d: first hyphal layer. – e: second hyphal layer. – i: third layer. – Bar: 50 µm.

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Fig 6. – Section through a four-layered peridium. a: internal edge of disintegrated hyphae. – d: first hyphal layer. – e: second hyphal layer. – g: third hyphal layer. – j: fourth layer. – k: hairs. – Bar: 100 µm.

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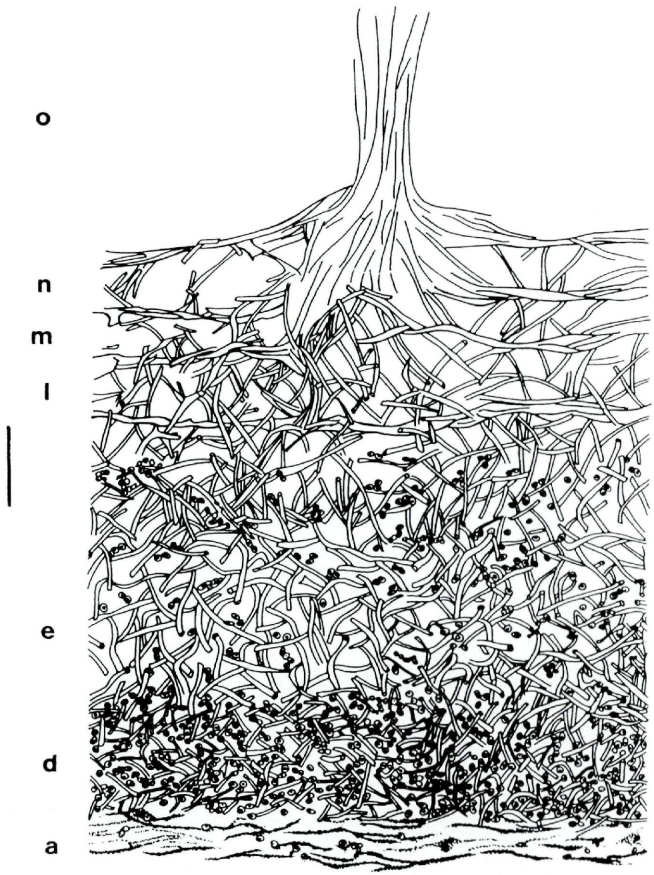

Fig 7. – Section through a five-layered form 1 peridium. – a: internal edge of disintegrated hyphae. – d: first hyphal layer. – e: second hyphal layer. – l: third hyphal layer. – m: fourth hyphal layer. – n: fifth hyphal layer. – o: hairs. – Bar: 50 µm.

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Fig 8. – Section through a five-layered form 2 peridium. – a: internal edge of disintegrated hyphae. – p: first hyphal layer. – q: second hyphal layer. – r: third hyphal layer. – s: fourth hyphal layer. – t: fifth hyphal layer. – u: hairs. – Bar: 50 µm.

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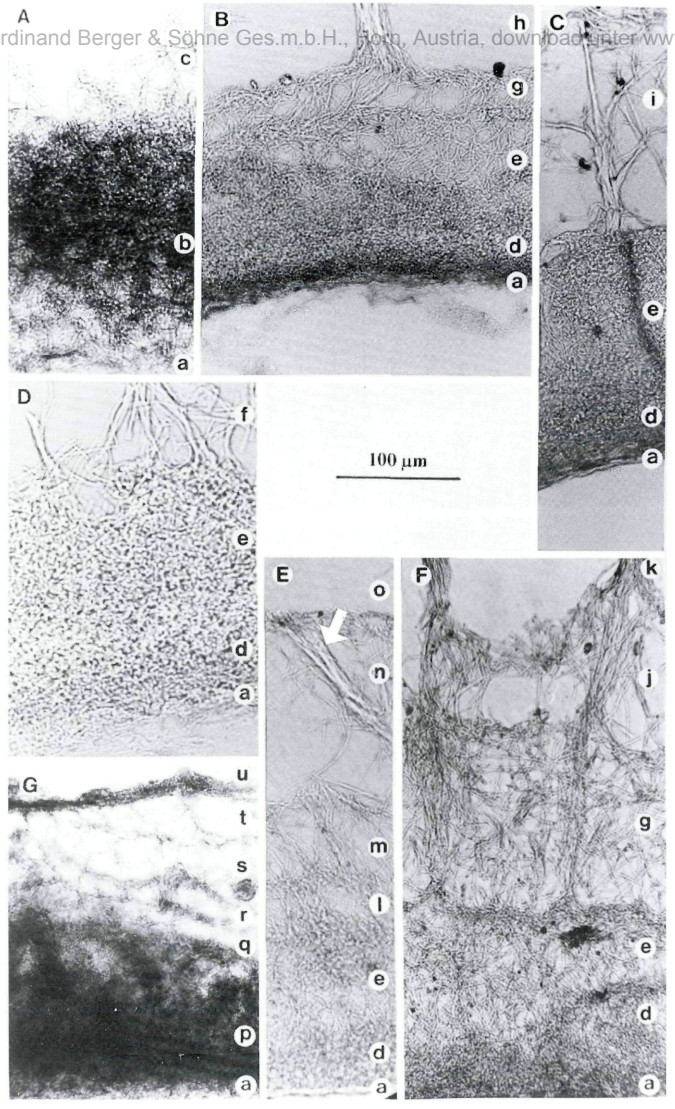

