EMENDATION OF THE GENUS *BENSINGTONIA* INGOLD

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YAMADA and KONO(1) and YAMADA et al. (2) reported that the coenzyme Q systems of all examined strains of species in the ballistospore-forming yeast genera *Bullera, Sporobolomyces* and *Sporidiobolus* consisted of Q-10. However, NAKASE and SUZUKI(3) recently reported the isolation of a ballistospore-forming yeast equipped with Q-9 from a leaf of *Oryza sativa*. They described this yeast as a new species of *Bullera, B. intermedia*, because of its colorless colonies and the assimilation of 2-keto- and 5-ketogluconic acids (4). Later, they transferred this species to the genus *Sporobolomyces* because it lacks xylose in the cell walls (5). Further, they added three new species to *Sporobolomyces*, viz. *S. miscanthi, S. subroseus* and *S. weijmanii*, which are all equipped with Q-9 (5). The significance of the presence or absence of xylose in whole cell hydrolyzates in the classification of ballistospore-forming yeasts was shown by WEIJMAN and RODRIGUES DE MIRANDA (6) and was confirmed by SUZUKI and NAKASE (7). The latter authors considered that these Q-9-
equipped, xylose-lacking species of *Sporobolomyces* should be included in a genus of its own. However, for the time being they retained them in the genus *Sporobolomyces* as the “intermedius” group, because they could not find any further differences other than the ubiquinone type between Q-9-equipped species and the Q-10-equipped species of *Sporobolomyces*\(^{(8, 9)}\). Very recently three new species, *S. naganoensis*\(^{(8)}\), *S. yamatoanus*\(^{(10)}\) and *S. yuccicola*\(^{(11)}\) were described in the “intermedius” group. Among the species described in the “intermedius” group of *Sporobolomyces*, *S. miscanthi* and *S. subroseus* form greyish red colonies and *S. naganoensis* forms pale pink to brownish orange colonies.

In 1986, Ingold\(^{(12)}\) described the genus *Bensingtonia* based on a single ballistospore-forming species, of which now several subcultures different in their morphology\(^{(13)}\) are available. Ingold regarded this fungus as a hyphomycete and concluded that it represented a new genus because it lacked clamp-connections and formed non-curved ballistospores, differing in these aspects from *Itersonilia* and *Tilletiopsis*, respectively. Strains of the hyphomycetous and ballistospore-forming genus *Itersonilia* occasionally form monokaryotic yeast-phases\(^{(14)}\). According to Yamada and Konda\(^{(15)}\), the members of the genus *Itersonilia* have Q-9, like strains of *Bensingtonia*. However, the former genus differs from the latter in the presence of xylose in the cell walls\(^{(14)}\). Despite Ingold’s observation that his fungus forms yeast colonies\(^{(12, 13)}\), biochemical and physiological characteristics were not studied by that author. According to our observations the morphological characteristics of *Bensingtonia ciliata* coincide well with the non-pigmented strains thus far maintained in the “intermedius” group of the genus *Sporobolomyces*.

Recently, Boekhout\(^{(14)}\) reported that *Bensingtonia ciliata* had Q-9 and lacked xylose in whole cell hydrolyzates. These characteristics coincide well with those of species in the “intermedius” group. Therefore *Bensingtonia ciliata* and the species of the “intermedius” group should be included in one genus. However, as the genus *Bensingtonia* is defined by the presence of subovoid ballistospores and its yeast colony is whitish\(^{(12)}\), we propose to emend the diagnosis of the genus *Bensingtonia* to include the species now classified in the “intermedius” group of *Sporobolomyces*.

*Bensingtonia* Ingold emend. Nakase et Boekhout

Cells oval, ellipsoidal or elongate. Ballistospores produced, of bilateral or rotational symmetry, straight or curved, sickle-shaped, kidney-shaped, ovoid, subovoid, ellipsoidal to broadly ellipsoidal, apiculate. Colonies whitish, yellowish white, pale pink, brownish orange or greyish red. True mycelia and pseudomycelium present or absent. clamp-connections absent. Diazonium blue B reaction positive. Major ubiquinone Q-9. Xylose absent in whole cell hydrolyzates.

Type species: *Bensingtonia ciliata* Ingold, holotype IMI 291091\(^{(12)}\).

With this emendation of the genus, the following six species can be transferred to *Bensingtonia*:
**Bensingtonia intermedia** (Nakase et Suzuki) Nakase et Boekhout comb. nov.


Typus: JCM 5291

**Bensingtonia miscanthi** (Nakase et Suzuki) Nakase et Boekhout comb. nov.


Typus: JCM 5733.

**Bensingtonia naganoensis** (Nakase et Suzuki) Nakase et Boekhout comb. nov.


Typus: JCM 5978.

**Bensingtonia subrosea** (Nakase et Suzuki) Nakase et Boekhout


Typus: JCM 5735.

**Bensingtonia yamatoana** (Nakase, Suzuki et Itoh) Nakase et Boekhout comb. nov.


Typus: JCM 2896.

**Bensingtonia yuccicola** (Nakase et Suzuki) Nakase et Boekhout comb. nov.


Typus: JCM 6251.

The emended genus *Bensingtonia* comprises species which form ballistospores varying in shape and size. In some species the ballistospores are broadly ellipsoidal to ellipsoidal and not curved, e.g. in *B. yuccicola* (11). In other species, e.g. in *B. yamatoana*, the ballistospores are sickle- or kidney-shaped and apparently curved (10). The shape of these two types of ballistospores is commonly described as rotationally symmetrical and bilaterally symmetrical, respectively (16–18). However, JoHRI and BANDONI (19) stated that these terms appear to be incorrectly applied in describing the ballistospores of *Bullera* and *Sporobolomyces*, because the ballistospores in both genera are essentially bilaterally symmetrical. In our view the use of the descriptive terms rotationally and bilaterally symmetrical ballistospores seems appropriate from a practical point of view, as most species of *Bullera* have nearly rotationally symmetrical, globose, obovoid to ampulliform bodies of the ballistospores and most species of *Sporobolomyces* have conspicuously bilaterally symmetrical bodies of the ballistospores. Only rarely both types of ballistospores...
are found in one strain, e.g. *Sporidiobolus pararoseus* (20).

Yamada and Nakagawa (21) regarded *Sporobolomyces weijmanii* synonymous with *S. intermedius*, based on the electrophoretic comparison of seven enzymes. The observed physiological differences (4, 5) between these species, e.g. the assimilation of sucrose, maltose, melezitose, lysine and the requirement of thiamine in *B. intermedia* are likely to represent infraspecific variation. The same probably holds for the observed difference of 2.2% in the mol% G + C of the DNA as analyzed by thermal denaturation. According to Kurtzman et al. (22) infraspecific variation of mol% G + C, as analyzed with this method, may be as wide as 2–2.5%. For these reasons, we listed *S. weijmanii* as a synonym under *Bensingtonia intermedia*.

The seven species which currently comprise the genus can be identified with the following key:

1. 2-Ketogluconic acid and 5-ketogluconic acid assimilated 2
   2-Ketogluconic acid and 5-ketogluconic acid not assimilated 3
2. L-Sorbose and cellobiose assimilated 4
   L-Sorbose and cellobiose not assimilated 5
3. Nitrate assimilated 6
   Nitrate not assimilated
4. Melibiose assimilated 7
   Melibiose not assimilated 8
5. Sucrose assimilated, *p*-aminobenzoic acid required 9
   Sucrose not assimilated, *p*-aminobenzoic acid not required 10
6. Sucrose and maltose assimilated 11
   Sucrose and maltose not assimilated 12

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REFERENCES