

Aleuria bicucullata versus Aleuria luteonitens (Pezizales, Ascomycetes)

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On the basis of fresh material collected in the environs of Venlo (province of Limburg, The Netherlands), the author describes two species of the genus *Aleuria* which are extremely difficult to distinguish in the field. Microscopical studies proved this material to belong to *Aleuria bicucullata* (Boud.) Gillet and *A. luteonitens* (Berk. & Broome) Gillet. In the present paper these taxa are compared and contrasted in detail, with Table 1 listing the differences between them.

Key words: *Aleuria bicucullata*, *Aleuria luteonitens*, anatomical differences, *Ascomycetes*, *Ascomycotina*, *Pezizales*

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Introduction

It may safely be assumed that most mycologists are familiar with the widespread ascomycete *Aleuria aurantia* Pers., type species of the genus *Aleuria*. In 1988, the author (Billekens 1990) received a collection of a taxon closely related to this species. The specimens I examined from this collection were identified as (following Boudier 1905–1910; compare plates 317a–e and 318a–e) intermediate in habit, with young cup-shaped apothecia representing *A. bicucullata* (plate 318), and adult specimens being typical *A. luteonitens*, growing in dense groups, with in the centre a plicate-veined hymenium and an undulate margin (plates 317a and c). On the basis of an anatomical study I was able to identify the species as *Aleuria bicucullata* (Boud.) Gillet.

Aleuria bicucullata (Boud.) Gillet — Fig. 1

Champ. Fr. Disc.: 206. 1886. — *Peziza bicucullata* Boud., Bull. Soc. Bot. France 28: 93. 1881. — *Humaria bicucullata* (Boud.) Quél., Ench. Fung.: 288. 1886.

Apothecia sessile, in dense groups, 1.5–10 mm in diameter, 0.6–1.5 mm high, gymnohymenial.

Receptacle at first subspherical or reversed conical; later flat, cup-shaped, convex or irregular; obliquely flattened; with rounded, never torn, undulate margin (with age), pruinose, maize yellow (Methuen, 4A6, see Kornerup & Wanscher, 1978), buttercup yellow (Methuen, 4A5), brownish red (Methuen, 8C6). *Hymenium* in adult individuals (through torsion of abutting apothecia) in the centre plicate-veined, bright golden yellow (Methuen, 5B7), brownish yellow (Methuen, 5C8), reddish golden (Methuen, 6C7), brownish orange (Methuen, 6C8). *Hypothecium* 10–20 µm thick, hyphae parallel to asci, septate; cells small, more uniformly ovoid, reniform, oval, weakly cyanophilous, 7–20 × 6–9.3 µm (textura prismatica to textura angularis). *Medullary excipulum* 70–80 µm thick, well demarcated from ectal excipulum, many hyphae grading into paraphyses towards the rim, at right angles to parallel to apothecium, branching, septate; cells short to elongate, regularly or irregularly ventricose, reniform, turbinate, lobate, near-circular, weakly cyanophilous, 9–40 × 2.5–14 µm (textura intricata). *Ectal excipulum* 70–110 µm thick, margin not projecting over hymenium, excipulum here 17–25 µm thick; hyphae at right angles to apothecium, branching, septate;

