

# The genus *Arxiozyma* gen. nov. (Saccharomycetaceae)

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The concurrence of the diploid condition of the vegetative phase, the verrucose ascospores with protuberances projecting from the electron-opaque outer layer of the ascospore wall and the Coenzyme Q6 system in the yeast species described as *Saccharomyces telluris*, excludes it from all recognized genera of the Endomycetes. It is consequently proposed that this species be assigned to the new genus *Arxiozyma*. The diagnosis of the new genus is given.

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Die gisspesie wat as *Saccharomyces telluris* beskryf is, word deur 'n diploïde vegetatiewe fase, vrattige askospore met uitwasse wat aan die elektron-ondeursigtige buitelaag van die askosporwand ontstaan en deur die teenwoordigheid van die koënsiem Q6 sisteem, gekenmerk. Op grond van hierdie eienskappe word die spesie van alle erkende genera van die Endomycetes uitgesluit. Dit word gevolglik voorgestel dat hierdie spesie in die nuwe genus *Arxiozyma* geplaas word. Die diagnose van die nuwe genus word gegee.

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## Introduction

The remodelling of the genus *Saccharomyces* Hansen and the reinstatement of the genera *Torulaspora* Lindner and *Zygosaccharomyces* Barker by Van der Walt & Johannsen (1975), Von Arx *et al.* (1977), Barnett *et al.* (1983) and Yarrow (1984), have led to a more natural classification of the species previously assigned to *Saccharomyces sensu* Lodder & Kreger-van Rij (1952). However, by restricting *Saccharomyces* to diploid species which (i) form unornamented, glabrous ascospores and (ii) are characterized by the Coenzyme Q6 system, the species described as *Saccharomyces telluris* Van der Walt (1957), has come to occupy an isolated position.

Although Yamada *et al.* (1976) confirmed the presence of the Coenzyme Q6 system in *S. telluris*, Kreger-van Rij (1966) had previously reported its ascospores, when observed by TEM, to be distinctly warty, with protuberances arising from the electron-opaque, dark outer layer of the ascospore wall. This was subsequently reconfirmed by Kurtzman *et al.* (1980) who also pointed out that the ascospores of *S. telluris* resembled those of most species of the genus *Issatchenkia* Kudriavzev in their surface topology and internal structure. Kurtzman *et al.* (1980) nevertheless excluded *S. telluris* from *Issatchenkia* mainly on the grounds that this genus had been delimited on the presence of the Coenzyme Q7 system.

The concurrence of the diploid condition of the vegetative phase, the verrucose ascospores with protuberances formed by the electron-opaque outer layer of the ascospore wall and the presence of the Coenzyme Q6 system in *S. telluris*, consequently excludes it not only from *Saccharomyces* and *Issatchenkia* but from all other recognized genera of the Endomycetes.

Since neither Kreger-van Rij (1966) nor Kurtzman *et al.* (1980) published TEM micrographs of the ultrastructure of the ascospores of *S. telluris*, their observations were extended to a strain of the species held by the Yeast Division of the Centraalbureau voor Schimmelcultures (CBS) in Delft, The Netherlands.

## Materials and Methods

Strain studied: CBS 5812, isolated from Man by M.R. Battesti, Lyon, 1967.

## Transmission electron microscopy

Ascigerous material of the strain was obtained from a slant culture grown on Gorodkova agar (see Van der Walt &

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Yarrow 1984) at 28°C for 7 days. Material was fixed for 6 h at 4°C in 5% v/v glutaraldehyde in 0,1 M phosphate buffer (pH 7,3) and post-fixed at the same temperature for 2 h in 1% osmium tetroxide in the same buffer. Fixed material was dehydrated in a graded series of ethanol and embedded in an Araldite-Epon mixture. Mounted ultra-thin sections were stained in 2% aqueous uranyl acetate and lead citrate (Reynolds 1963). TEM micrographs of sections of the ascospores are shown in Figures 1–4.

### Observations and Conclusions

Figures 1 & 2 depict dormant ascospores and Figures 3 & 4 early stages of their germination.

As shown in Figures 1 & 2 the spores are distinctly verrucose to tuberculate, with the protuberances arising from the electron-opaque, dark outer layer of the ascospore wall. These findings are in full agreement with observations reported by both Kreger-van Rij (1966) and Kurtzman *et al.* (1980). Figure 2 also shows a distinct, dark line in the midregion of the ascospore wall, similar to that which Kreger-van Rij (1978; 1979) and Kreger-van Rij & Veenhuis (1976) observed in the ascospores of species in the genera *Saccharomyces*, *Zygosaccharomyces*, *Torulaspota* and *Kluyveromyces*. Sections through germinating ascospores (Figures 3 & 4) show this dark line to be implicated in the formation of the outer layer of the cell wall of the newly-formed, emerging vegetative cell.

Since the combination of characters of *S. telluris* excludes it from all recognized genera of the Endomycetes, it is proposed that the species be assigned to:

*Arxiozyma* Van der Walt & Yarrow, gen. nov. (Saccharomycetaceae).

Cellulae vegetativae diploideae globosae vel ellipsoideae, propagantes per gemmationem. Asci e transformatione cellularum vegetativarum oriuntur. Ascospores globosae vel ellipsoideae, verrucosae vel tuberculatae, binae in singulis ascis. Systema coenzymatis Q6 adest. Fermentatio. Nitrato non utitur.