Fig 9. – Sections through the different types of peridia. – A: one-layered peridium. – B: three-layered peridium form 1. – C: three-layered peridium form 2. – D: two-layered peridium. – E: five-layered peridium form 1 [the arrow indicates the hairs (o)]. – F: four-layered peridium. – G: five-layered peridium form 2. – a–u: see captions of figs. 2–8.

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Five-layered peridium: Also in this type two forms have been observed.

Form 1 (Figs. 1 E-1, 7, 9E). – The two internal layers are similar in structure, size and colour to those of the two-layered peridium, and the remaining three outermost layers are hyphal strata of very lax "intricata" texture (l, m, n); they are separate from each other by a cord of grouped hyphae. Each layer may vary in thickness between 50 and 180 µm, sometimes reaching up to 290 µm. The hairs (o) come out of the cords of hyphae passing through the last three layers or only the last two layers.

In some cases all the layers in this type of peridium may be chestnut-brown, matching the colour of the fruit body.

Material examined. – BCRU 401; BCRU 1731; BCRU 1739; NYS 1966b; BPI 728166; BPI 728167; BPI 728168.

Form 2 (Figs. 1E-2, 8, 9G). – In this case, the two first layers of the peridium do not follow the pattern of the two-layered peridium otherwise found in all the types. The five layers are separated from each other by a cord of grouped hyphae. All the strata are chestnut-brown and have an "intricata" texture, the first one being more compact (p) and the remaining ones less compacted (q, r, s, t). Thickness varies from 40 to 160 µm. The hairs (u) have been observed as dense hyphal groups growing from the superior cord.

A special feature of this type of peridium is the presence of only three layers in some portions of the same fruit body. In these cases the thickness of the layers varies between 60 an 300 µm.

Material examined. – K 54746 (type of *Nidula emodensis*).

Discussion

The one-layered type of peridium is a characteristic structure of *Nidula macrocarpa* Lloyd and has been included in the description of the species (Brodie, 1975). This feature has never been found in the collections of the remaining species investigated here.

This is unique within the genus *Nidula* White, as the variation in the structure of the peridium is extreme, up to the point of finding two different forms in the same specimen. The structure of the five-layered form 2 peridium was observed only in the type specimen of *Nidula emodensis* (Berk.) Lloyd. As other collections of that species have not been examined, it is not possible to assert that this type of peridium is a specific characteristic as it is the case in *Nidula macrocarpa*.

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The *Nidula candida* (Peck) White type specimens present three-layered form 1 peridium, but other collections of the same species do not share this feature and possess a four-layered peridium.

Three-layered form 1 and form 2, and four-layered structures have been observed in the herbarium collections of *Nidula niveo-mentosa* (Henn) Lloyd and in collections with similar morphological characteristics that were collected in the area.

The remaining types of peridium (two and five-layered form 1) correspond to not yet identified collections of *Nidula* that have morphometric characteristics not agreeable with the original descriptions of the four known species. At present, intraspecific variability is being studied. There are also specimens among these collections that have three-layered form 1 peridium and four-layered peridia.

Initially, it was thought that the variations in the peridium structure would correspond to different development states of the fruit bodies. The study of young and mature specimens, however, confuted this hypothesis, as young basidiocarps present the same peridial structure than mature ones.

According to the results obtained it is possible to establish that, unlikely the rest of the Gasteromycetes, the anatomic structure of the peridium in the genus *Nidula* cannot be used as a character of taxonomic importance at generic or specific level because of the presence of various structural types in specimens of the same species. The constant presence of only one peridium structure has been confirmed only for *Nidula macrocarpa*.

Acknowledgments

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References

Brodie, H. J. (1975). The Bird's Nest Fungi. – University of Toronto Press, Toronto. 199 pp.

Dominguez de Toledo, L. S. (1993). Gasteromycetes (Eumycota) del centro y oeste de la Argentina. I. Análisis crítico de los caracteres taxonómicos, clave de los géneros y orden Podaxales. – Darwiniana 32(1–4): 195–235.

—— & M. A. Castellano (1996). A revision of the genera *Radiigera* and *Pyrenogaster*. – Mycologia 88(5): 863–884.

Hawksworth, D. L., P. M. Kirk, B. C. Sutton & D. N. Pegler (1995). Dictionary of the fungi. – International Mycological Institute, Surrey. 616 pp.

Stärback, K. (1895). Dyscomyceten-Studien. – Bih. Kongl. Svenska Vetensk.-Akad. Handl. Afd. 3, 21(5): 1–42, 2 pl.

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