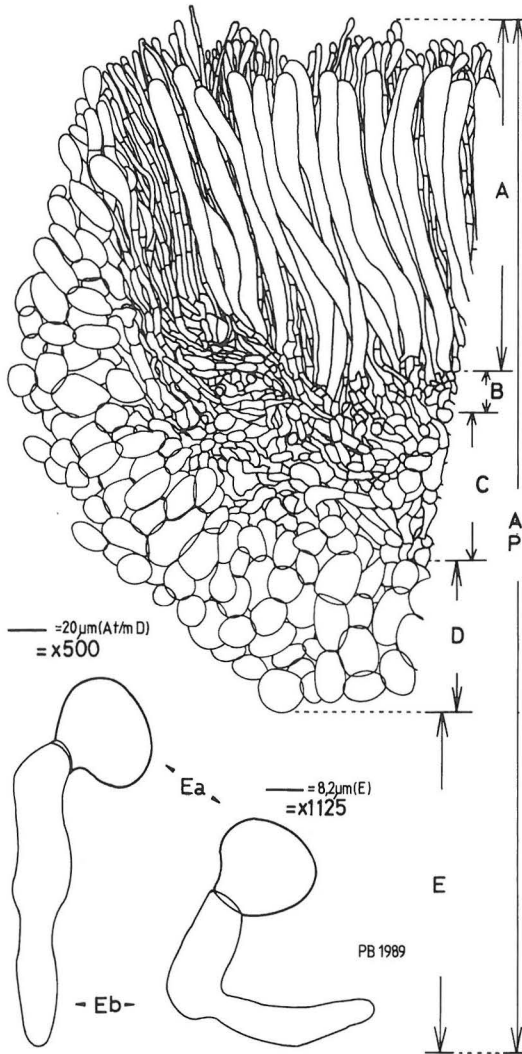


Fig. 1A-E. *Aleuria bicucullata*. Median section of margin of apothecium. — A) hymenium, B) hypothecium, C) medullary excipulum, D) ectal excipulum. Ea: endcells ectal excipulum, Eb: hyphoid hairs.

cyanophilous, short to elongate globose, ovoid, pyriform, angular to irregularly angular to near-circular, isodiametric, $19-26 \times 7-12 \mu\text{m}$ (textura globulosa to textura angularis), with excipular hairs. Hairs $8-15 \mu\text{m}$ in diameter, hyaline, hyphoid, straight or sinuous, round at the tops, thin walled, septate, outstanding. Spores ellipsoid; hyaline with yellowish, strongly cyanophilous ornament; uninucleate, uniseriate; with 1

or 2 large oil globules, either with or without a single or a few smaller ones, smooth; with ornament consisting of a combination of uninterrupted $5.5-6.3 \mu\text{m}$ high ribs which thus form so-called collars or caps, and of irregularly interrupted $2.8-6.3 \mu\text{m}$ high ribs and a fine network of low ribs interconnecting the high ribs; $13.1-14.8 \times 7.4-8.2 \mu\text{m}$ without, $17.6-22.1 \times 9.0-11.1 \mu\text{m}$ with ornament. Asci non-amyloid, 8-spored, uniseriate, operculate, cylindrical, gradually narrowing towards pleurorhynchous base, $183-214 \times 10-15 \mu\text{m}$. Paraphyses in hymenium mostly projecting above asci, straight, branching; in lower part $2.3-3.3 \mu\text{m}$, towards the top becoming gradually broader to clavate or irregularly widened, $4.4-8.2 \mu\text{m}$; septate; with orange, intracellular, carotenoid pigment.

Habitat and distribution. Observed on gravelly, calcareous, humus-deficient sand (also on/in organic material lying on the surface) or in symbiosis [?] with *Molinia caerulea*; amongst *Ceratodon purpureus*, *Calluna vulgaris*, at the foot of burnt-down clumps of *M. caerulea*; occurring in large numbers; in rainy periods; rather rare. France (Boudier 1881, 1905-1910; Patouillard 1885; Quélet 1886; Grélet 1938; Le Gal 1947); United States (Seaver 1928, 1942); Denmark (Dissing 1983); Germany ? (Moser 1963); Russia, Norway, Czech Republic (Kristiansen 1985) and The Netherlands (Billekens 1990).

Specimen examined

The Netherlands. Limburg: Venlo, Grote Heide, 12.X.1988 *Gatzen* (Herb. Billekens, L), 15.X.1988 *Billekens* (Herb. Billekens).

In December 1992, I came across a number of ascomycetes which closely resembled *Aleuria bicucullata* in a field levelled with loam and sand, bordering on a small clay pit. Young individuals were wholly identical with *A. luteonitens* (see Boudier, 1905-1910; plate 317). However, what I missed in this comparatively large group was the dense mode of growth and the plicate-veined hymenium, features which Boudier illustrated for this species in his plates 317a and c. Upon an anatomical examination, making use of Berkeley & Broome (1871), Boudier (1905-1910) and Grélet (1938), I was able to confirm that the material is *Aleuria luteonitens*.