Species typica: *Arxiozyma telluris* (Van der Walt) Van der Walt & Yarrow.

Specimen generotypicum: No. PREM 47388 in herbario mycologico Instituti Investigationis Custodiaeque Plantarum, Praetoriae in Africa australis.

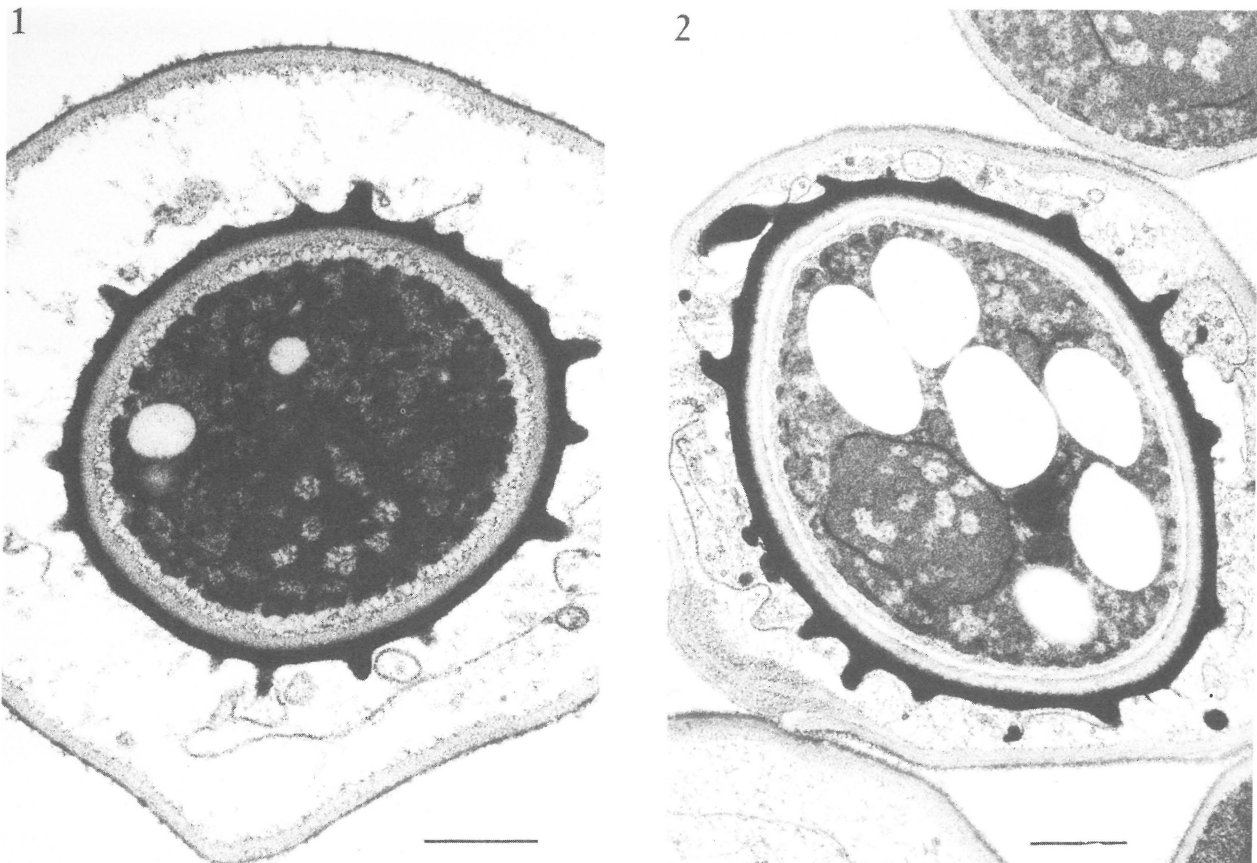
Vegetative cells diploid, globose to ellipsoidal, reproducing by budding. Asci arise by the direct transformation of vegetative cells. Ascospores spheroidal to ellipsoidal, verrucose to tuberculate, 1–2 per ascus. Coenzyme Q6 system present. Fermentation. Nitrate not assimilated.

Type species: *Arxiozyma telluris* (Van der Walt) Van der Walt & Yarrow nov. comb.

Basionym: *Saccharomyces telluris* (as *tellustris*) Van der Walt in Antonie van Leeuwenhoek 23: 27, 1957.

Generic type specimen: No. PREM 47388 deposited in the Herbarium for Fungi of the Research Institute for Plant Protection, Pretoria, South Africa.

The generic name honours Dr. J.A. von Arx, for his contribution to the classification of the filamentous ascomycetous yeasts.



Figures 1 & 2 *Arxiozyma telluris*. TEM micrographs of sections through ungerminated ascospores. The bar represents 0,5  $\mu$ m. (Material fixed in glutaraldehyde and osmium tetroxide; stained with uranyl acetate and basic lead citrate.)



**Figures 3 & 4** *Arxiozyma telluris*. TEM micrographs of sections through germinating ascospores. The bar represents 0,5  $\mu\text{m}$ . (Material fixed in glutaraldehyde and osmium tetroxide; stained with uranyl acetate and basic lead citrate.)

Although the type strain of *A. telluris* was recovered from a sample of South African soil, most subsequently recorded isolates come from warm-blooded sources. It may be speculated that this association with warm-blooded sources might be indicative of the rather recent evolution of the genus.

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