Aleuria luteonitens (Berk. & Broome) Gillet —
Figs. 2, 3

Champ. Fr. Disc.: 205. 1886, as '*luteo-nitens*'. — *Peziza luteonitens* Berk. & Broome, Ann. Mag. Nat. Hist., ser. 4, 7: 425. 1871.

?*Peziza luteonitens* var. *josserandii* Grélet, Bull. Soc. Bot. Centre-Ouest: 72. 1938.

?*Octospora pleurozii* Eckblad, Nytt Mag. Bot. 15: 47. 1968.

Apothecia sessile, in a single group, 7–10 mm in diameter, 2–3 mm high, gymnohymenial. *Receptacle* at first turbinate, then cup-shaped, obliquely cup-shaped; with broad, never torn, rounded, very finely serrate margin; pubescent; at first cream (Methuen, 4A3), pale yellow (Methuen, 3A3), light yellow (Methuen, 4A4); later in lower half remaining thus, towards the margin adopting the colour of the hymenium. *Hymenium* smooth; at first flat, later concave; bright buttercup yellow (Methuen, 4A7), deep yellow/reddish yellow (Methuen, 4A8), melon yellow (Methuen, 5A6). *Hypothecium* 40–60 μm thick, well demarcated from medullary excipulum; hyphae mostly at right angles to medullary excipulum, branching, septate; cells relatively large, short to elongate urn-shaped, pyriform, ventricose, reniform, turbinate, lobate, irregular, weakly cyanophilous, 6–28 \times 4–12 μm (textura epidermoidea to textura intricata). *Medullary excipulum* in lower part of apothecium 80–110 μm thick; easily distinguished from ectal excipulum, with which it gradually coalesces halfway to the margin; hyphae mostly parallel to apothecium, branching, septate; cells short to long, turbinate, ventricose, utriform, reniform, irregular, hyaline, weakly cyanophilous, 7–31 \times 2–13 μm (textura porrecta). *Ectal excipulum* in lower part of apothecium to halfway margin 80–125 μm thick, hyphae at right angles to that of medullary excipulum, branching, septate; from there to below the broadly rounded margin which does not project above the hymenium, inclusive of medullary excipulum, 40–105 μm broad, hyphae parallel or at right angles to apothecium, branching, septate; cells weakly cyanophilous, short to elongate-angular, almost pyriform, lobate, isodiametric, 10–53 \times 11–28 μm (textura globulosa to textura angularis), with excipular hairs. *Hairs* 6.2–17.3 μm in diameter, hyaline, hyphoid, straight or sinuous, with rounded tops, very thin walled, septate, often appressed or

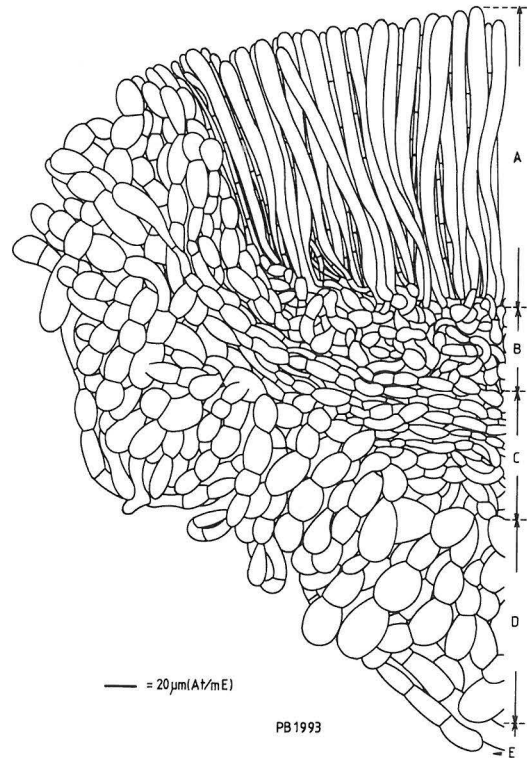


Fig. 2A–E. *Aleuria luteonitens*. Median section of margin of apothecium. — A) hymenium, B) hypothecium, C) medullary excipulum, D) ectal excipulum, E) hyphoid hairs.

outstanding. *Spores* ellipsoid, hyaline; with yellowish cyanophilous ornament, uniseriate, with two moderately large oil globules, smooth; ornamented with a complete or incomplete network of angular to irregular meshes which at their poles may be stretched out to apiculi, separated by 0.5–2.3 μm high, very thin to moderately broad ribs; in places where ribs are interrupted the remains form pointed, wart-like protuberances; 13.9–16.1 \times 5.9–8.6 μm without, 16.4–22.9 \times 8.1–10.3 μm with ornament. *Asci* non-amyloid, uniseriate, operculate, cylindrical or subcylindrical, remaining equally wide or slightly narrowing to pleurorhynchous base, projecting above paraphyses in hymenium, 80–210 \times 8–11 μm . *Paraphyses* straight or slightly curved, in lower half branching; in lower part 1.2–3.3 μm , gradually broadening towards

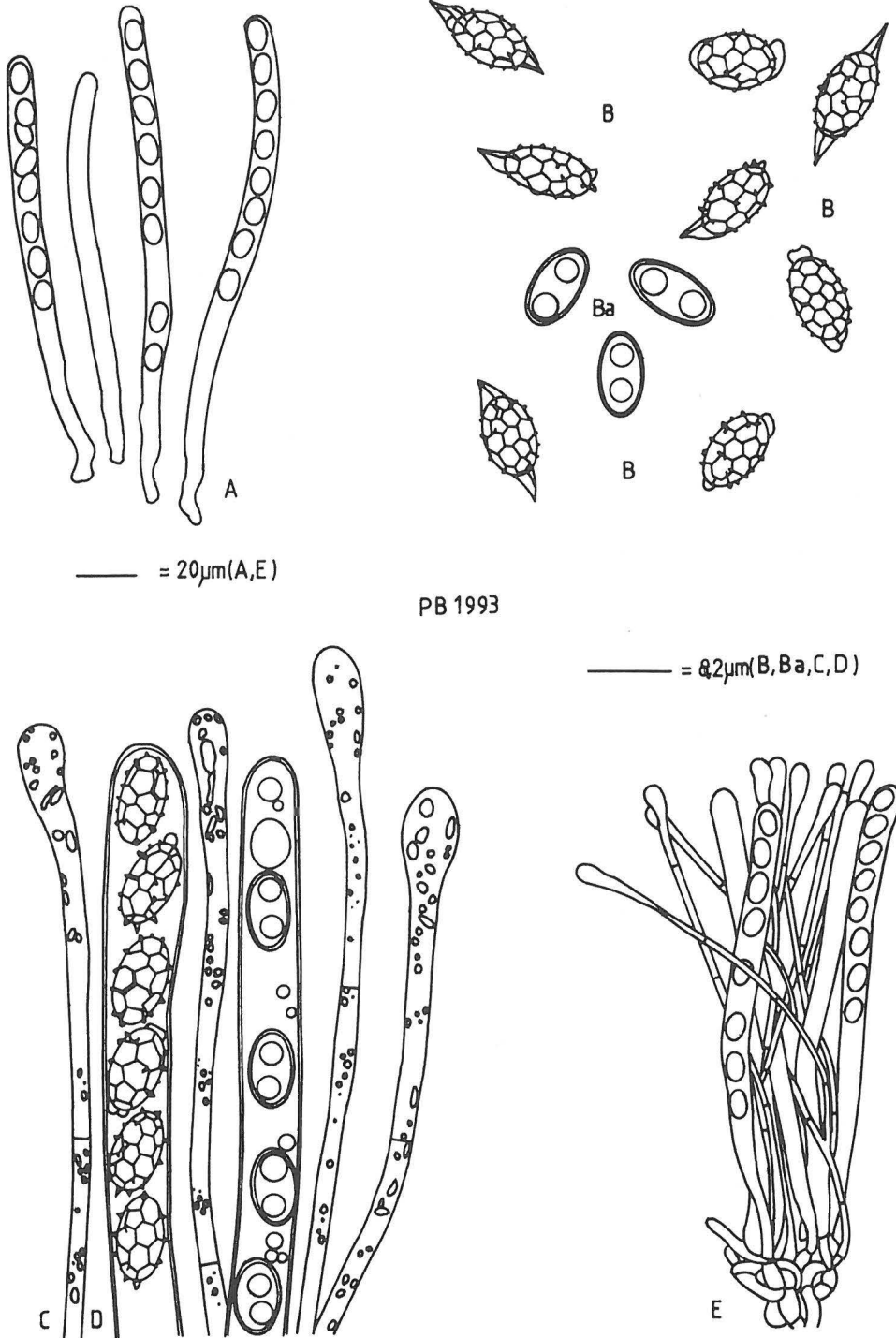


Fig. 3A-E. *Aleuria luteonitens*. — A) asci with (one without) contents, B) mature spores (without contents); Ba half mature spores, C) upper parts of paraphyses with intracellular carotenoid pigment, D) parts of closed asci with contents, E) asci and paraphyses with transition into hypothecium.

top or clavate or irregularly widened there, 4.9–9.8 μm , septate, with intracellular, carotenoid pigment.

Habitat and distribution. Observed in a field levelled with loam and sand bordering on a disused clay pit; no trees in direct vicinity; amongst *Ceratodon purpureus*; in a single large group; rather rare. Great Britain (Berkeley & Broome 1871; Cooke 1875–1879; Dennis 1978), France (Gillet 1886; Boudier 1905–1910; Grélet 1938), Germany (Moser 1963).

Specimen examined

Germany. Nordrhein-Westfalen: Kaldenkirchen, Ravensheide, 21.XII.1992 *Billekens* (Herb. Billekens).

As indicated above, following a comparison of macroscopical features with literature data, it became clear that external features may vary to such an extent that identification in the field is almost impossible. I also noted that these species could be distinguished on details of their anatomy. Both taxa are described in more detail below, based on the results of my studies.

Discussion

Spore ornamentation

According to Boudier (1881; 1905–1910: 177), *Aleuria* (*Peziza*) *bicucullata* is especially characterised by spores that possess fine spinelets as well as a few larger spines and nearly always also caps, so well illustrated in the Icones (plate 318k). He described and illustrated these spores by means of regular light microscopy. This is apparent from the illustration, the scale of which is given as 820:1. The same spore ornament was also observed by Grélet (1938) and Le Gal (1947). Le Gal devoted a separate paper to the evolution of this spore ornament in *Aleuria bicucullata*. In those days, technically speaking, mycologists were handicapped, not having access to such methods as scanning electron microscopy. Today, SE microscopy is widely used in mycology, especially in the study of spore ornaments, ultrastructures and opening mechanisms in Ascomycetes (see Merkus 1973, 1974, 1975, 1976; Van Brummelen 1981; Verkley 1992). Thus Dissing (1983) and Kristiansen (1985) discovered with the help of Schumacher and SEM facilities that what Boudier had noted in *A.*

bicucullata and illustrated as ‘épines’ and ‘collerettes’, in fact would be better described as, ‘being part of ribs c.q. forming a reticular mesh over the spores’ (see Billekens 1990).

In contrast, in *Aleuria luteonitens*, isolated spinelets are found on the spores (see Berkeley & Broome 1871), as illustrated by Boudier (1905–1910) in the Icones (plate 317j), who described the ornament of this species on page 176 as ‘verruës pointues’. Unfortunately, this is again an erroneous interpretation. A few decades later, Grélet (1938) reached the same conclusion when re-examining the material depicted in the Icones. He characterised the ornament as: ‘verruës pointues...en...réalité, étant aspérulées par le crêtes proéminentes d’un réseau mal forme.’ He illustrated this in figure 6, on page 72. Le Gal (1947), upon having examined material of *A. luteonitens* preserved in Boudier’s herbarium as well, came to the same conclusion and demonstrated this in text-figure 48F, on page 198.

The ornament of specimens of *A. luteonitens* I examined (Fig. 3B) displays a strong resemblance to that of *Sowerbyella reguisii* (Quél.) J. Moravec (Moravec 1985: 429–430, figs. 1, 6, 7; Moravec 1986: 98). Species of the genus *Sowerbyella*, however, are characterised by a different tissue type (see Boudier 1905–1910: plate 335; Nannfeldt 1938; Heim 1962).

A comparison of the spore ornaments of the above-mentioned species shows that *A. bicucullata* has a comparatively large, to 6.3 μm high, regular to irregular ribwork (see Billekens 1990, fig. 2e), while *A. luteonitens* is characterised by a fine web-like ornament which reaches heights of 2.3 μm or less (see Fig. 3B).

Hypothecium and excipulum

In principle, light microscopy may have as many advantages as does SEM, especially so in the examination of excipular/hypothecium structures (see Figs 1, 2). This is apparent from Boudier’s illustrations of hypothecium structures in the Icones. From plate 317f it is clear that *A. luteonitens* has a different kind of hypothecium (i.e. larger, differently shaped cells) than does *A. bicucullata* (plate 318f). I examined the hypothecia of both species and the cells indeed differ in size, form and position. In *A. luteonitens* the comparatively large, differently sized cells are found in a textura epidermoidea/intricata tissue, while the small, more uniformly sized cells

of *A. bicucullata* are found in a transitional tissue (textura prismatica/angularis). The hypothecium layers also vary in thickness: in the former species this is 40–60 µm thick, in the latter 10–20 µm. In addition, I studied in more detail the medullary excipulum of both species: *A. bicucullata* has a textura intricata type tissue, *A. luteonitens* a different kind of tissue (textura porrecta). About the medullary excipulum the following can be stated: cells vary considerably in size. In *A. luteonitens* the cells of the medullary excipulum are much larger than those in *A. bicucullata* (10–53 × 11–28 µm versus 19–26 × 7–12 µm).

Hairs

Both species of *Aleuria* have 'hyphoid' hairs, i.e. they resemble hyphae. In *Aleuria bicucullata* the

hairs are predominantly outstanding: Boudier illustrated this feature in plate 318b: a hairy structure, depicted in a more or less fictitious manner; the outstanding hairs are especially well illustrated in Kristiansen's (1985) figure 22e on page 429. In *Aleuria luteonitens* the hairs are appressed to the outermost cells of the ectal excipulum, as seen in Boudier's illustration (figures 317k) and my own drawing of this structure (Fig. 2).

Summary

The aim of the present paper was to point out that *Aleuria bicucullata* and *Aleuria luteonitens* are difficult to distinguish in the field, and that differences are found especially in their anatomy. From Table 1 it is clear that the spore ornaments and tissues of the above-mentioned species differ

Table 1. Combination of microscopical differences between *Aleuria bicucullata* and *A. luteonitens*.

	<i>A. bicucullata</i>	<i>A. luteonitens</i>
Hairs	outstanding	appressed, outstanding
Ectal excipulum		
demarcated towards margin	invariably good	good to halfway margin than difficult
cell size	19–26 × 7–12 µm	10–53 × 11–28 µm
thickness of margin	narrow, 17–25 µm	narrow to relatively wide, 40–105 µm inclusive of Med. ex.
Medullary excipulum		
tissue type	textura intricata	textura porrecta
Hypothecium		
thickness	10–20 µm	40–60 µm
tissue type	textura prismatica to textura	textura epidermoidea to
angularis		textura intricata
Spore ornament		
height/structure	2.8–6.3 µm, relatively large, lattice	0.5–2.3 µm, fine, web-like
illustrations	Dissing 1983: fig. 1; Kristiansen 1985: fig. 23	Moravec 1985: figs. 6, 7 (<i>S. reguisii</i>)
Relation		
spore ornament/cells of hypothecium	large/ small	fine/ relatively large

to such an extent that they may indeed be seen as co-occurring, but distinct species. It is stressed once again that identification in the field should be done with great care.

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